

**Thai Agriculture:
Golden Cradle of Millennia**

Lindsay Falvey

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Table of Contents

Chapter 1 - Uniquely Agricultural

- Golden Cradle
- The Land of the Thai
- Soils
- Water Resources
- Climate
- Other Natural Resources
- Regional Origins
- Intensification
- Industrialisation
- National and Global Responsibilities
- Current Situation
- Ingredients of Thai Agriculture
- Summary

Chapter 2 - Agricultural Origins

- From Gathering to Growing
- Neolithic to Iron Age
- Domination of Rice
- Early Thai Agriculturists
- Khmer Agriculture
- Pagan Agriculture
- Southern Thailand
- Summary

Chapter 3 - Arrival of Tai Agriculture

- Chinese Tai
- Muang F
- Integrating Technologies
- Tai Agriculturists
- Migrating Farmers
- Tai in Thailand
- Tai Traits
- Environmental Traditions
- Tai and Buddhist Environments
- Summary

Chapter 4 - Expansion of Thai Agriculture from 1200 C

- Agricultural Organisation
- Agricultural Administration
- Integrating Irrigation Systems
- Agricultural Domination
- Tai to Thai Agriculture

Agricultural Life
Summary

Chapter 5 - Emerging Agribusiness: Ayutthaya to the Early Twentieth Century

Agriculture, Environment and Morality
Export Rice
Cash Crops
Foreign Influence
Administering the Peasants
State Irrigation Development
Traders and Early Agribusiness
Summary

Chapter 6 - Agriculture and Politics: From the 1930s

Agricultural Policies from 1932
Policies Post-World War II
Agro-Social Change
Highland Agriculture
Agribusiness and The State
The Culture of Irrigation
Environmental Change
Summary

Chapter 7 - Thai Agriculture to the 1990s

Agricultural Planning Context
Planning History
Foreign Fillips to Planning
Plans One to Eight
Agricultural Growth
Cropland Expansion
Fertiliser
Irrigation, Mechanisation and Credit
Social Effects
Post-1997 Agriculture
A New Agricultural Paradigm
Summary

Chapter 8: Crops

Rice
Rice Policy
Rice Production Systems
Glutinous Rice
Rice Breeding
Rice Husbandry
Maize
Mung Bean

- Cassava
- Sugar
- Coconut
- Rubber
- Fibre, Extraction and Other Crops
- Fibre Crops
- Oil and Extraction Crops
- Other Crops
- Fruits and Vegetables
- Crop Seeds
- Summary

Chapter 9 - Livestock and Fisheries

- Animal Production Systems
- Buffalo and Cattle
- Dairy Cattle
- Pig
- Poultry
- Aquatic Animals
- Freshwater
- Marine
- Brackish Waters and Shrimp Culture
- Fish Production
- Goats, Sheep and Elephants
- The Future for Livestock
- Summary

Chapter 10 - Forestry

- Frontier Forests
- Forest Types
- Forest Destruction
- Logging
- Forest Policy
- Prohibition of Logging
- Conservation and Social Forestry
- Agriculture – Forestry Interactions
- Private Forestry
- Forest Production and Industries
- Summary

Chapter 11 - Agricultural Institutions' Development

- Government and Agriculture
- Institutional Instruction
- Origins of the Ministry of Agriculture and Cooperatives
- Agricultural Research
- Livestock, Fisheries, and Forestry

Research Impact
Agricultural Education
Agricultural Cooperatives
Bank of Agriculture and Agricultural Cooperatives
Marketing Organisation of Farmers
Agribusiness and the Small Farmer
Summary

Chapter 12 - Agribusiness

Agricultural Inputs
The Agribusiness Story
Charoen Pokaphan
Shrimp Agribusiness
Forest Agribusiness
Rubber Agribusiness
Horticulture, Textiles, and Technology
Government Agribusiness
Future Agribusiness
Summary

Chapter 13 - Small-holders and Development

Economic Context
Agriculture and Growth
Small-holders as Family Farmers
Integrated Crops and Livestock
Research and Development
Alternatives and Self-Sufficiency
De-marginalising Small-holder Agriculture
Summary

Chapter 14 - Agriculture, Environment, and Values

Global Agriculture and Environment
State of the Thai Environment
Tracing Thai Attitudinal Shifts
Global Development Forces
Missing the Middle Path
Seeking Environmental Traditions
Popular Buddhist Thought
Conservative Canons
Rising Eco-Buddhism
Practical Approaches
Buddhist Economics
Alternative Agriculture
Self Sufficiency
Summary

Chapter 15 - Whither Thai Agriculture?

From Past to Present

Current Position

Policy Outcomes

The Asian Financial Crisis

The Challenge

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The book is heavily referenced, as one of its objectives is to encourage wider analysis through further reading on the range of subjects that impact and derive from Thai agriculture. Nevertheless, errors, omissions, and biases are mine alone, and for any which cause offence, I apologise.

JLF

Abbreviations and Acronyms

AVRDC	Asian Vegetable Research and Development Center
BAAC	Bank for Agriculture and Agricultural Cooperatives
BCE	Before Current Era
CE	Current Era
CGIAR	Consultative Group for International Agriculture Research
CIAT	Centro Internacional de Agricultura Tropical
CIF	Cost Including Freight
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo
CIP	Centro Internacional de la Papa
CP	Charoen Pokaphan
DFPO	Dairy Farm Promotion Organisation
EEC	European Economic Community
EU	European Union
FAO	Food and Agriculture Organisation
FMD	Foot and Mouth Disease
GATT	General Agreement on Trade and Tariffs
GDP	Gross Domestic Product
GHG	Green House Gas
GINI	
GNP	Gross National Product
IRRI	International Rice Research Institute
JICA	Japan International Cooperation Agency
MOAC	Ministry of Agriculture and Cooperatives
MOF	Marketing Organisation of Farmers
NESDB	National Economic and Social Development Board
NGO	Non Government Organisation
OECF	Overseas Economic Cooperation Fund
RTG	Royal Thai Government
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organisation
WTO	World Trade Organisation

Foreword

The story of Thai agriculture is too voluminous to contain in one book such as this. It includes all elements of the Thai culture, economy and environment, and has been the subject of specialist research in the various branches of these fields over centuries. Because Thai traditions of writing have not emphasised the same technical and economic approaches common to Western documentation until recent times, much of the origins of Thai agriculture is derived from professional extrapolations. Nevertheless, there are voluminous writings surrounding the subject, beginning in the thirteenth century, from Thai, Chinese, Japanese, and various European authors. It is their experience and knowledge which comprise the bulk this book much more than the eclectic experiences on which I reminisce with increasing frequency in this twenty-fifth year of working in Thailand. Having a year to collate information has been most beneficial. As Zimmerman noted in his 1930s treatment of the subject, one year to write on Thai agriculture is grossly inadequate, twenty years' research being a minimum.

The book seeks to highlight unique aspects of Thai agriculture. As Thailand has many faces, so there are differing types of agriculture. It is misleading to assume that this is an ecologically and ethnically uniform rice-producing Buddhist country; agriculture of the South differs from that of the Central Plain, which differs from that of the Northeast, which differs from that of the North's river valleys, which in turn is distinct from highland agriculture. So this book, in taking an historical as well as technical, economic and cultural perspectives, seeks to use examples from Thailand's different regions to highlight the diversity which in itself adds to the resilience of Thai agriculture.

The book traces the origins of Thai agriculture from pre-history through historical times to the present day, concluding with speculation about the future. As it strives to cover a wide range of disciplines and views, and to stimulate deeper local interest in study of the subject, the work contains more references than may be customary. It is thus synoptic in an attempt to present a flow of thought which is something a middle path through sometimes contentious opinions. To facilitate the flow of chronology, technical evolution, and cultural thought, each chapter concludes with a three paragraph summary, which in turn is referred to as part of the concluding chapter where the elements which may influence the future of Thai agriculture are discussed.

There have been many exceptional works which relate to Thai agriculture in both Thai and other languages. Most are included in the hundreds of references used to compile this work. Many have taken a technical and development approach; others have taken economic historical approaches, while yet others have taken cultural perspectives, although, in numbers of words, the post-1960 development literature dominates. Works in the Thai language have also followed similar trends, often deviating in their conclusions and emphases from foreign works on apparently similar subjects. However, such differences appear to have steadily declined with the rise of English language publications in Thailand, such that today many Thai and English language works are the same, and where different, the English work may be the more carefully presented. For these reasons, works in the Thai language are included together with those in English in

one list of references, rather than follow another tradition of assuming separate groups of readers. Notwithstanding the implications of these views, this work is also expected to appear in the Thai language as a means of extending it beyond the usual educated elite. With some 900 references, some sentences have more than one reference; this has the dual aims of providing direct guidance for further reading on the summarised detail, and to highlight the source of the thought behind statements which might otherwise be assumed to be in error.

The story of Thai agriculture is one of importance to all. It contains lessons about the importance of culture and history in development. It highlights the shortcoming of the economic development models. It illustrates the durability of an export industry which also employs most of the population, leads the world in some business fields, and rescues the non-agricultural classes from catastrophe in times of crisis. Yet it also contains lessons about the civilising of development, and is bold enough to relate spiritual aspirations to those of industry. Very briefly, the story flows as follows.

From hunters and gatherers through agro-cities, State-religious Empires infiltrated by migrating Tai persons with a wet glutinous rice technology, evolved to produce a sustainable agriculture. Rice culture determined administrative structures in a pragmatic society which regularly produced a saleable surplus. Ayutthaya's ascendancy, continuing today, consolidated the importance of rice agriculture to national security and economic well-being, as Chinese and European influence benefited agribusiness and initiated the demand which would expand agriculture through population increase until accessible land was expended. The resulting central interest in the spoils of agriculture more than its producers pervaded decision-making until recently, and was supported by narrow economic development advocates.

As agriculture declined in relative financial importance, it continued to provide the benefits of employment, crisis resilience, self-sufficiency, rural social support, and cultural custody. Technical and economic globalisation forces which assumed a cultural uniformity were eventually revealed to require modification, but had meanwhile allowed unregulated exploitation of community resources and excesses in economic activity, all with at least the tacit approval of development financiers. Agricultural institutions evolved from a taxation and dispute resolution base to provide research, education, and technology transfer at levels below potential as they supported commercial agriculture funded by credit. Agribusiness, both private and government, expanded from the 1960s and small-holders were partly viewed as a past relic which agribusiness could modernise. However, small-holders' intensive integrated production systems continued to offer efficiencies uncounted in narrow financial analyses, including social benefits which have now caused agriculture to be treated as both a social and financial sector in planning, with increased cognisance of environmental and cultural values.

Unique elements of Thai agriculture include: irrigation technologies which spanned a millennium; administrative structures which originated with agricultural water control; its global leadership in production and export of a number of agricultural commodities; its agribusiness sector which includes one of the world's huge multinational

conglomerates; the negotiating approaches of the culture over several centuries; potential for further large increases in productivity from known technologies, and an open culture which has allowed new ideas and peoples to be absorbed at various times, and which can still relate a national cultural ethic to traditional agriculture with its religious and environmental management associations.

Now one of the world's few major agricultural exporters, leading the world in rice, rubber, canned pineapple, and black tiger prawn production and export, the region in chicken meat export and several other commodities, and feeding more the four times its own population from less intensive agriculture than its neighbours, Thailand is poised to benefit from predicted expansion in livestock products demand. Poverty reduction, and improved education, research, and legal and social systems, which may be addressed in the wake of the recent Asian financial crisis, stand to benefit from popular concern for environmentally and socially sensitive alternatives for small-holder farmers to co-exist with commercial agriculture. Unlikely to rapidly industrialise, Thailand will remain one of the world's major agricultural countries in social, environmental and economic terms for the foreseeable future.

Apart the overriding dichotomies of Thai agriculture in terms of; self-sufficient and commercial agriculture, national income and rural poverty alleviation, and traditional and imported value systems, which will necessarily inform future policy formation, other issues remain. Sunthorn Phu's¹ love lament evoked through agricultural metaphor...

*at a sugar mill, they feed in sugarcane, buffaloes are noisily urged to pull the vice;
juice gushes forth onto a row of jars. Oh, I see tears dropping from my eyes:
the sugar cane is crushed like my heart; the juice pours out like my tears. ...*

If he wrote today, the flood of sugar juice in large mechanised mills might symbolise tears for lost 80 percent of the buffalo herd, itself a metaphor for lost traditions and values in the society. If one lives by the financial efficiency sword, one dies by it; thus social costs of unbalanced development may yet force genuine reconsideration of agriculture and rural dwellers.

It has been a fulfilling experience to collate the works of others, to challenge my own conclusions, and to assimilate diverse information into, what I hope is, a cohesive text. My hope is that the diversity which is still common in Thai agriculture remains, and that a central component of future development can be the small-holder farmer.

Lindsay Falvey

¹ Umavijani, Montri. (1986)

Chapter 1

Uniquely Agricultural

The story of Thai agriculture is unique. One of the world's major agricultural exporters as a result of innovative political strategies and bounteous natural resources, Thailand continues to rely on agriculture as it experiments with lost traditions which appear compatible with modern environmental management. Within this context, the following is a mean attempt to unify the fields which coalesce as Thai agriculture - history, technology, science, economics, politics, culture, religion, and economics. This chapter introduces Thailand's global agricultural importance and responsibilities, its resources, and the history which lead to this unique position, as an introduction to the specific chapters which follow.

From a religious and trading region to a united Kingdom through sophisticated political and social integration strategies, the peoples who emerged as Thai have exemplified a relationship between man and nature in the development of an agriculture which fuelled wider political and industrial development. Today, agriculture remains critical to the Thai nation for social, environmental and economic development. As an introduction to Thai agriculture and its role, it is appropriate to first introduce the underlying resources which have created a reality from the legend of an agricultural golden cradle.

Golden Cradle

The golden cradle of agriculture which nursed and nourished a nation's development, at least partly with southward migration of Tai peoples over the past millennium, continues to be the envy of the neighbours and the minority of the Tai diaspora which did not become part of Thailand. Thailand's \$2,200 in GNP per capita compared to the world average of \$4,890 hides its relative wealth, which is better indicated from comparisons on a purchasing price parity basis which lifts it to 95 percent of the \$6,200 world average and raises its global ranking from 102 to 91.² Agriculture as a proportion of Thailand's GDP fell from over 30 percent in the 1970s to around 10 percent in the 1990s reflecting both the country's wider economic base, and the global decline in agricultural prices. However, these figures omit the contribution of agriculture through agribusiness, agro-industry, and social support such as rural employment and even environmental management. In terms of the Human Development Index which considers life expectancy, education and GDP, Thailand ranks as 52 against its neighbours' rankings of; Myanmar 133, Lao-PDR 138, Cambodia 148, Malaysia 53, and for example, Indonesia 102.³

Agriculture is important to Thailand, and Thai agriculture is important to the world. It can be briefly characterised in the following terms:

² World Bank (1999)

³ Alpha Research (1997)

- As the world's largest rice exporter, and high ranking exporter of other food stuffs, Thailand feeds⁴ some four times its population; that is something around 250 million people.
- As the world's largest rubber producer and exporter, Thailand supports global industries particularly in more developed countries, and influences rubber marketing policies.
- As the world's largest producer and exporter of Black Tiger Prawns, Thailand dominates one of the few agricultural sectors which continues to experience rising prices.
- One Thai multi-national group, Charoen Pokaphan has grown to become the region's largest agribusiness conglomerate, ranking in the world's ten largest such firms.
- Thailand is the region's largest exporter of chicken meat and dominates the Japanese market.
- An estimated 80 percent of Thai persons are engaged in agriculture and its industries.
- Overwhelmingly, the managers of the natural environment of Thailand are farmers, and fishers.
- The national identity has developed around symbols of agricultural bounty consumed responsibly through images of abundant rice and fish in a benign environment.
- The Chaophraya River valley developed for irrigated rice production has symbolised an approach to sustainable production.
- Thailand has enjoyed foreign investment and relative political stability which have supported development of an infrastructure oriented to agricultural production for export.
- Over-production of fish, timber, and agricultural commodities has recently degraded the natural environment in which the majority of the population live necessitating informed adaptation of agricultural practices to meet social and environmental needs.

Thailand's top five trade surplus products in recent years have been natural rubber products, crustaceans and seafood, cereals particularly rice, garments, and canned fish. The top five trade deficit products in 1996 were; mineral fuel, mechanical equipment, vehicles and parts, iron and steel, and electrical equipment. Countries with which Thailand maintains large trade surplus have been Singapore, Hong Kong, the Netherlands, and the USA; trade deficits have been with Japan, Germany, Taiwan, and South Korea. Non-agricultural manufacturing industry has relied mainly on inexpensive labour and attractive foreign investment conditions, contributing less to the economy than official statistics may suggest.⁵

Thailand is one of the world's seven major agricultural exporters which separates it from its neighbours and allows an interpretation of; its economic responses to world and regional events, cultural associations with agriculture and rice in particular, and the types of manufacturing industry which underpin further industrial development. However, agriculture has declined in economic importance worldwide, and agricultural commodity prices indicate a long term trend of decline. In terms of share of gross world product, agriculture has fallen from around 90 percent at the end of the eighteenth century to

⁴ FAO (1999)

⁵ Alpha Research (1997)

around eight percent at the end of the twentieth century. The relationship between decline in contribution of agriculture to a country's economy and its economic growth has spawned a view that agriculture should be of declining importance if the country is to develop. This view may be wrong in many cases, especially for Thailand.

Agricultural exports rely on domestically produced raw materials, and while now less than manufactures, involve a larger proportion of the economy by virtue of their employment capability, net export value, and lifestyle support. Table 1.1 indicates the relative contributions of major Thai agricultural exports, and benefit of the 40 percent currency devaluation of 1997 on agricultural export earnings.

Table 1.1 Export Values of Major Thai Agricultural Products (million baht)⁶

	1990	1992	1994	1996	1998
Crops	90,894	109,082	114,622	152,595	186,344
• Rice	27,770	36,214	39,187	50,735	86,806
• Maize	4,130	510	544	279	622
• Cassava Pellet	20,257	24,100	12,159	12,359	11,456
• Cassava Flour	2,862	3,382	4,320	4,584	5,213
• Other Tapioca Products	1,346	2,131	2,294	3,707	5,464
• Rubber	23,557	28,925	41,824	63,373	55,413
Fishery Products	33,047	49,288	68,353	63,972	90,047
• Shrimp	20,865	32,154	49,847	43,978	58,807
• Cuttlefish, Squids	6,230	7,123	7,926	7,671	12,811
Livestock	8,896	12,566	13,031	14,092	28,096
• Poultry	7,718	11,128	31,704	12,457	25,293
Agro-Industrial Products	73,521	91,325	107,465	142,030	202,642
• Prepared Airtight Fish, etc	24,762	28,809	37,083	40,461	76,454
• Cane Sugar, Molasses	18,831	20,057	18,311	34,058	28,057
• Prepared Airtight Fruits	9,699	13,995	12,840	15,059	15,453
• Canned Pineapple	5,524	8,274	6,608	6,510	6,925
• Pineapple Juices	1,592	2,007	1,681	2,988	2,445
• Vegetable Canned	2,650	3,460	3,878	5,126	6,353

Agriculture is the main natural resource export sector, and in terms of providing the livelihood of the populace is overwhelmingly the most important sector. It is the most international sector of the Thai economy⁷ and contains the elements of continued comparative advantage in broad social and economic terms, and probably most environmental terms for a country of its population density.

With a population of around 61 million people, Thailand's population density of 120 people per square kilometre compares with a global figure of 45; other low-middle income countries average 25, and the East Asia and Pacific region averages 114. Itself an indicator of the high agricultural productivity of the country rather than over-population, Thailand's relative wealth is also clear in terms of a Purchasing Power Parity GDP

⁶ Poapongsakorn, Nipon (1999)

⁷ Siamwalla, Ammar., Setboonsarng, Suthad., and Patmasiriwat, Direk. (1989)

average of some \$5,840.00 per capita, compared to 4,080 and 3,400 for other low-middle income countries and the region respectively.⁸

Thailand exhibits a high proportion of arable land compared to other lower-middle income countries, and the East Asia and Pacific region, resulting in deforested areas increasing at the equal second highest level with Paraguay after first-ranking Malaysia.⁹ Social development in terms of infant mortalities improved from 73 per 100 live births in 1970 to only 33 by 1997, by which time 89 percent of the total population had access to safe drinking water.¹⁰

Such a significant agricultural nation has emerged from specific human and natural resources. Thailand can therefore be considered in terms of its natural environment, its modified agricultural environment, and its people and their development of an agricultural nation. The golden cradle of this civilisation includes the essential ingredients of a sustainable agriculture, which have been apparently abundant natural resources of land and water and a favourable climate.

The Land of the Thai

Located between 5°40' and 20°30' North latitude and 97°70' and 105°45' East longitude with a total area of some 513,112 square kilometres. (approximately 320,697,000 rai), Thailand borders Lao-PDR to the north and east, Myanmar to the north and west, Cambodia to the southeast, and Malaysia to the south. It has some 2,614 kilometres of coastline and a maximum length north to south length of some 1,620 kilometres.¹¹

The country's natural assets are defined by the Central Cordillera, the Annam Cordillera and the Arakam Yoma, three mountain ranges which are linked in geotectonic terms to the mountains of the Tibetan Plateau. These ranges have affected soil types, continue to affect rainfall, and determine the major drainage patterns which in turn create the agricultural environment.

Administratively, the country is often divided into four regions plus Bangkok although a six way physiographic division provides a more convenient basis for some discussions.¹² The six divisions are the Central Plain, Southeast Coast, Northeast Plateau, Central Highlands, North and West Continental Highlands, and Peninsula Thailand as indicated in Figure 1.1. The Central Plain is the large alluvial delta of the Chaophraya system comprising quaternary alluvial deposits which exceed 300 meters in depth. The Southeast coast is comprised of quaternary terraces predominantly of marine origin interspersed with alluvial deposits and also contains a minor volcanic plateau. The Northeast plateau comprises wide river terraces of the Mekong River and tributaries and is commonly separated into low, middle and high terraces, the latter of which has largely disappeared.

⁸ World Bank (1999)

⁹ World Bank (1999)

¹⁰ World Bank (1999)

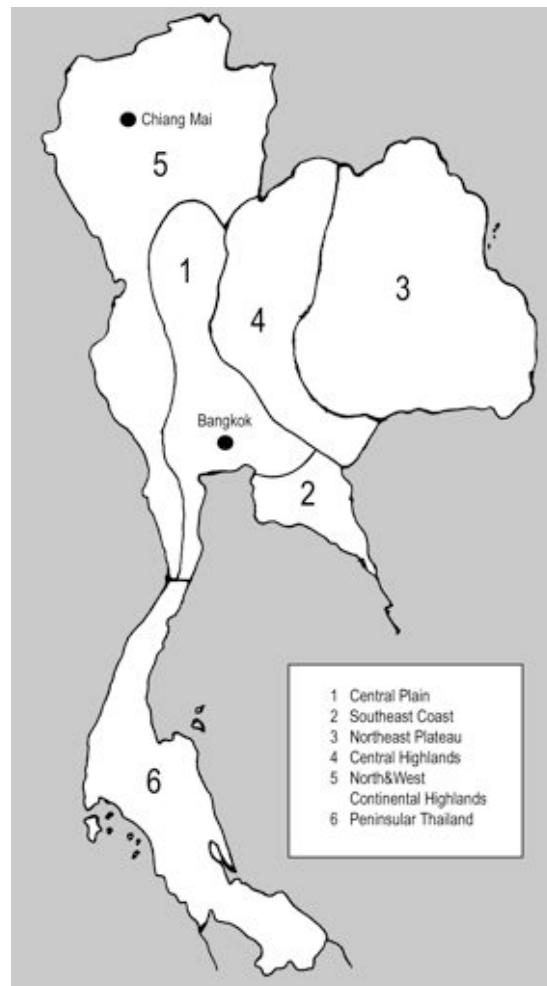
¹¹ Arbhabharama, Anat. et al

¹² Moormann, F.R. and Rojanasoonthon, S. (1968)

The Central Highlands is a complex region comprising hills plateaux, peneplains, and valleys across altitudes of 300 to 1,200 meters.

The north and west Continental Highlands is commonly separated into the western mountains of the Central Cordillera, and the northern hills and valleys which is a series of north-south mountains and plateau interspersed with long flat river basins. Peninsular Thailand comprises several distinct mountain ranges and low hills and undulating terraces of fluvial origin.

Figure 1.1 Six Physiographic Divisions of Thailand¹³



Soils

Land forms of Thailand can be divided into; beach and dune formations, low and high alluvial terraces, dissected erosion surfaces, hills and mountains, and depressions¹⁴ in a

¹³ Moormann, F.R. and Rojanasoonthon, S. (1968)

¹⁴ Scholten, J. and Siriphant, Chamlong. (1973)

system which builds on the Pendleton Provisional Map of Soils and Surface Rocks of Siam of 1935. Detailed land capability maps which began to emerge in the 1960s¹⁵ have usually divided Thailand into areas suited to both paddy and upland crops, upland crops, and areas not generally suited for cultivation. While useful definitions in the past, changing demands, environmental impacts of large scale developments, and a rising focus on forestry in both agricultural and conservation areas now requires more manipulable information.

The general soil map of Thailand presents ten general soil categories (Table 1.2) containing 38 groups. The proportions of agricultural land suited to various crops have been suggested as; upland crops 21 percent, paddy rice 26 percent, perennial crops five percent, special crops with appropriate soil enhancement measures 16 percent, with the remaining 31 percent being classified as unsuitable for agriculture. The lack of congruence of these areas with current land use reflects population, political, and commercial pressures, and also indicates areas of environmental concern. With changes in agricultural technology and population, a gradual shift from mono-cropping of rice has occurred. For example, in 1960, 60 percent of the cultivated area was under rice, 12 percent under upland crops, and 16 percent under tree crops of which forest cover represented some 60 percent. By 1993, the area cultivated for upland crops had quadrupled representing 26 percent of cultivated land at the expense of forest land.

Table 1.2 Soils in Thailand¹⁶

Soil Type	Square Kilometres	Million Rai	Percent
Entisols	16,860	10.5	3.29
Vertisols	4,156	2.6	0.81
Inceptisols	48,253	30.2	9.40
Mollisols	6,003	3.8	1.17
Spodosols	615	0.4	0.12
Alfisols	4,6991	29.4	9.16
Ultisols	21,6192	135.1	42.13
Oxisols	153	0.1	0.03
Histosols	718	0.4	0.14
Unclassified	173,174	108.2	33.75
Total	513,115	320.7	100.00

Water Resources

More than land forms, water has conspicuously shaped the Thai culture. The Salween and the Mekong Rivers which largely define Thailand's land borders, originate in the broad

¹⁵ FAO (1972)

¹⁶ Land Development Department (1972)

region influenced by the frozen Himalayan reservoirs where ten of the world's great river systems originate within a radius of 200 kilometres. Cultural associations with water include; religious affiliations across this region, migration of Tai people along river valleys to what is now Thailand, and the development of food production systems which assume ready availability of water.¹⁷

The Chaophraya River, wholly within Thailand, is fed by the Ping, Wang, Yom and Nan Rivers which drain the northern highlands and the Pa Sak River which drains the Phetchabun mountains. Around 33 percent of the Kingdom is drained by this complex, the deposition of silt from which has extended the river mouth south into the Gulf of Thailand. Siltation has reduced the functionality of various cities across Thai history, from Lopburi to Ayutthaya to Bangkok, while providing extensive lands suited to agriculture with once surplus surface water resources (Table 1.3).

In the twentieth century, the Chaophraya, and to a lesser extent the Kwaie Yai and the Kwaie Noi Rivers in the Mae Klong basin of the west and the Mun and Chi Rivers of the Northeast, have been viewed as irrigation, hydro-electricity and/or domestic and industrial consumption resources. The creation of dams on major rivers has significantly modified the environment, as has associated agricultural change.

Table 1.3 - Surface Water Resources of Thailand (million cubic metres)¹⁸

Region	River	Reservoir	Natural Storage	Rainfall volume
Northeast	26558	6231	193	236400
North	23175	48723	34	220500
East	29720	18781	156	76700
Central	3747	333	-	91000
South	6795	6708	53000	169700
Total	89995	80775	436	794300

Underground water varies according to local hydrological conditions in the northern highlands. Alluvial and older terrace deposits yield viable and apparently sustainable sources of water, while the alluvium aquifers of the Central Plain and the Khorat aquifer of the Northeast yield salty water except from the upper aquifer which lies under highly populated areas. A 450 x 22 kilometre plain south of Nakhon Sri Thammarat in the South yields viable levels of water. The eastern provinces, even in the alluvial and terrace deposits, have the least groundwater potential of the Kingdom.

Notwithstanding the significance of irrigation, rivers and underground water resources, the major water resource for agriculture continues to be rainfall.

¹⁷ Jumsai, Sumet. (1997)

¹⁸ Kiravanich, Pakit (1983)

Climate

Thailand's monsoonal climate is experienced as three seasons; a hot season from approximately March to May, a rainy season from approximately May to the end of October, and a sometimes less distinct cool season from approximately November through February. The two climatic classifications commonly applied to Thailand are; Tropical Rainforest, and Tropical Savanna. The rainy season is more protracted along the southeastern coast of Peninsula Thailand where average annual rainfall commonly exceeds 2,000 mm and reaches up to 4,000 mm in some areas. The majority of Thailand experiences average annual rainfalls between 1,100 and 1,500 mm, with the lowest rainfall commonly recorded in the Western Continental Highland rain shadow where average annual rainfall is less than 1,100 mm. Rainfall is influenced by monsoons, cyclones, and convection from all directions except the protected northwest.

Temperature variations between seasons are mainly small. Minimum cool season temperatures in January range from around 26°C to 28°C for most of the Kingdom. During the hot season, April temperatures range from 28°C to 32°C. Altitude reduces minimum temperatures in the highlands in the North and Northeast rarely to near 0°C, while in southern Thailand variations are the lowest, between 26°C and 30°C all year.

Weather variations in Thailand attract speculation, as elsewhere. Current knowledge can only suggest that these are a result of:

- inter-annual variations in which climate varies between years and which is most commonly depicted to the public in terms of droughts, floods, and severe winters
- decade-scale climate variations such as recorded over eastern North America in 1958 and 1976
- long-term changes which may have 200 year or other cycles.

Greenhouse gas effects remain difficult to detect among these natural variations.¹⁹

Anthropogenic environmental changes in Thailand are clearer in terms of forest and soil losses which affect native habitats as part of a continuous modification of the natural environment .

Other Natural Resources

The flora, fauna, and people of the Kingdom form part of the natural resource base. The natural fauna is linked, to a large extent to the natural environment being preserved which, in this era relates predominantly to conservation or remaining forest resources. The wide ecological diversity of the Kingdom includes more than 170 endangered animal fauna species.²⁰ Forests are less than 50 percent evergreen which includes tropical evergreen forest which is the most bio-diverse. Other evergreen forest types comprise typical evergreen, coniferous, and mangrove forests which are believed to provide habitat for some 40 endangered fauna species, 20 of which are found exclusively in such forests. Deciduous forests which occupy the drier, inland, and steep slopes include mixed

¹⁹ Falvey, L. (1996)

²⁰ MIDAS (1991)

deciduous and dry *Dipterocarpus* species, and particularly in the past, have included large teak (*Tectona grandis*) dominant forests.²¹

However, it is the resource of humans that has created a sophisticated agriculture, and which concerns this book. From a population within what is now Thailand of around four million in 1700, growing to some six million towards the end of the 1900's, today's almost 70 million has both been created by, and created a challenge for, Thai agriculture. Individual smallholdings necessitated by high rural populations allows for intensive cultivation and attention to crops which can, for example, maximise the effectiveness of chemicals used in agriculture. However, balanced against this are lower levels of education, higher levels of monetary poverty, and entrenched ideas about agriculture of both rural dwellers engaged in agriculture and the powerful urban elite.

For a society grounded in agriculture, each of art, culture, and tradition reflect associations with the soil. Just as a broad view of art is necessary to understand this axiom through, for example, considering more than temple art derived from an Indian city and jungle based religion,²² so a broad view of agriculture and the environment is necessary to understand the special characteristics of Thai agriculture. Thus an appreciation of Thai agriculture requires consideration of historical, political, scientific, social, environmental, and economic changes.

Regional Origins

Thai agriculture originated in what is now China, which supported several distinct types of agriculture and appears to have the oldest of all agricultures as Vavilov first suggested.²³ The agriculture on the Tai people, who probably originated in what is now China, is but one of these. The rice agriculture of Thailand built on that of the Tai and borrowed from other neighbouring and indigenous forms of agriculture. While millet was an adaptable upland crop and a staple in early Asian civilisations, its production by shifting cultivation utilising a pointed planting stick did not allow development of large population concentrations. Rice usurped millet as the preferred cereal for dominant cultures by its adaptability to agriculture which produced cities and states across Asia, where eventually more than 90 percent of the world's rice would be produced.

Rice seed could be broadcasted into wet areas and with minimal labour produce a viable crop. Over time, variations in yields were reduced by bunds which initially impeded natural drainage, and domesticated buffalo which puddled soil to reduce water infiltration. Buffalo were subsequently utilised in ploughing, and their supplementary benefit of fertilising the fields while performing work provides an early glimpse of the integrated nature of rice cultivation. By about the eighth century, a wet rice production system including fish and coconut production seemed to be preferred across all suitable areas of Southeast Asia, with taro, yam, sago, and vegetables maintained as mere standby reserves.

²¹ Sadoff (1992)

²² Gordon, A.C. (1998)

²³ Bray, F. (19??)

Control of water and land was essential to the development of this agriculture, aspects of which appear to emerge with the Tai ethnic group.²⁴ However, such Tai innovations were not introduced into a technological vacuum; rather they blended with technologies of earlier regional powers, in particular the Mon-Khmer, and independent agriculturists. The latter may have retained elements of the prehistoric agriculture of Ban Chiang in the Northeast, where domestication of pigs, cattle, chickens, and rice may have occurred some 4000 years ago.²⁵ The advance from a hunting and gathering economy to agriculture was the first step in intensification of food production; further intensification which became the hallmark of civilised societies, occurred from the Ayuthaya period..

Intensification

Agricultural intensification has usually been associated with large scale irrigation, low levels of labour productivity, and severe population pressure.²⁶ However, in the case of early Thailand, the human population does not seem to have been sufficiently large to place any significant pressure on its fortuitously productive land and efficient farming systems. Even in recent times up to the 1960s, the majority of Thai farmers in irrigated areas elected to produce only one rice crop per year. Central Thailand populations during the Dvaravati and Lopburi periods, while high by contemporary regional standards, appear to have produced a surplus of food.²⁷ This historical export capacity provides a clue to understanding Thai agriculture today.

A culture of adequacy of food production continues to pervade Thai decision making concerning agriculture and its development. The ability to expand agricultural production without a large decrease in the output per unit of labour, and a cultural attitude to share community tasks, has allowed Thai agriculture to largely escape a widespread association of agricultural labour with drudgery. It also ensured integration of the very persons who fed the nation with cultural activities.. Off-season and part-time farmers of early Thai Kingdoms were valued craftsmen. Production of one's family needs for food could be a first priority with surplus to meet community, tax, religious or other obligations, or one's spare time could be allocated to cultural and other pursuits. These characteristic links between culture and agriculture remains evident in the role of food and its presentation within Thai culture, and possibly provides some understanding for slow acceptance of some labour and capital intensive agriculture.

Even in, or perhaps resulting from, this agricultural Eden, the impacts of war, variable seasons, and periodic social decline have been evident through the centuries. The first publication in Thailand in a western language records drought, famine, green water, and poisoned fish in the early 1700s, which was the beginning of the agricultural export economy.²⁸

²⁴ Hall, K.R. (1992)

²⁵ Wyatt, D. (1984)

²⁶ Boserup, E. (1965)

²⁷ Bronson, B. (1989)

²⁸ Turpin, F.H. (1771)

Thailand has increased its food production through the usual means of:

- increasing the area of cultivated land
- increasing the yield per hectare
- increasing the number of crops per year
- replacing lower yielding with higher yielding crops and varieties
- reducing post harvest losses.

Modern, as ancient, developments in Thai agriculture have been associated with irrigation. Expected returns from rice have been used to justify large irrigation investments this century, and domestic rice prices have been manipulated to reflect these intentions, notwithstanding the influence of the less easily controlled export price. However, the early selection of superior sites for development of irrigation facilities may also be seen in terms of aristocrats gaining control of land which would benefit from slow implementation of an intricate and far reaching irrigation plan developed on behalf of King Chulalongkorn by van der Heide (1904).²⁹ In retrospect, one could suggest that Thailand's irrigation has been implemented in a piecemeal fashion, often long after demand for the water was established, and as having been relegated a less important role than industrial and communication infrastructure.

Industrialisation

Increased agricultural production resulting from population increase and irrigation provided surplus wealth for national economic development. Agriculture shrank in relative terms while growing and funding growth in other sectors. In 1960 and 1970 the sector of agriculture, forestry, hunting, and fishing engaged 82 percent and 97 percent of the active population respectively.³⁰ Between 1970 and 1990, the growth of the agricultural sector was approximately four percent per annum compared with 8.5 percent and 7.3 percent for the industrial and service sectors respectively. The continued growth of the agricultural economy albeit at a slower rate than other sectors continues as an essential underpinning of the economy of agriculture, as is particularly evident in periods of large scale correction in the industrial and service sectors, such as during the 1990s. If social factors are ignored, agriculture's fall from the largest sector to only 14 percent of the 1981 economy in value added terms compared to manufacturing's rise to 22 percent, appears to indicate decreased reliance on agriculture.³¹ By 1993, the agricultural sector represented about one third of total exports by value, and more than 38 percent of land use within the Kingdom - 60 percent of which was paddy rice production, 23 percent field crops, and 9 percent fruit and perennial crops.³²

The rising contribution of manufacturing industries was observed rather than caused by economic planners, incidentally leading to poor agricultural policies in the late 1970s and early 1980s. Subsequently, maize export was liberalised in 1982, the centuries'-old rice

²⁹ Siamwalla, Ammar. (c.1986)

³⁰ Donner, W. (1978)

³¹ Siamwalla, Ammar., et al (1992)

³² Chomchalow, N. (1993)

export taxes were removed in 1986, and taxes on rubber were reduced, while cassava and sugar continued to be protected. Restrictive regulations for licensing, cross-province transport, and slaughterhouse ownership continued to stifle livestock development through this period. Liberalisation was interpreted as an emerging economic maturity and allowed more open communication in international trade and development.³³

Critically, the era of policy shifts away from agriculture towards industry were associated with rising agricultural impact on the environment. Thailand ranked ahead of Burma, Indonesia, the Philippines, Korea and Japan in terms of; increases in cultivated area, reductions in forest area, increases in agricultural production, increases the percentage of the labour force engaged in agriculture, and variability of agricultural production. Increases in irrigated area, in the use of tractors, and fertilisers were exceeded by some neighbours. Of particular interest, is the maintenance of paddy and cereal yields in Thailand compared to all of the other countries.³⁴ The potential for further production increases from Thai agriculture through water management, efficient fertiliser usage, and mechanisation have remained technologically achievable goals since that time. The difference between Thailand and its neighbours, and most countries of the world, remains its significant contribution to global food production from a less environmentally stressful form of agriculture.

Notwithstanding an emphasis on industrialisation, agriculture contributed around 50 percent of Thai exports from 1980 through 1985, with the absolute value of these agricultural exports increasing from some 73 to 95 billion baht. Major contributions from employment which reduced the cost of social services, and from export income which repaid foreign development debt, were not publicly reported as of special significance. Underestimation of such benefits from agriculture parallel the underestimation of benefits from forests in watershed management, habitat preservation, and general environmental improvement³⁵ where social and natural resource economic analyses have yet to be applied. For a major agricultural country such as Thailand, consideration of the social and environmental benefits of agriculture is probably more important than it is to the majority of the world's countries engaged in such industrialisation comparisons.

National and Global Responsibilities

Agriculture has created Thailand and continues to shape the Thai identity, support Thai lifestyles, and portray the Kingdom to the world. The very association between food and rice in the Thai language, and the tenacity with which Thai farmers have clung to planting at least enough rice for their own family before engaging in cash crops, testify to the deep association of wet rice culture and the peoples who are Thai.³⁶ Lapses from this central element have been highlighted by His Majesty the King *Thailand derives income from many sources but we must remember that we survive from agriculture and therefore we must nurture each aspect of the industry including farmers of all types to*

³³ Siamwalla, Ammar. (c.1986)

³⁴ World Bank (1983)

³⁵ Arbhabhirama, Anat. (1987)

³⁶ Silcock, T.H. (1970)

*continually develop in order to increase the quality of production in a manner that does not reduce the natural resource base*³⁷

Modern agriculture is the main form of terrestrial natural resource management, meeting rising food demands as it impacts on the environment in a manner which we only beginning understand. Historically, an essential foundation of civilisation, the world's six billion people could not today survive without productive agriculture. Humans could move from an exhausted to a new site until recently, as our behaviour continues to reflect. Now agricultural technologies are increasingly assessed against their ability to continually produce the required output while maintaining the underpinning natural resource base.³⁸ Practically, this is interpreted as optimising production and its sustainability within the controlled agricultural environment, as distinct from the original natural environment which has largely disappeared.³⁹ Unfortunately food production to meet global demands, or even Thailand's current debt and lifestyle demands, is not yet possible from low input systems alone; nevertheless, co-existing self-sufficient and commercial agricultural systems may be the best future approach for Thailand.

World population shows an exponential rise, which should decline as birth rates fall with rising levels of health and affluence. However, under the best scenario, population continues to rise through most of our lifetimes. The Green Revolution of the late 1960s and early 1970s enabled Asia in particular, to feed itself, new varieties of rice with doubled yields to cover 33 percent of rice areas, and maize yields to quadruple.⁴⁰ Feeding that global population of 3.7 billion, twice that of fifty years earlier, was thus accomplished. By 1990, 1.5 billion more people being fed, and economic progress was evident, particularly in Southeast and East Asia. Such rising affluence increased demand for food per person and of special foods often produced with lower resource-use efficiencies. Total food production requirements therefore rose further, causing greater environmental pressures in a country such as Thailand which relies on food exports for national wealth. With such environmental pressure, and the frequent prospect of famine in many nations of Africa and Asia,⁴¹ Thailand faces the dilemma of feeding fellow human beings as a good global citizen while preserving its underlying resource base.

— Modern agriculture has preserved the maximum possible space for nature and wildlife through its high efficiency of production on productive land.⁴² The areas of land saved by the introduction of modern cereal varieties to China calculated from expected yield increases without modern varieties compared to actual use indicate wide-scale protection of sensitive land. In this way, agricultural research form part of natural resource management research; it also highlights the anachronistic position of Thailand in effectively subsidising food importing countries though low agricultural prices and uncosted environmental impacts. Thailand is faced with the options of:

³⁷ Chantalakhana, Charan. (1999)

³⁸ Wilken, G.C. (1991)

³⁹ Hillel, D.J. (1991)

⁴⁰ Gutmang, G.(1995)

⁴¹ Orr, D W (1992)

⁴² Bourlaug, N. (1995)

- continuing to subsidise the development of other nations for minimal benefit
- reducing exports, and hence income, where environmental conflicts are clear
- rationalising investments; in research to ensure responsible agricultural practise, in education to ensure a widespread ability to apply improved technologies, in industry to build on national strengths in agriculture.

As an efficient major agricultural exporter in a price environment that neither reflects social or environmental costs of production, Thailand assists the world to meet higher ends. Global responsibilities must balance management of the natural resource environment with the ambitious declaration of the World Food Conference that (by 1984!) ... *no child will go to bed hungry, that no family will fear for its next day's bread and that no human being's future and capacity be stunted by malnutrition* ... Subsequent famines in Africa, South Asia, and elsewhere are now understood in political and exploitation terms which echo reconsideration of policies which reduce the rights of any citizens to produce their own food.⁴³ In the case of Thailand, a rising association of agricultural production with poverty suggests disenfranchisement of the many in the population who have contribute to the national well-being and global demands.

Current Situation

From a land fortunate in its natural resources, and the infusion of rice into the culture of the peoples who have created Thailand, sustaining the resource base for agriculture is a new challenge. Modern Thai agriculture embodies new technologies which have built on traditional technologies developed over its 5,000 year rice farming history.⁴⁴ However, the harmony between culture, economy, history, and religion which agriculture provided, was noted as failing even in the 1970s.⁴⁵ Historical governance approaches were beginning to show their weaknesses in a new economic system.

Thailand has met economic demands from export income which traditionally relied on expansion of the agricultural area and moderate intensification. Modern mechanisation and chemical pesticides and fertilisers in association with large scale irrigation facilities have allowed regularity of agricultural production for export. Other simultaneous changes in Thai society have created apparent labour shortages and oriented agriculture to a global system.⁴⁶ The current agricultural situation derives particularly from such developments of the past three decades.

Five characteristics of arising from developments of the past 30 years, are:

- An orientation to export markets with domestic prices in the main being strongly influenced by international prices - some 77 percent of the value-added in crop agriculture arises in the production of traded goods.

⁴³ Sen, A. (1982)

⁴⁴ Sriwatanapongse, Sutat. (1997)

⁴⁵ Donner, W. (1978)

⁴⁶ Kunstadter, P. (1989)

- Expansion of the crop sector in the past has been mainly based on conversion of forest land to cultivated area - availability of such new land is extremely limited and hence increases in production must arise from increases in yield.
- Rice, once the epitome of Thai agriculture, has been progressively replaced by field crops including maize, kenaf, cassava, and sugar cane - from 1961 to 1985, the area cultivated for field crops expanded 3.3 percent per annum compared with 1.8 percent for rice.
- Governmental involvement in the agricultural sector includes regulation of foreign trade, taxation, exchange rates, and trade restrictions, and also public resources for infrastructure and support services for agriculture.
- Institutional changes, such as the emergence of large food processing agribusiness, have affected farming systems, for example in the pineapple, tobacco, and some livestock and vegetable industries - tractor costs have reduced through the development of secondary industry, biotechnology has accelerated the production of new crop varieties, and usage of fertiliser, pesticides and herbicides has increased significantly.⁴⁷

Having largely achieved the 1930s' political objective of stability and global respect, at least partly through following the common approach of natural resource exploitation, Thailand has reached a barrier. Apparently locked into the need for high levels of agricultural exports to repay international debts of other sectors, a higher intensity of production using Green Revolution technologies seems inevitable. One benefit of the late adopter in this case is the luxury of learning from the experience of other countries. It is therefore critical that appropriate legislation and action following attitudinal changes reflect a commitment to, and knowledge of, environmental management. Shifts in policy may already be reflected in such mechanisms as the unique nationwide ban on logging⁴⁸ and rising agreement that land and water are no longer free or abundant resources.

Total land availability in 1985 was assessed at some 321 million rai (51.4 million ha) of which 136 million (21.8 million ha) was designated as national forest reserves, 93 million rai (14.9 million ha) of which remained intact. Some 26 million rai (4.2 million ha) had been abandoned or was used only for grazing, and the cultivated area represented some 152 million rai (24.3 million ha) planted to rice, (84 million rai) upland crops (52 million rai), and perennial crops (70 million rai).⁴⁹ In addition to the limitations on land, the 1994 drought refocused attention on earlier advice that harvested water was declining in quantum while demands from agricultural, and in particular urban and industrial use, were increasing.⁵⁰

At the same time, FAO reported that crop yields due to such factors as:

- physical, chemical and biological deterioration
- cultivation on steep sloping land without soil conservation practices
- inappropriate farming systems for increasingly intensive agriculture

⁴⁷ TDRI (1988)

⁴⁸ Sadoff, C.W. (1992)

⁴⁹ Arhbabirama, Anat (1987)

⁵⁰ United Nations (1991)

- poorly defined land ownership with associated restrictions of access to fair credit
- a poorly developed farm credit sector
- poorly developed agricultural infrastructure
- irregular rainy seasons.⁵¹

However, any analysis of the cropping sector requires a separate discussion of rice which can statistically dominate other trends. The average yield per rai of rice in the early 1980s was estimated to be approximately 300 kg per rai (1,875 kg per ha) which is about one third of that achieved in such countries as Japan, Taiwan and the USA. In contrast, yields of rubber have increased rapidly over the past 30 years from some 30 kilograms to more than 90 kilograms per rai, (563 kg per ha) and similarly maize yields have been maintained or risen. Cassava, increasingly grown on marginal land with marginal economic returns, and possessing an ability to produce a yield under a wide range of environmental circumstances, shows a declining yield trend and remains indicative of poverty. Forestry, variously included or excluded in agricultural assessments as a function of its overriding harvest orientation, typifies the current paradigm shift concerning agriculture and the environment.

With a decline in the official forest reserves, which themselves are overestimates, an environmental and production focus is required, with cognisance of its economic sector through employment of some 130,000.⁵² A strategy for sustainable extraction of forest products should help preserve the forest areas which are recorded as; tropical evergreen - 42 million rai (6.7 million ha), mixed deciduous - 21 million rai (3.4 million ha), dry *Dipterocarp* - 30 million rai (4.8 million ha), mangrove - 1.7 million rai (0.3 million ha), pine - 1.3 million rai (0.2 million ha) and scrub - 0.5 million rai (0.08 million ha). Timber plantations and agroforestry which meet continuing strong demand for timber products within the domestic market will also be required. An overlap with perennial fruit trees, even in steep mountainous areas, now links forestry to horticulture.

In a manner similar to Thai lowland and upland agriculture, the shifting cultivators of the highlands have exceeded the limits of sustainability as a result of population pressure. These Thai shifting cultivators have long practicing cyclical field rotation,⁵³ in some cases in conjunction with small-scale irrigated agriculture in narrow valley floors. Future highland agriculture, notwithstanding its special social and political issues, is likely emphasise perennial fruit crops, and to borrow from Chinese experience.

Government leadership is paramount in such a country, yet its influence on agricultural practices is limited to incentives which must compete with those of market prices. Apparent influence through water allocation in the central Chaophraya system is constrained by political pressure, and policy initiatives directed via field extension officers are typically of short term impact, due to officers' competing responsibilities and frequent changes in policy.⁵⁴ Now globally oriented, Thai agriculture requires a global

⁵¹ FAO (1984)

⁵² RFD (1982)

⁵³ Kunstadter, P. et al (1978)

⁵⁴ TDRI (1995)

policy perspective in more than fiscal terms; agriculturally-linked poverty requires enlightened social policy, and international political influence depends on sound environmental practice.

At the cross roads, Thai agriculture includes forestry and comprises the majority of land managers whose own relative poverty may necessitate their taking a short term focus on cash, and in some cases, food production. The current situation of Thai agriculture varies markedly from its traditional role in ensuring abundant food from a bounteous environment. The late 1990s financial crisis provided an opportunity to reconsider social and environmental policies relating to agriculture and rural development, and a bifurcated production environment with self-sufficient and commercial agriculture coexisting.

Policy responses to environmental degradation from over-extraction from resources, unregulated resource use, and privileged access to resource exploitation, have been political bargaining points rather than attempts at, for example, full cost resource pricing. The Office of Environmental Policy and Planning is developing new economic instruments to improve sector management,⁵⁵ which may benefit from consideration of an emerging revival of traditional practices and Buddhist teachings.⁵⁶

The current situation for Thai agriculture derives from traditional practices and the integration with global production. Traditions which allowed the transition from river valley agriculture to one of the world's important agricultural centres can be traced through the history of Tai and other ethnic groups as they absorbed new technologies and cultures in creating the Thai nation.

Ingredients of Thai Agriculture

Thai agriculture has been an amalgam of the cultures absorbed into the Thai nationality. Prehistorical agriculture of Thailand matches other ancient dates, and was most probably absorbed into the agriculture which had evolved in the Mon-Khmer culture by the time migrating Tai peoples added their unique technologies. Each borrowed from the cultures with whom they came in contact through religion, trade, and later, colonial interests. From the eulogised Sukhothai agriculture and institutions to the politically successful Ayutthaya and Ratanakosin period, Thai agriculture has introduced new technologies from innovation, migration, and adaptation. Some of the civilisations which have contributed to its agriculture are indicated by through the periods commonly termed:

- Ban Chiang c.3600 BCE. - 300 CE.
- Funan 1-600 CE.
- Chenla 300-800 CE.
- Dvaravati 1-1300 CE.
- Khmer 700-1500 CE.
- Sukhothai 1240-1351 CE.
- Lanna 1200-1600 CE.
- Lan Xang 1300-1800 CE.

⁵⁵ Kaosaard, Mingsarn. and Pednekar, S.S. (1996)

⁵⁶ Wasi, Prawase (1988)

- Ayutthaya 1351-1767 CE.
- Ratanakosin 1767 CE. to current⁵⁷

The adoption of new technologies, both separately and as part of cultural assimilation over the centuries, is treated in more detail in subsequent chapters. Perhaps the most easily understood aspect in modern terms relates to the large scale expansion of agriculture in central Thailand surrounding Ayutthaya during and after that city's dominance. Through the Ayutthaya period, rice was exported regularly to Malacca, Europe, and China,⁵⁸ as well as aloe, camphor, and beetle nut among other commodities. While the opening of new agricultural land is usually seen as the basis of expansion, the development of water control technologies for vast Chaophraya delta required innovative adaptation of current technologies. Irrigation-based, and recently rain-fed land expansion, particularly between 1850 and 1980 when some 150 million rai (24 million ha) of new land was cleared and settled in some five million farm holdings, allowed the rural population to expand from a few hundreds of thousand to around 40 million. By the late 1800s, rice had displaced forest produce as the major export, and continued to grow until around 1950. Peasants were encouraged to clear new areas and farm them with minimal initial interference from the Crown. Escaping colonial domination through this period, Thailand relied on Chinese and European middlemen and traders linked to a self-contained peasant agriculture.

As the peasant based farming system produced a viable if small exportable surplus, a few Chinese traders were entrusted as commission tax agents (tax farmers) on behalf of the Crown in remote areas, while the aristocracy controlled lands in accessible areas. However, seeking more revenue and control over the wealthy aristocracy, the Crown built on taxation of the agrarian frontier economy⁵⁹ which incidentally institutionalised a selective taxing of agriculture which persisted until the 1980s.

From time immemorial, the peoples of what is today known as Thailand have been self-sufficient in food production. Current account imbalances have always been eased, even through the 1990s, by the economic underpinning provided by agriculture. When export revenues decline with prices, Thailand has been able to limit its import of other products, unlike most other countries. The history of Thailand can be interpreted in terms of immigration, assimilation, political management, and gaining control of the agrarian base in terms of producers and its produce to ensure a consistent ability to export agricultural products. Against this backdrop, the subsequent chapters consider the origins of Thai agriculture, its unique aspects, and its global role. To begin the historical discussion of the agriculture in the area now known as Thailand, the next chapter discusses its inhabitants over the centuries and the possible linkages between food production and environmental respect.

Summary

⁵⁷ Rogers, P. (1996)

⁵⁸Yuthavong, Yongyuth. and Wojcik, A.M. (1997)

⁵⁹ Phongpaichit, Pasuk. and Baker, C. (1997)

Key points pertinent to Thai agriculture which may be elicited from this introduction include:

- The fertile and well watered area which eventually became Thailand through innovative technological, social, and political management contains unique elements associated with diverse ethnic origins unified through wet rice culture developed north of Thailand which have allowed rising exports for at least five hundred years from expansion of agricultural land, intensification of cultivation, and diversification.
- One of few major agricultural exporters, Thailand now leads the world in rice, rubber, and black tiger prawn production and export, is the regions largest exporter of chicken and duck meat, and through these and other exports, feeds more than four times its population from an agriculture less intensive than that of most of its neighbours.
- As important as agriculture is to the export income of Thailand, it is as the employer of 80 percent of the population that it is critical, and the increased impoverishment of marginal farmers represents a continuing challenge to Thai policy makers which is linked to domestic and international concerns for improved environmental regulation.

Chapter 2

Agricultural Origins

Rice is synonymous with Thai agriculture. This results from the cultural development and origins of Tai and Thai people, and the role of rice in political development, economic progress, international trade, and in the modern era, providing a large part of the fuel for 'agriculture as the engine of development'.⁶⁰ However just as the Thai were not the original inhabitants of Thailand, so wet rice was not the country's first important agricultural crop. Shifting cultivation, possibly including some dry rice within a range of vegetable crops are thought to have predated the use of wild wet, and certainly, domesticated, wet rice production. While some claim that Thailand was the world's first site of plant domestication, the wet rice cultivation system originated in China. With the improvements in wet rice cultivation came animal agriculture, wealth creation, and the trappings of a sophisticated culture. While agriculture in Thailand has been more than rice, rice has been more than agriculture to Thailand, and remains critical to an understanding of modern Thai agriculture.

The context for the emergence of a Thai agriculture included prehistorical agricultural developments, the later major regional Kingdoms of Angkor and Pagan, and the long and influential contact of the South with Srivijaya Kingdom of Java, as introduced in this chapter.

From Gathering to Growing

The shift to agriculture from less labour demanding hunting and gathering was probably motivated by a desire for greater regularity and security of food supply under conditions of environmental change and population increase. Initially involving only a few societies with demographic advantages for further expansion and eventually domination of the foragers, agriculture became the food production norm throughout lowland Southeast Asia. Its geographical origins remain conjectural, yet some evidence of pre-historical rice cultivation suggest its early and widespread development in the region.

In the 1970s, archaeological research in Ban Chiang, northeastern Thailand claimed the earliest date of plant domestication in the world.⁶¹ More recent finds confirm the domestication of plants before 9,700 BCE and one view of both the development of agriculture suggests a Thailand to China transmission.⁶² Regardless of the exact place of plant domestication in the region and the direction of technology transfer, the association of cultures based on wet rice agriculture suggests wide cross regional contact in the design of domestic architecture, utensils, and crafts. The development of rice culture in Thailand is contentious and impossible at this stage to link to the historical period. One theory suggests that dry rice sown with a digging stick into the ashes of a cleared and

⁶⁰ Tribe, D.E. (1994)

⁶¹ Solheim, W.G. (1970)

⁶² Jumsai, Sumet. (1997)

burned forest predates the cultivation of wet rice. The theory which is based on a traditional stories in Vietnam, that rice originated in the mountains and moved to the plains, may be challenged in terms of river valley based migration patterns, and the apparent absence of relevant historic sites in the mountains. Rice seed broadcasted into receding flood water areas was labour efficient, and probably became the earliest form of wet rice domestication⁶³ as a simple modification of primitive husbanding of useful plants in their natural environments.

Shifting cultivation in upland and mountainous regions of Thailand long predates that of today's hill tribe groups. The extensive use of fire in forest farming provided a labour cost-effective means of introducing root and tree crops, particularly along the water courses of lowland and contiguous rising regions before the creation of irrigation fields.⁶⁴ This contrasts with a common view that tending of seed plants in the Northern and Northeast may have in fact predated the domestication of the root and tree crops.⁶⁵ From scant information, one can only conclude that fire-based shifting cultivation, long practised in Thailand, has little apparent association with the emergence of larger rice-based populations.⁶⁶

Ban Chiang archaeological indicators of rice domestication are subject to some doubt about the differentiation of wild and cultivated forms of rice grains found in pots and rice husks used to fire pottery. Nevertheless, cultivation of rice in southern China near Hang Chow has been dated to approximately 5000 BCE,⁶⁷ from vegetative layers up to 50 centimetres thick containing rice leaves, straw, husks, and grain. Vegetational change over the past 10,600 years, at least in southern Thailand, includes forest destruction phases more than 4,000 years ago which may indicate human activity, as it is associated with a rise in presence of *Artocarpus* pollens which are thought to have been a shifting horticultural product grown with dryland rice.⁶⁸ However, archaeological sites with rice-based agriculture seem to be more easily found than those of equally complex societies originating from other forms of agriculture.

Legumes and chickens may have been encouraged around dwellings by about 10,000 to 20,000 years ago which was around the time of linguistic and cultural differentiation of groups which had hitherto shared a common culture for up to 30 millennia. Subsequent defining characteristics of the cultures of Southeast Asia included rice consumption, associations with swine, chickens, and cattle, and water transport through outrigger canoes.⁶⁹

Neolithic to Iron Age

⁶³ Wyatt, D.K. (1989)

⁶⁴ Pelzer K.J (1978)

⁶⁵ Gorman C.F (1971)

⁶⁶ Kunstadter, P. and Chapman, E.C. (1978)

⁶⁷ Labbe', (1975)

⁶⁸ Maloney, B.K. (1998)

⁶⁹ Wyatt, D.K. (1998)

The absence of one primary agricultural development site within Asia suggests that the domination of peoples already familiar with the crops of rice, millet, yam, taro and perhaps even a form of sugar cane. Domestic animals, chickens, dogs, and even cattle, probably expanded from coastal civilisations. The large grain cereals of these societies facilitated regular bulk production from minor manipulation of the natural environment until a decrease in temperatures during the early Holocene period probably caused the disappearance of wild rice from some northern environments. The hot and humid areas further south then suited domesticated rice, especially seasonally flooded and natural swamp areas. The seeking out of these natural swamps with slowly receding water regimes characterised neolithic Thai agriculture.⁷⁰

The relatively abundance of Thai prehistorical information and claims to the source of plant domestication results from high levels of archaeological activity. For example, plants remains found in Spirit Cave in north west Thailand which were once believed to be domestic rice are now generally considered to be the wild rice gathered by a pre-agricultural group.⁷¹ Hunting and gathering communities of Thailand possibly survived through to the first millennium of the current era with some contact with agricultural communities emerging from about 3,500 BCE. However, the then flooded areas of the Khorat Plateau do not seem to have been peopled by hunters and gathers, and archaeological sites dating from around 3,500 BCE which include bones of domesticated animals and rice husks were possibly early agricultural communities which had migrated south in search of naturally flooding swampy soils suited to rice cultivation. The Khorat Plateau is considered to have been largely vacant until the late fourth millennium BCE when technologies and crafts similar to those evident in Chinese and Vietnamese sites occur, and which are distinct from those of other sites in Thailand. Cultural influence along coastlines is suggested although the location of the coastline through these periods remains a matter of speculation.⁷²

Thus neolithic Thai agriculturists co-existed with hunters and gathers for millennia as agricultural settlements slowly expanded and proliferated through population growth and migration.⁷³ Migrants from China by sea as well as down river valleys is suggested through the Khok Phanom Di site between 2,000 and 1,400 BCE. Khok Phanom Di, now land-locked, was once an estuary with mangroves and fresh ponds suited to rice production with the benefits of alluvial deposition to maintain fertility. The Ban Kao culture of Kanchanaburi dated at 2,000 to 500 BCE further supports the likelihood of agricultural technology at least co-originating from sea migration. Linguistic analyses have then been used to posit that agriculture from Austro-Asian languages groups came from southern China before the arrival of the first Austronesian speakers in southern Thailand and Malaysia in the first millennium BCE. The prehistoric sites of the Northeast were possibly those of Austro-Asiatic speakers who were eventually assimilated into the southward migrating Tai peoples before the thirteenth century.⁷⁴ The

⁷⁰ Bellwood, P. (1992)

⁷¹ Yen D.E. (1977)

⁷² Sternstein, L. (1964)

⁷³ Shoocongdea, Rasmi (1996)

⁷⁴ Zide, A. and Zide, N. (1976)

association of rice with migration and development of larger communities, while tenuous from the scant available information, provides a common foundation to the agricultures of the major Kingdoms which subsequently influenced what became Thailand.

Domination of Rice

The diets of these early agriculturists of Thailand seem to have included peas, beans, cucumbers and water caltrops. By the time of the introduction of animal agriculture in the form of water buffalo to assist in rice cultivation, the diet may well have included deer, rabbits, pangolin, civets, and even rhinoceros, from the surrounding forests. Fish, snails, and frogs, and a range of forest derived plants, would have supplemented a diet to which domesticated pigs, cattle, and chickens would soon be added.⁷⁵ The use of buffalo for trampling and incidental fertilising of wet rice fields probably predated their use as draught animals and, particularly in Tai sites, it would appear that their use for ploughing was associated with wooden rather than the iron plough-shares found in Vietnamese sites of a similar era.⁷⁶

With such new technologies in agriculture, seasonal variations in rice yields could be reduced, albeit with increased labour inputs. However, with larger population densities supportable through these systems, division of labour, and increased efficiency for its use would soon develop through the iron age allowing further increases in settlement size. Prior to the iron age, three hectares (19 rai) seems to have been a maximum area for an independent site compared to more than twenty hectares (125 rai), possibly in association with reservoirs or moats, once iron was introduced. This more managed agriculture allowed the development of politics, social ranking systems, and military organisation. Such developments in Thailand appear to have occurred independent of those of India or China although there must have been contact and exchange of technologies. This probably explains the use of iron in implements found at the Ongbah Cave and the Ban Don Ta Phet sites in western Thailand which date from about 100 BCE and overlap with a period of increased sea contact with the subcontinent of India.⁷⁷ The demand for new techniques grew with the expansion of rice agriculture.

Once introduced, rice fed foreign contact and technological development. Chickens and pigs were raised in rice-based settlements although monoculture of sugarcane, yam, banana, and coconut were not practised. Sea trade widened technological awareness and food supply which allowed more free time for development of a society. Technical innovations of puddling, ploughing and even contrived annual replenishment of alluvium, led to a reliable form of low intensity Thai agriculture by the eighth century. The agro-economic base in the most developed areas by that time appears to have been based on rice, fish, and coconut as the preferred major dietary components with taro, yam, sago, and vegetables as supplements in times of seasonal uncertainty. The greater potential of the wet rice cultivation system to sustain the development of a civilisation was now

⁷⁵ Rogers, P. (1996)

⁷⁶ Bellwood, P. (1992)

⁷⁷ Bellwood, P. (1992)

clear.⁷⁸ The alternatives, hunting and gathering or reliance on another staple, could not have produced this situation. Hunting and gathering relied on small groups and low population densities. The best available alternative cereal was the widely adaptable species, millet which had predated rice as a staple throughout the region; however, its shifting cultivation prohibited large population concentrations with the labour economies of wet rice.

Not only did rice contain this potential which has so dominated the Tai and Thai views of agriculture, the wet rice cultivation system itself appears to be one of the most sustainable forms of agriculture. Continuous wet rice cultivation over long periods have been demonstrated in a range of countries and civilisations as a result of its flooded production.⁷⁹ While this condition is physiologically essential for only a small period of the growth of the rice plant, it provides other benefits in terms of nutrition, suppression of weeds, and creation of a stable environment while leading to minimal changes in soil structure after an area has been developed into a paddy field.⁸⁰ The role of soil reduction and nitrogen fixing organisms in the aquatic rice growing environment contribute significantly to the sustainability of the traditional form of wet rice cultivation.⁸¹ Modern intensive productions systems do not share all of the attributes.

Today, agriculture in Thailand remains dominated by rice visually and culturally. The world's largest rice exporter, peopled by connoisseurs of rice varieties and quality, the symbol of Thailand is rice in many ways. Technologies rely on innovative adopters whose cultures affect and are affected by such adoption; knowledge of the ethnic and cultural origins and influences relevant to early Thai agriculture are limited, yet informative in a quest for the essence of Thai agriculture.

Early Thai Agriculturists

A bountiful land would inevitably attract immigrants. Thus Thai agriculture is traced from the earliest inhabitants through subsequent migratory waves introducing new technologies, absorbing those of past and existing cultures, while mostly remaining alert to the introduction of other new ideas. Such increases in efficiency may be interpreted as means of reducing agricultural labour inputs, for in this respect, Thailand's agriculture is unique; food surpluses appear to have been, and be expected to be, easily produced. Whether this attitude is climatically determined as is popularly assumed, or relates to the bounty of the land, or to the peoples of the land, some consideration of early Thai farmers themselves is warranted.

The hunting and gathering progenitors of Southeast Asian peoples were inhabiting small, relatively permanent sites around 40,000 years ago. The design of many of their bamboo and wooden tools can still be seen in today's utensils. With stone cutting implements other tools such as blow pipes, bows and arrows, baskets, and animal and fish traps were

⁷⁸ Hall, K.R. (1992)

⁷⁹ Pelzer, K.J. (1945)

⁸⁰ Matsuo, T. (1961)

⁸¹ Tanabe, S. (1994)

created.⁸² Hunters and gatherers evolved to today's Chao Nam, Phi Tong Luang, and Samang, all marginalised groups who prefer minimal contact with the wider Thai community. The initial displacement of the hunters and gatherers was probably by the Austronesian migration from somewhere north of Thailand down through the east Indian Archipelago bringing the forebears of the people who later became the Malays.⁸³

The environmental changes of the late Pleistocene period brought minimal changes compared to those which impacted on the peoples of Europe of that era. As a consequence, stone flakes indicating human activity dating back 40,000 years are widespread. The oldest dated so far on the Southeast Asian mainland appears to be between 37,000 and 27,000 years old, from the Lang Rongrieng site in Krabi, Thailand. The post glacial expansion of peoples in western Thailand and northern Vietnam is so far untraceable until the agriculturists of some 5,000 years ago such as those of the Khorat Plateau. Plant remains such as almonds, legumes, beetle nut, butternut kernels, bamboo, gourds, but no millet or rice, have been found in sites such as Spirit Cave in north western Thailand, indicating that the Austronesian speaking agriculturists expanded across wide areas of Southeast Asia displacing the pre-existing hunting and gathering communities of the region.⁸⁴

These early Thai agriculturists moved by water and land to settle in various parts of Thailand and surrounding Asia. For example, the Isthmus of Kra was an important trading site by about 350 BCE on the basis of high agricultural productivity and convenient topography for surplus rice production, long before the introduction of canal based irrigation systems. The trading culture of the Isthmus of Kra was part of Funan Chinese influence which extended from the Mekong River mouth to Kra along the coast. By the third century CE, Chinese, Persian, and Indian traders were prevalent in these sites.

The Indian origin of writing for the region is evident in accounts of the regularity of the rice surpluses.⁸⁵ Fragments of Funan records describe the inhabitants of areas now in Thailand in a manner suggestive of Austronesians, and also describes their honest nature and devotion to agriculture. Noting that... *they sow one year and harvest for three*, ... records also indicate the people's involvement in ornamental engraving, silver utensil production, and trade in gold, silver, pearls, and perfumes. Later documents suggest Mon and Khmer residents elsewhere in Thailand, although the influence of Funan beyond coastal areas appears to have been minimal and their understanding of changes inland was probably limited.⁸⁶ Other Chinese records nevertheless do confirm the existence of significant cities in the Chaophraya Basin from the seventh century CE, particularly around Nakhon Pathom and U-Thong.⁸⁷

⁸² Wyatt, D.K. (1984)

⁸³ Donner W. (1978)

⁸⁴ Bellwood P. (1992)

⁸⁵ Hall K.R. (1992)

⁸⁶ Rogers P. (1996)

⁸⁷ Van Beek S. (1995)

Early settlement of U-Thong, probably from the first century BCE, suggests the emergence of irrigation canal engineering skills in Thailand.⁸⁸ A thirteen kilometre straight geological formation running east from U-Thong to, what would have been at that time, the head of the Gulf of Siam suggests separate development from coastal trading settlements. The ability to control water links directly to the subsequent Khmer Empire and suggests that the intervening Dvaravati cultural period of Thailand probably focused more on trade than political domination.⁸⁹

The Dvaravati culture appears to have arisen between the sixth and ninth centuries based on Buddhism, the Mon language, and overland trade between the Gulf of Martaban and the Gulf of Siam via the Three Pagoda Pass. More a civilisation than an Empire, no capital is known to have existed although archaeological sites appear to be densest around the fringes of the central plain. Sites fan out from those around the Gulf along trade routes to Burma, Cambodia, Chiang Mai, towards northern Laos, and northeast towards the Khorat Plateau. Frequent finds of foreign objects provide further evidence of the trade orientation of the civilisation. Foreign ideas, tools, and innovations flowed speedily along trading routes and demand for agricultural produce stimulated the testing of new techniques for producing food surpluses along trading routes.⁹⁰ Lasting until the eleventh or twelfth century CE, Dvaravati influence is otherwise poorly understood. Ethnically it is suggested that it was controlled by peoples of Mon⁹¹ or Mon-Khmer origin although there appears little supporting or contrary evidence.

While the Dvaravati Empire is difficult to define, the production of the centre of U Thong contains evidence of its Mon origin, Indian influence, and ability to absorb diverse pre-existing cultures, migrants, and seafarers, such as from the Funan trading sites. Its culture appears to have extended beyond its governed realm, interfacing easily with the expanding Khmer culture. It was around this time that migration from the southeast China and Vietnam introduced the water buffalo which displaced draught cattle and ultimately assisted expansion of rice production within the Chaophraya Delta.⁹²

Meanwhile, the coastal exposure of the South continued to provide separate development options. By the sixth century a widespread network of agricultural communities existed in Pattani and Yala as much as they did in the North, Northeast, and Central Plain. The cultural differences of the South today reflects these different origins, and histories, even in some agricultural practices. However, the Central Plain has long been a focus of the region, both because of its subsequent history and its potential, which was clearly apparent to Indian Missionaries who, in the third to second century BCE, named the region linking southern Myanmar, central Thailand and eastern Cambodia, Suvannabhumi, Land of Gold. Through this period the central cities of importance appear to have been Suvannabhuri, City of Gold, and U-Thong, Cradle of Gold. Upland river valleys in the west and south west leading into areas of northern Laos and southern

⁸⁸ Van Beek S. (1995)

⁸⁹ Rogers P. (1996)

⁹⁰ Wyatt D.K. (1998)

⁹¹ Guillon, E. (1999)

⁹² Suchitta, Pornchai (1989)

Yunan remained sparsely populated by the aboriginal Austronesian or Austro-Asiatic speaking groups, possibly ancestors of some of today's hill tribes. These peoples were poorly equipped to deal with the technologically superior wet rice growers.

Wet rice irrigation probably evolved to river off-takes to augment natural pondages. Ponding and canalling of water to maintain a stable rice growing environment would have been an easy development with rice terraces evolving as an adjunct of nature's own micro-environments. In contrast to this hydraulic domination, populations closer to the sea where water was abundant and hence did not need to be conserved, or in the delta where water remained mainly uncontrollable, adapted their lives to the flux of water and its control.⁹³ In all cases, life in Thailand was increasingly dominated by water; the name *Sayam* or 'Siam' may have even contained the meaning of 'people of the river'⁹⁴ or 'water people'.

Migration has been the hallmark of the devolvement of Thai agriculture. The earliest inhabitants provided inputs to today's Thai agriculture notwithstanding their demise as migrating agriculturists gained influence. The initial wave of Austronesians into what is now Thailand was subsumed by the next migration of the Mon-Khmer, probably from northern India supplemented with other tribes from Indo-China while coastal areas were influenced by Chinese, Indian, and Arabian trade. By the time peoples of the Tai ethnic group with their own unique skills in irrigation arrived in numbers in later centuries, much of the scene for future agricultural development had been set. A further migratory wave of the Tibeto-Burmans is today represented by the Lahu, Lawa, and Karen ethnic groups which began migrating before the influx of Tai people to Thailand with subsequent migration occurring into the present century.⁹⁵ Chinese immigration in the nineteenth and twentieth centuries maintained the pattern of introducing new agricultural technologies to Thai agriculture. The amalgam which is today's Thai agriculture may thus be seen as a reflection of the unity within ethnic diversity of the country and its openly assimilatory culture.

Within the first millennium CE, inland communities had discovered means of reliably producing rice surpluses and within centuries, organisational skills to continually increase surpluses would allow the emergence of the Khmer Empire centred at Angkor. Technologies developed through Khmer agriculture provided the next major fillip for Thai agriculture.

Khmer Agriculture

The agricultural settlements which gradually displaced hunters and gatherers grew to agricultural cities, some of which were subsumed into the emerging State-religious Empire of the Khmer. Such agro-cities required an assured rice production base, which in the case of the Khmer, relied on supplemental water management, and appropriate rice varieties. Judged by today's standards, such systems might be considered sustainable

⁹³ Jumsai S. (1997)

⁹⁴ Van Beek S. (1995)

⁹⁵ Donner W. (1978)

within the parameters of the technical applications, and they did last for centuries before finally failing. In the event, Khmer wet rice culture proved less sustainable than the pre-Green Revolution river-basin wet rice systems of the Tai and others.

An indication of the probable distribution of prehistoric villages and patterns of agrocities in natural floodplains of what is today Thailand are presented in Figure 2.1. Onto these, the sophisticated Khmer society grafted its culture. The flood plains, complimented with grasslands which included clusters of wooded vegetation, and the mangroves both in inland freshwater areas and along the coast, provided the genesis of agriculture in Thailand and formed the basis of its subsequent development. The original dense forests of the hills and mountains, the thorny scrub of the rain shadow areas, and hard laterite crusts, on the other hand, were of little interest to early and later agriculturists alike.

Agro-cities in the shallow and gentle floodplain areas have been found in the central plains around the delta of the Mae Klong River, an area now dominated by sugarcane on the higher ground and rice in the floodplains. The cities of Nakhon Pathom and the agrocities of the Northeast on the Mun-Chi River floodplains were likewise located on the basis of reliable flooding areas, in contrast to river bank developments in many other areas of the world. The agro-cities apparently extended through the Mekong River delta in what is now Cambodia and Vietnam.

The transition from agricultural settlements to agrocities⁹⁶ arose from the apparent abandonment of prehistoric villages and concentration into larger settlements, often surrounded by more than one moat with radiating canals. The agrocities were overwhelmingly associated with the gentle flooding regimes around the boundaries of large flood plains. This significant change in settlement patterns was associated with the adoption of monocultural flooded rice production which reduced labour inputs and risk compared to that of the smaller agricultural settlements. Nevertheless, the significant individual earthworks undertaken appear to have been related to governance within each agro-city without coordination across a wide area. Many of these large settlements contained no religious edifices and hence the term 'agro-city' has been adopted to indicate this stage of agricultural development prior to the emergence of religious States.³¹

Figure 2.1 Probable Pre-historic Village and Agro-city Sites

(From fig 9.2 and 9.4 of pg 140+ van liere in ref 6)

In the ninth century, the civilisation of the north western shore of the large natural overflow reservoir of the Mekong River, the Tonlesap in Cambodia, grew to dominate the areas including much of what is today Thailand. Rice fields around the edge of the Tonlesap, down into the lower reaches of the Mekong River, and into the Mun and Chaophraya basins, allowed the Khmer Empire to establish itself with rice as the primary source of growth and wealth. Earlier sites along the coast between the second and sixth

⁹⁶ Van Liere, W.J. (1989)

³¹ Van Liere, W.J. (1989)

centuries had been based on the China-India trade routes which had a landing point in what is now Cambodia linked to the Kra Isthmus land connection. Whether it was a natural limitation of growth of the several small trading cities, or shifts in trade which restricted the growth of the coastal cities, is rendered less relevant by the fourth century technology which allowed ships to sail at a greater distance from the coast and thus only call at major trade centres. However, the emerging dominance of an inland over a coastal culture hailed the consolidation of an agriculturally powerful region with the effect that hinterland agricultural cultural origins have blended with coastal cultures in the modern Thai culture. Thus the centrality of rice was confirmed.

Various Khmer attempts to consolidate power were constrained until they understood the central significance of a secure rice supply. This allowed, with foreign religious influence, the development of a State-religious Empire in which temples owned land and agrarian workers contributed labour motivated by both coercion and future spiritual reward. The Empire eventually crumbled from within, as a result of, among other factors, alternating strong kings and interregal disorder which disrupted maintenance of domestic water systems which incidentally served rice production. Policies to ensure rice surpluses were also negated. Around the same time an increase in trade and commerce may have encouraged the disillusioned Khmer to abandon the high cost and increasingly difficult to manage site of Angkor in the 1430's in favour of better sites for trading; such an alternative theory to the fall at the hands of advancing Tai military force seems consistent with the likely limited organisational capabilities of the Tai at the time.⁹⁷ The Khmer Kingdom, an antecedent to the Thai culture, supported a population in excess of one million in its Angkor capital at a time when the Norman army marched on the city of London and its population of 35,000. The agricultural system to support this major world centre required skilled engineering and agronomy.

The Angkor agricultural system was based on the natural rise of flood waters and their rapid recession in the Tonlesap, and their supplementation by a network of dams and bunds to divert or retain receding waters. No large dam technology is evident. Phnom Kulen, approximately fifty kilometres north west of Angkor was the centre of the water management network, which as the civilisation evolved was increasingly dedicated to religious and domestic water supply purposes. Control of land as well as water was essential to the development of the Empire. Landed elites donated their land and its farmers to the temple and registered these transactions for possible spiritual and probable commercial gains. Control of labour and production, including management responsibilities, seems to have been handed to temples while the donor continued to retain a percentage of the harvest. Donations also included domestic stock such as cattle, buffalo and goats, tree crops such as coconuts, fruit, areca nuts, and other agriculturally related items such as threshing floors and clothing. Concentration of economic power in the temple consolidated political development, which in turn was reflected in agricultural legislation, for example, a tenth century edict concerning negligent grazing of buffalo in proximity to rice fields. The King, difficult to separate from the temple, retained the right of ownership of all unused and unallocated land and could also influence ownership rights in all areas. The Thai system was to retain these elements centuries later.

⁹⁷ Taylor, K.W. (1992)

Thus the temple was the central agricultural institution. As a source of investment it was the agricultural bank. It had the capital and land, and increasingly became the repository of technical information for agriculture itself, albeit with a cosmological emphasis. The temple managed agricultural labour, including war captives, through promises of spiritual rewards as they opened unpopulated lands donated to the temple. The water management system required large infrastructure to control receding floodwaters, and for canals to supplement irrigation, and thereby proscribed small private agricultural producers, who would have in any case been inconsistent with the evolving political system.

By the twelfth century, the Empire was producing around 38,000 tonnes of hulled rice each year⁹⁸ for the Pra Khan temple complex from a system with no formalised bureaucracy but simply a temple-King assignment of land rights balanced with spiritual and subsistence rewards to the poor. The King, as the largest land owner and the temple as the owner of labour led to easily accommodate the God-King system compatible with the adopted Indian religions of Angkor.⁹⁹ Inscriptions from the ninth to thirteenth centuries proclaimed the King as both creator and director of public works which irrigated some five million hectares (31 million rai),¹⁰⁰ incidentally with providing water for domestic and religious purposes. The water system which has been termed 'theocratic hydraulics' as many water sources were, latterly at least, of symbolic or religious importance rather than having been designed for a central irrigation purpose. Through this period, Angkor was known through the region for its 55 million rice fields.

The Khmer selected sites for high labour efficiency in the simple rice water management system. The sites themselves suggest use of rice varieties with relatively low water requirements and probably modest yields. Ranking reliability of production over maximising yields reflect the limitation of the water management systems, and the State's emphasis on stability of production, an approach which flowed into Thai agriculture and politics. As the Khmer Empire waned, Sukhothai, one of its outposts, was progressively dominated by Tai whose own irrigation technologies had been integrated with those of the Khmer. However, infrastructure developed for agriculture is now difficult to discern from other purposes.

The Sukhothai and Sisatchanalai sites in northern Thailand include a 100 kilometre long earthwork extending as far as Kamphaengphet which was probably a flood-controlling barrage. The two fifty-five and sixty-eight kilometre constructions are not considered to have been a canal even though Sukhothai hydraulic engineers are known to have gained considerable experience in canal construction by this time. Nevertheless, they avoided attempts to manage the major rivers and areas subjected to deep inundation, concentrating on diversion of flood waters. It was the Tai who mastered the management of water directly from large rivers such as the Ping at the Kamphaengphet site.¹⁰¹ A barrage construction also serving as a road would have assisted Khmer management of

⁹⁸ Hall, K.R. (1992)

⁹⁹ Hall, K.R. (1992)

¹⁰⁰ Van Liere, W.J. (1980)

¹⁰¹ Van Beek, S. (1995)

regions away from the Sukhothai and Sisatchanalai complexes; one may assume that such developments reflect a mode of extending Khmer political influence and incidentally an approach to agriculture. The significance in barrage construction to Thai agriculture lies in its blending with Tai irrigation systems for eventual control of the waters of the Central Plain.

The construction of urban dams and dykes by the Khmer appears to have been based on gravity feed tanks feeding fields via canals with water control managed through wooden sluice gates.¹⁰² That these are considered by most observers to have been oriented to religious purposes may hide an earlier agricultural purpose overtaken by the religious State. Nevertheless, rice culture in the Khmer period seems to have been simple and reliable, and was probably only marginally dependant on the major water works presented in Table 1.

Table 1. Water Related Construction Sites of the Khmer

Name	Size	Comment
Indratataka		Reservoir built 877
Yashodharatataka (eastern Baray)	1.8 x 7 km; 30,000,000 cu m reservoir	Also linked to modification of the course of the Siem Reap River.
Rahal	360 x 1,200 metres.	Built on tributary of the Siem Reap River south east of Prasat Thom.
	2.2 x 8 km; 40,000,000 cu m capacity	Largest of all Khmer reservoirs; eastern section silted.
	Up to 14 x 100 m; brick ponds and fountains.	Fed by Siem Reap River and rain water; drinking, fish ponds and bathing.
Jaytataka (north Baray)	900 x 3,700 metres.	Designated the holiest of the waters.

Much of the information concerning Khmer agriculture and life is derived from Zhou Dagan, a Chinese adventurer who wrote of his visit in 1296–1297. From his descriptions and other evidence we know that rice was hulled through bruising with mortar and pestle rather than by grinding stones, and that women were a dominant part of agriculture, and in particular trading. Small trading transactions at the time were effected through barter of rice, cereals, and objects from China, medium sized transactions included fabrics, and large transactions included gold or silver. Such a civilisation required a sound land use and food production system.

The Khmer land use system was an evolution of India's as an adjunct to the religion. Initially and for some 400 to 500 years, rice production was based on the use of naturally flooding areas. Forested areas were lightly used until the later large Empire converted forests to banded rice fields. Resulting square rice fields and bunds suited an overall auspicious shape for city layout, possibly planned with a cosmological intent. The clearing of forests for rice and city development limited water run-off through the millions of paddy fields, retained wet season silt in these fields and in canals and reservoirs, and the changed soil chemical and physical characteristics in paddy fields on a scale hitherto unknown. The wetting and drying of soils allowed reduction and oxidation

¹⁰² Murray, S.O. (1996)

of silica among other soil components, increasing crystallisation and hence the sand component of the soil profile. Agriculturally generated environmental change, in some cases irreversible, appears to start at this stage of Thai agriculture - around 1,200 CE. Nevertheless, wet rice cultivation under the different Tai traditional conditions continued to yield satisfactorily on such impoverished soils for centuries because of the essential benefits of the modified aquatic environment for the rice plant.¹⁰³

Khmer influence on agriculture extended beyond techniques adopted by the Tai as it extended deep into the psyche of the persons that would assume the Khmer cities of Lopburi, Ratburi, and Muang Singh, among others.¹⁰⁴ The slow immigration of Tai from the north down the river valleys led to a significant number of Tai persons in the Khmer Empire. This force may have developed influence and seized an opportunity at a time of weakness of the Khmer Empire in outlying Sukhothai as the Empire began to decline after 1,150 when massive investment in construction and deification of kings, caused neglect of water management and food production. Canals accumulated silt, and rice production plummeted, forcing large scale emigration to other flood plains in the Mekong delta system.¹⁰⁵ The imposts of malaria and Tai attacks possibly fastened the final rapid fall of the Empire.¹⁰⁶

The Khmer Empire provided a pervasive Indian influence in religion and culture which continues to flow through Thai agricultural development and culture. Through much of the Khmer period, a parallel although technologically different form of agriculture evolved to the west centring on Pagan.

Pagan Agriculture

Khmer influence from the east met Mon influence from the west in what is now Thailand. This Mon-Khmer culture, with Tai infusions, represents the source of Thai art and language, and likewise of Thai agriculture. While the Khmer Empire developed large State-religious edifices, the ancient Mon culture within Thailand was less well represented architecturally and as a consequence, is less well understood.

Mon-Pyu authority across large areas of Burma was interrupted by immigrants displaced from Nanchao in southern China who possibly assumed the power of the Pyu from about the ninth century. As a consequence, the Mon centre on the coast at Thaton fell and the Mon migrated predominantly to Pagan. The Pagan Empire of the Mon, who united with the Pyu and Burmans from about 1,200 CE to repel invasions from both the mountains and the seas, was based on an agriculturally sufficient Empire located in the dry zone of Burma on the banks of the Irrawaddy River. The initial headquarters was between the two rice production areas of Minbu and Kyaukse, both of which had extensive irrigation systems. Pagan's success relied on its ability to mobilise agricultural resources and, in common with the Khmer, develop an inland rice-based culture which overshadowed

¹⁰³ Van Liere, W. J. (1989)

¹⁰⁴ Rogers, P. (1996)

¹⁰⁵ Rogers, P. (1996)

¹⁰⁶ Groslier, B.P. (1962)

coastal trading cultures. Pagan also developed monumental religious sites, at least in its immediate area of control. By the thirteenth century, various power struggles, including land control issues within the monkhood, led to the establishment of a new Mon Kingdom at Pegu.¹⁰⁷

The period known as Dvaravati in Thailand was linked to the rise of Mon influence from the west. Intensification of iron production and probably of copper, lead, and silver, indicate an advanced culture which enabled such architectural feats as the first large *chedi* constructed at Nakhon Pathom. The attraction of the region appears to have been the consistent ability to produce surplus from relatively low labour inputs. This stability and wealth stimulated trading in food and forest products through Thailand and brought new ideas and technology. Named from a coin found at the site, Nakhon Pathom appears to have been a major Dvaravati centre utilising the city's then coastal location to combined the benefits of regular agricultural production and trading access to the protected Gulf. Other Dvaravati sites in Thailand include U Thong, which was probably a sub-centre of Nakhon Pathom, Kubua south west of Nakhon Pathom with access across the Tenasserim mountain range to Mons in the west, Khao Ngu caves in Ratchburi province, and overland routes through Petchaburi and other centres in the south of Thailand.

The pre-existing agro-city of U Thong is thus a probable site of agricultural technology transfer starting with trade and contact with overseas powers in the second century CE. Rising population stimulated the development of a more suitably located city at Nakhon Pathom, which was known to be well established by the end of the sixth century. By the seventh century, the three important cities of Nakhon Pathom, U Thong and Kubua provided in the western interface¹⁰⁸ to a rising Khmer culture which produced the Mon-Khmer period of Central and Northeast Thailand, with effects in the North, east and the South. Khmer suzerainty over Mon Kingdoms in the North and South were complemented by working relationships in areas of central Thailand. Throughout this period Tai were increasing in number through continual southward migration. Insignificant at first, this tribe was to become important as an integrator of agricultural and other technologies across the region. The first indication of a rising political ambition of the Tai appears in this disjointed history of Burma.

Neither the Mon nor the Burmans appear to have been interested in the upland valleys of the Shan States which were being populated by Tai. The Mon culture was largely absorbed into other cultures including the Pyu, Burman and Khmer as a result of its inferior military force in the ninth and tenth century when the Kingdoms of Burma were smaller than that of the Khmer. A strong military pressure from Nanchao from the mid-eighth century until the mid-ninth century accelerated the demise of the Pyu State at Prome and Shwebo allowing Burmans to move into the extensive irrigated rice lands of the Mandalay region. The relatively smaller new State at Pagan developed from the mid-ninth century coincided with the new Mon Kingdom which was developing at Pegu.

¹⁰⁷ Taylor, K. W. (1992)

¹⁰⁸ Saraya, D. (1989)

Through the ninth and tenth centuries, Tai were living in the relatively peaceful river valleys between the major States that surrounded them. However, various military drives through these valleys from Nanchao, Burman, Khmer, and Vietnamese interests inevitably led to Tai being pressed into Nanchao and other armies; as war captives, slaves, traders and religious pilgrims,¹⁰⁹ they began to learn of wider world. To this stage the Tai, had not yet featured in Southeast Asian history, although their technologies developed in managing rivers were to prove critical in assuming a political profile upon the demise of the Mon-Khmer.

The influence of the Tai in the Burmese centre of Pagan rose around the thirteenth century when Tai Shan from northern river valleys assisted the then weak Pagan to repel the Mongols. In helping the Pagan kings, the Shan gained sufficient influence to assume power. The subsequent establishment of the centre at Ava adjacent to the Kyaukse rice fields and the Mon centre at Pegu was one of the first mixed Tai States. However, their power was balanced against the other closeby independent Kingdoms at Arakan and Prome.¹¹⁰ Further information about Tai peoples and these Kingdoms is limited; early Shan contact with Pagan was probably as slaves and soldiers, which accounts for Tai presence down to the Isthmus of Kra as part of the twelfth century campaigns of the Burmans against the Malays.

The irrigated agriculture of the Mon and Burman cultures complemented that of the Khmer. They included canal irrigation associated with major rivers across ancient alluvial flood plains. Tai with their small *Muang fai* river valley irrigation¹¹¹ systems were to learn from this for their eventual domination of the delta. With the rise of the inland agricultural Kingdoms, coastal regions remained exposed to foreign trade and ideas, with the South, through its strategic location, receiving quite different influences from the inland regions of what is now Thailand.

Southern Thailand

The agriculture of southern Thailand has been historically determined by the sedimentation of clay and mud in this relatively young geological area. As soils determined the patterns of agricultural settlement, the geographical location of trading centres and subsequent Indianisation follows the development of agriculture. Variations in rice cultivation methods across southern Thailand reflect its many micro-environments, as well as variations in cultural influences associated with trading and migration.¹¹²

Sea trade routes and the narrow land connection across the Isthmus of Kra shaped further development of the South. With new nautical technologies in the fourth century, trade via the Straits of Melaka led to Palembang and Sumatra becoming a major trading centre, incidentally attracting Buddhism and Chinese culture. The Malay-controlled trading

¹⁰⁹ Wyatt, D.K. (1998)

¹¹⁰ Taylor, K.W. (1992)

¹¹¹ Surareks, Vanpen. (1998)

¹¹² Trebil, G. (1984)

system was managed on a cooperative basis which attracted avaricious invaders including Javanese and Tai who sought to vassalise the Malay rulers of the Straits region.¹¹³ The rich archaeology of the ceremonial centre Palembang derives from its regularity of rice production from extensive rice fields. Gaining further influence through international trade, it traded and dominated the Srivijaya Kingdom of Java. The Majapahit State of Java relied on a decentralised agrarian culture which was unprepared for the dealings of wealthy commercial centres which its own wealth had helped to create. Such transition from food security through agricultural Kingdoms to domination by trading powers flows through Thai agricultural and political history.¹¹⁴

The agriculture of the South therefore combined technologies from Java, Malaysia, India, and China from extensive trading connections. Technologies emanating from Java and Sumatra, which differ from the rest of Thailand are still evident today, such as rice harvesting techniques. The first Tai may have reached southern Thailand as soldiers or slaves from Burman armies, or have been attracted from Khmer-dominated Thailand by the trading wealth of the south. Their influence in the South was to become significant in the fourteenth and fifteenth centuries, by which time Melaka had instituted a modified version of the Srivijaya model to accommodate Chinese protection from invading Tai. By the fifteenth century, rulers adopted Islam. Prior to these developments, a rapid rise of Tai power in Nakhon Si Thammarat occurred the thirteenth century to subjugate Khmer, Malay, Burmese, Mon, and south Indian rulers in what was probably the major centre of the region. Nakhon Si Thammarat had become at that time a major centre for Theravada Buddhism, being the point from which monks carried this new message to the Khmer-Angkor Empire, Lopburi, Sukhothai, and Llano.¹¹⁵ The rise and fall of such Tai influence remains an anomaly, except as an illustration of the rising influence of Tai across wide areas of Southeast Asia. Perhaps, alternative explanations of the origins of the Tai people's¹¹⁶ and Asian settlement¹¹⁷ have something to add to future interpretations.

To this stage, no Tai ruler had developed a centralised means of governance which could incorporate remote territories. Individual principalities remained the basis of Tai governance, and yet their widening influence suggested that, with control over manpower, the Tai could establish a State. In a region with surplus agricultural production capacity, manpower shortages related to military and State infrastructure requirements. Harnessing these resources was to prove the essence of forming a Tai nation, provided sound agricultural management remained the central focus.

Summary

¹¹³ Taylor, K.W. (1992)

¹¹⁴ Hall, K.R. (1992)

¹¹⁵ Wyatt, B.K. (1984)

¹¹⁶ Jumsai, Sumet. (1997)

¹¹⁷ Oppenheimer, S. (1999)

Key points pertinent to Thai agriculture which may be elicited from this introduction of its origins include:

- The origins of Thai agriculture are part of a wider Asian agriculture, known through various archaeological sites many of which are in modern Thailand, and indicate a slow domination of hunters and gatherers by migrating agriculturists who had determined means of encouraging reliable production from a crop which suited the tropics after climate changes, wet rice.
- Rice dominated and became the preferred staple over the previously domesticated millet, and technologies which exploited natural recession of flood waters allowed experience to innovate rice production towards a controlled environment production system and so to provide a reliable food base for the development of agro-cities and then State-religious Empires, most notable that of the Khmer.
- While these Empires managed their agriculture well, security over rice production allowed inland cities became more influential than coastal trading centres, except in the South; the differing agricultural technologies of the eastern Khmer, western Pagan, and increasingly widespread Tai among others, provided for a future interaction which would expand agricultural production across the region.

Chapter 3

Arrival of Tai Agriculture

The emergence of the Tai tribe coincident with the decline of Mon-Khmer domination reformed agriculture in the region. While known in China before the eleventh century as wet rice cultivators, Tai-specific technologies may better be deduced from cultural associations with similar technologies across the Tai diaspora. With the gradual southward movement of the Tai prior to the twelfth century, and in particular in the thirteenth century and after, Tai technologies in irrigation and agriculture mixed with those of the Khmer and Mon. As valley dwellers, they had developed and refined technologies through experience and contact across valleys from Assam to Vietnam. Their water management systems complemented those developed by Mon-Khmer. In particular, the *muang fai* irrigation system represented a technological and socially sophisticated system which proved sustainable through at least eight centuries.

Blending technologies and human resource management systems provided the basis for expansion of a self sufficient Kingdom. The agricultural systems which supported this emerging force, the human resource management systems which were critical to its persisting, and the environmental beliefs of the Tai, are discussed in this chapter.

Chinese Tai

The development of agriculture in areas such as China and India was associated with an eighty fold increase in population over the period of 10,000 to 400 BCE. Irrigation in China is first mentioned in 563 BCE in the context of opposition to the introduction of a novel technology; the Chinese may thus have been the last of the great civilisations to utilise irrigation.¹¹⁸ By way of contrast, rice cultivation in China appears to predate barley cultivation in the Middle East by several centuries. Still today more than ninety percent of the rice of the world is produced and consumed within Asia making it the staple food of more people than wheat. The gradual development of rice technologies suggests that while double-cropping of rice was known in China from the twelfth century CE, it was probably imported from technology developed for the earlier maturing varieties of rice known as Champa from Vietnam about 300 BCE.

The development of technologies around environmental opportunities suggests their separate origins and slow diffusion. For example, the use of draft animals in rice cultivation is based on lightweight ploughs which required smaller, often single, animals than were required for the heavy mould-board ploughs of Europe;¹¹⁹ the use of dual draft cattle equipment in southern Thailand, like bull-fighting traditions,¹²⁰ probably reflects coastal Indo-European influence. However, before draft animal technology came irrigation technologies which allowed substantial modification of the natural environment

¹¹⁸ Ho, P.T. (no date)

¹¹⁹ Evans, L.T. (1998)

¹²⁰ Chantalakhana, Charan. and Skunman, Pakapun. (2000)

to suit rice production.

The Tai of whom the Chinese wrote universally lived in lowlands and valleys, having developed an economy based on wet rice cultivation.¹²¹ Linguistic and cultural associations suggest contact between the Tai culture and for example, Hua Xia culture of southern China more than one thousand years ago.¹²² Domestic livestock including cattle, or perhaps buffalo, were significant as a measure of status and wealth or as part of rituals, as much as for their utility for draft power.¹²³ The progressive southward migration of the Tai introduced their *muang fai* irrigation system to the narrow river valleys of northern Thailand, as indicated by the associated innovation, the *luk*, a huge bamboo water lifting wheel used in Thailand since before the Sukhothai period. The *luk*, powered by the river current, used short sections of bamboo attached to the outer rim of the paddle-wheel to collect water and lift it above the level of the riverbank and empty the water from each bamboo cylinder into a drain leading to a field. Dismantled or abandoned prior to the river rising each wet season,¹²⁴ *luk* seem to have been used by Tai for more than ten centuries with *muang fai* irrigation systems and glutinous rice culture in southern China and northern Thailand.¹²⁵

Muang Fai

The *muang fai* irrigation system was used on fast flowing streams up to twenty metres in width, across which weirs elevated water by up to two or more metres.¹²⁶ The *fai* held back water which was directed to major and minor canals known as *muang* in which gates, *tang*, controlled flow rates. Where a *muang* could be constructed by diverting water from a river, no *fai* was needed. Constructed from bamboo and wooden stakes driven into the river bed against which rocks, poles and sand were placed, the *fai* allowed water to pass through and over the barrier while restricting the rate of flow and thus raising the water level. Annual maintenance necessitated by peak wet season water flows and siltation formed the basis of the community ownership of these resources and the development of a democratic Tai administrative system. The system allowed the development of States with a ruler over several *muang fai* in a river valley, although independent systems appear to have existed in parallel with consolidated arrangements through to the nineteenth century in the larger northern rivers.¹²⁷ The porous weirs with water brimming over the top enabled successive *fai* to be built on a river. The system as depicted in Figure 3.1 required sound social organisation¹²⁸ and appeared as early as 757 CE to have been managed through the local rulers as a means of coordinating irrigation or rice fields belonging to a significant proportion of the populace. The well documented northern reign of Mengrai in the thirteenth century indicates a widespread and well managed irrigation system in the northern river valleys.

¹²¹ Kato, K. (1998)

¹²² Yamchong, Cheah (1996)

¹²³ Wyatt, D.K. (1984)

¹²⁴ Penth, H. (1994)

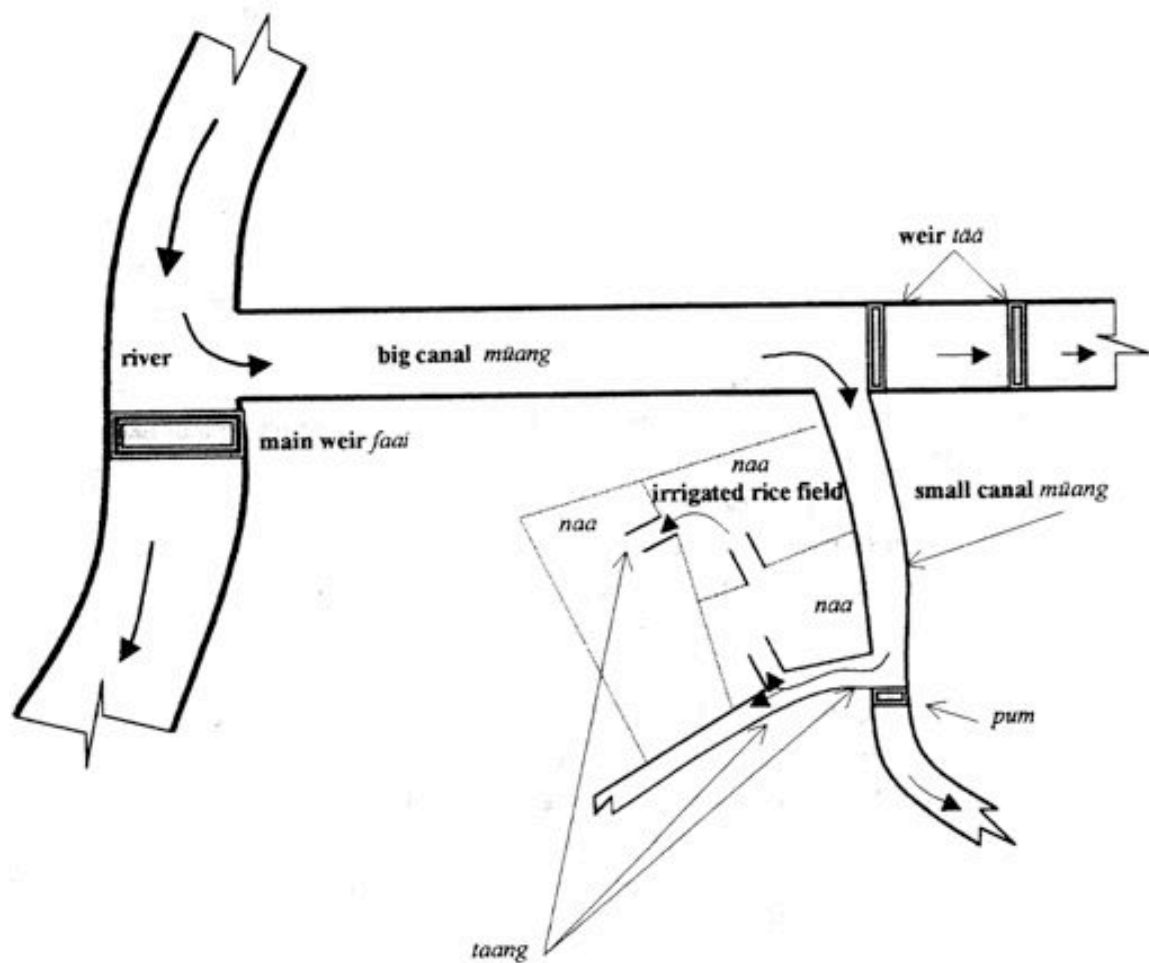
¹²⁵ Van Beek, S. (1995)

¹²⁶ Surareks, Vanpen. (1998)

¹²⁷ Cohen, P.T. (1980)

¹²⁸ Attwater, R. (1998)

Figure 3.1 The *Muang Fai* Irrigation System¹²⁹



The social organisation allowing the management of the system evolved to rely on officials, such as the *Khun Nai Fai* and the *Hua Na Fai*, as managers of systems on behalf of the ruler. These offices become local leaders and were elected by those participating in the irrigation system. The irrigation manager's responsibility was to:

- calculate the amount of water and its allocation to individual farmers
- coordinate the initial construction of weirs and canals
- coordinate annual repairs required after each wet season
- manage propitiatory and other rituals associated with rice culture
- collect fees for irrigation system maintenance and associated rituals.

Requirements of farmers to provide labour on the basis of their area of paddy fields formed part of an early user-pay system within a community-based activity which was uniquely Tai. This sustainable social system was critical to its technical sustainability. Elaborate rules evolved to maintain systems and to avoid damage, with policing power

¹²⁹ Surareks, Vanpen. (1998)

vested in the irrigation manager. Serving Thai agriculture until the twentieth century, the *muang fai* system was eventually incorporated in the national Royal Irrigation Department system where it was superseded by developments in pumping and piping technology.

The *muang fai* system suited the valleys draining northern Thailand although it was universally popular with other ethnic groups. Even in this century, some hill tribe groups have eventually engaged northern Thai persons to advise on the techniques of irrigation, weir construction, and canal orientation, with an incidental outcome of adoption of rituals and prayers directly from the northern Tai language as part of the 'development package'.¹³⁰ The *muang fai* system was less suited to delta areas of the Central Plain with its heavy river sediment loads and extensive flood plains. In these areas, the opportunistic use of minor earthworks to delay receding flood waters continued as the basis for rice cultivation until later merging of Mon-Khmer and Tai approaches to water control enabled settlement of the hitherto lightly populated delta.

The talents of the Tai people with the *muang fai* system were a critical input to the development of Sukhothai, and subsequently, Ayutthaya. While the rising influence of the Tai at Sukhothai is difficult to separate from their assumption of Khmer ideology, culture, and technologies, the later Sukhothai period when Tai control was well established suggests that sediment settling ponds used as ritual architectural artefacts were of less interest to the Tai than the Khmer. Tai inscriptions from Sukhothai refer to the use of the *muang fai* system to irrigate crops adjacent to smaller streams in conjunction with more opportunistic system of bunding to retain receding water in areas protected by flood barrages. Thus Sukhothai, represents a blending of the smaller scale community *muang fai* irrigation system of the Tai with the extensive system of the Khmer and their agriculturally less significant pond and gravity feed system. It is from this era that the two different approaches to irrigation in Thailand have thus been classified as:

- inter-montane basin farming systems, *muang fai* and others
- delta farming systems.¹³¹

Integrating Technologies

The interface between Tai and Khmer technology led to the diversion of major river waters into canals built at the river's natural height. This allowed swamps and old river bows to fill when flows were high, and for that water to be trapped and subsequently drained quickly towards the end of the rainy season. By this means, the simple earthworks which delayed receding flood waters as practiced from the time of the Agrocities through to the Khmer period could be used to greater effect. As the Tai had not been associated with large rivers and broad flat plains for centuries,¹³² it is probable that these technologies were developed elsewhere and transmitted through the extensive network of Tai people extending from southern China through Vietnam, Laos, Thailand,

¹³⁰ Kunstadter P. et al (1978)

¹³¹ Tanabe, S. (1994)

¹³² Van Liere, W.J. (1989)

Burma, Bangladesh, India, and Bhutan, and along trade routes which passed Angkor and Sukhothai.. Nevertheless, this technology, while widely used on rivers with a significant gradient, was inappropriate for the meandering delta distributaries of the Chaophraya River in the Central Plain.

The relatively scant rice based-agriculture of the Central Plain supported a small population based on simple water engineering. Abundant flood water enabled areas which flooded naturally for four to five months a year to be used with minor earthworks to enhance the depth of water, and retention rate at the margins. Through this period, the deposition of sediment and a gradual fall in sea level, led to the creation of natural distributary canals in the alluvial mud, thereby creating potential rice fields in adjacent areas. These changes in the natural environment provided a significant advantage for the rising population in the Chaophraya River delta. The annual replenishment of fertility through sedimentation, and the abundance of water to irrigate rice and other crops, provided a basis for further expansion which modified irrigation technologies derived from the *muang fai* and Mon-Khmer systems.

The bountiful irrigated rice production system allowed the Tai peoples to develop crafts as part of their evolving culture. Even at the village level today these crafts can still be seen in the sensitive and time consuming skills of designing such utilitarian items as fish baskets. One basket design for example, designed to keep fish alive after they have been caught resembles a duck which the fisher pulls along in the water while seeking further fish.¹³³ These crafts were developed long before the emergence of a Thai identity, which was to require wisely managed assimilation policies to obtain scarce resources, usually labour. Tai characteristics of adoption of new technologies, innovation within their own environment, and the changes which migration itself induced, allowed realisation of the natural potential of this new land for production of the essential ingredient of civilisation and expansionism, reliable paddy fields.

Critical to the emergence of Thai agriculture, the Tai were a self sufficient race with high levels of adaptability and innovation. The origins of these people provides further information about the essential ingredients which contributed to the successful development of the Chaophraya basin, the northern rivers, and the Khorat plateau.

Tai Agriculturists

According to a theory which links the development of three language groups, one of them Tai, with the development of rice agriculture, the association between Tai and irrigated rice flows through early southeast China history.¹³⁴ Suggestions of historical traces of the Tai in an area between the Yellow and Yangtse Rivers date from about four and a half thousand years ago;¹³⁵ these Chinese sources report that tribes such as Tai had settled in the land north of the Yangtse River by 2,000 BCE and in about 1,600 BCE these settlers, by then referred to as Tai, had settled in the Yangtse region itself, thus providing the first

¹³³ Suchitta, P. (1989)

¹³⁴ Bellwood, P. (1992)

¹³⁵ Chakrabongse, C. (1967)

indication of what appears to be an extended southward migration.¹³⁶ These persons were subsistence farmers producing rice and vegetables while tending cattle and other domestic animals and supplementing their diet with from streams, rivers, and the forest. Sharing of labour for harvesting rice and other agricultural crops was probably the first major form of communal operations of an agricultural enterprise among these groups.¹³⁷

The next entry of Tai into history¹³⁸ appears to be their contentious involvement in the management of Nanchao Kingdom¹³⁹ of southern China. Including Tai peoples, the Kingdom had been a buffer between Tibetan and Chinese interests until 1253 CE, when Kublai Khan accelerated the pace of integration and migration for various ethnic groups. Those Tai peoples remaining in what was Chinese-influenced territory were largely assimilated while those who migrated found more wet rice lands, developed techniques to assume ownership of others' fields, and utilised displaced owners as soldiers in bids to gain further fields. By the thirteenth century the Tai assumed the void left by the decline of Mon-Khmer influence. The political organisation of the Tai, which had developed around their irrigation management, provided a foundation for superior organisational techniques possibly learned from the Chinese; such techniques included fortification walls around towns which served as centres of agricultural and military activities rather than trading.

Migrating Farmers

The southward migration of Tai took place over centuries, rising to a critical peak at the time of Kublai Khan. Migration is confirmed by Tai presence in Angkor records around the beginning of the twelfth century. The absorption of some Mon laws into the Thai system suggests that Tai contact with the Mon predated the dominance of the Mon Dvaraviti Kingdom by the Khmer Kingdom under Suryavarman I around 1,000 CE.¹⁴⁰ Thus small, possibly separated Tai groups were probably scattered across the region for centuries before their emergence as a force at Sukhothai.

Around 1,300 CE, Chinese annals note that the Tai who migrated to what is now Thailand benefited from the fertile soils of the region, while those who migrated to Laos inherited soils less suited to wet rice agriculture. Buddhist missionary campaigns from 307 BCE had assisted the emergence of the Mon-Khmer culture through subsequent centuries, later also providing a basis for conflict when the King of Pagan attempted to forcibly standardise Buddhist practices across the region. The Tai, who had possibly learned skills in administration, customs, land allocation procedures, and taxing of agricultural produce in southern China,¹⁴¹ were well placed to take advantage of weakened areas between powerful Empires.

¹³⁶ Donner, W. (1978)

¹³⁷ Wyatt, D.K. (1984)

¹³⁸ Carter, M.D. (1952)

¹³⁹ Pholdi, Orathai. (2000)

¹⁴⁰ Seidenfaaden, E. (1946)

¹⁴¹ Thompson, V. (1967)

In migrating, the Tai found themselves the occupants of upland river valleys surrounded by the Vietnamese State centred in the Red River Valley and delta regions, the Kingdom of Champa on the coast of central Vietnam, the Khmer Empire centred at Angkor and the Kingdoms of the Mon and Pyu of Burma. These States were oriented to either the coast or their own State-religious Empires. Widespread shortages of labour in expanding Kingdoms meant that campaign victors took slaves; through such mechanisms the Tai experienced different techniques of agriculture across the whole region. Tai slaves were mentioned in an inscription of the Champa Kingdom of coastal Vietnam during the eleventh century.

Independent Tai States of southern Yunan were recognised in Chinese chronicles as having entitlements to revenues from northern Thailand, northern Vietnam, Laos, and Sipsongpanna. By the end of the thirteenth century, Tai chieftains had established their right to manpower within their realms. From the differing Tai involvements across the region, Tai were to either form a Kingdom capable of assimilating other cultures into a new (Thai) culture, or be absorbed as they assumed leadership roles in a new culture, as occurred in the case of the Ahom Tai of Assam.¹⁴² In any case, it appears that agriculture was a more common unifying theme of the Tai than the, perhaps more romantic version of an increasing militaristic Tai group marching southward to take over the fertile valleys of the Khmer.¹⁴³

Tai in Thailand

The migration of Tai groups across several countries was associated with river valleys, river-based irrigation systems, and the grasping of opportunities. Southern China experienced famine while the Tai found themselves in an untapped land where climate change further favoured wet rice agriculture. Mon-Khmer power had passed its zenith and, by the time they assumed its mantle at Sukhothai, the Tai had established a river-valley communication system and stable communities which flourished to become the major northern valley centres of Luang Prabang, Chiang Mai, and Chiang Saen.

Thus Tai migration was not necessarily *en mass* or stimulated by Kublai Khan.¹⁴⁴ It blended with the assimilatory Dvaravati then Mon-Khmer cultures until the latter's demise when Tai assumed Khmer trappings of power while continuing with their adopted religion, which was common with that of the Dvaravati. Continued assimilation ultimately produced a culture now known as Thai; while for other Tai groups such as the Ahom, integration with another culture led to diminution of Tai traditions.¹⁴⁵

The upper Chaophraya basin into which the Tai migrated in increasing numbers from the thirteenth century provided an isolated area for the development of local autonomy within the mixture of existing ethnic groups.¹⁴⁶ In the smaller river valleys of the north, the

¹⁴² Wyatt, D.K. (1984)

¹⁴³ Terwiel, B.J. (1991)

¹⁴⁴ Yuting, D.E. and Lufan, Chen (1989)

¹⁴⁵ Terwiel, B.J. (1983)

¹⁴⁶ Loubere, K.S. (1969)

development of Kingdoms separated by mountains¹⁴⁷ provided a secure rice production base for residents, the absorption of migrants moving south, and encouragement for those travelling to areas short of labour for development of further wet rice.

The numerous Tai speaking settlements of the era emerged as four groupings according to the river basin of their location:

- the Mekong River group which is found in Sipsongpanna region of Yunan Province of China and extending down through the northern areas of Myanmar, Laos, and Thailand, and including the northeastern region of Thailand
- the Salween River group which is concentrated predominantly in northern Myanmar, although part of this group subsequently moved to the Phrommabutr River Basin in India
- the Red and Black Rivers groups which include the Tai speaking groups of present day Vietnam
- the Chaophraya River group which includes the Tai speaking groups of present day Thailand.

Tai Traits

The small cultural differences between the different Tai speaking groups are overshadowed by their overwhelming cultural similarities which include language, rice cultivation systems, consumption of glutinous rice, and the distinctive form of raised-floor house construction. In particular, the association of Tai people with glutinous rice appears to have been almost absolute. Other groups who planted and consumed glutinous rice were related to, or closely associated with, Tai groups. While during the modern era, groups with whom the Tai mixed in delta regions have forsaken glutinous rice production and consumption, their rituals continue to reflect Tai origins; sticky rice is used in spirit and ancestor offerings, marriage ceremonies, as well as a component of specialised dishes, now regarded as delicacies. Glutinous rice remains the preferred diet in the northern part of the Mekong area in northeastern Thailand¹⁴⁸ and in the northern river valleys.

Descending via river valleys in small relatively continuous migrations over several centuries and settling on the tributaries of main rivers or on flood plains, the Tai occupied land previously considered unsuitable for agriculture. Growing a range of crops on the river banks and practicing *muang fai* and receding flood agriculture for rice production, the Tai introduced new ideas to their neighbours with whom they apparently coexisted satisfactorily for several centuries.¹⁴⁹ Traits of readiness to travel, open-heartedness, and assimilation of and with other cultures, may be derived from such early migrants.

However, the association with wet rice production is the overwhelming Tai trait. It saved many Tai from the population pressure which had outstripped agricultural production in

¹⁴⁷ Kasetsiri, C. (1976)

¹⁴⁸ Wongthes, E. and Wongthes, S. (1989)

¹⁴⁹ Van Liere, W.J. (1989)

their Chinese homeland leading to the 1793 Malthusian predictions of Hung Ling-Chi.¹⁵⁰ Extreme food shortages along the Yangtse fuelled the civil war known as the Taiping Rebellion in the mid nineteenth century. Wet rice agriculture which had in part, fuelled their southward migration, had yielded its harvest for the Tai people in a manner reminiscent of second century BCE observations that the proto-Tai people of the Yangtse River were then blessed by a bounty of food in an area not subjected to floods or droughts.¹⁵¹ Wet sticky rice was the hallmark of the Tai; as the first culture to develop wet rice agriculture,¹⁵² Tai were the most suited migrants of the region who, as the Thai, eventually developed the country to be the world's largest rice exporter.

Eighteenth century Thailand was to be eulogised in similar words by French visitors who noted the bounty of nature for irrigated rice agriculture requiring minimal labour inputs.¹⁵³ By this time, the Tai people had mixed with the peoples of the Mon-Khmer Kingdoms with their Indian Buddhist and Hindu associations and languages incorporating Pali and Sanskrit words clipped to suit mono-syllabic languages.¹⁵⁴ In the form of the emerging Thai, one group had assumed control of Sukhothai, others had dominated much of the northern river valleys from Chiang Mai, others the Lang Xang Kingdom headquartered at Luang Prabang, while yet others took over Mon-Khmer centres such as Lopburi, and developed the powerful Ayutthaya culture. All practicing a reliable form of wet rice agriculture under levels of sustainability not approached by modern systems.

Inseparable from wet rice, the history of the Tai and later the Thai, includes cultural elements which have institutionalised; religious observance, farmer approaches to self sufficiency, and bureaucratic systems funded by rice levies, as well as maintaining some ancient beliefs about natural environment management, and propitiation of its spirits.

Environmental Traditions

Thai environmental management has been pragmatically agricultural insofar it modified the natural environment minimally yet sufficiently to ensure a sustainable output of rice. It has followed the common path of:

- seeking to increase the availability of a natural resource such as water, soil, or nutrients, or to increase the availability of feeds for animals, or reduce crop and animal losses by controlling predators, diseases or weeds
- managing the evolution of both plants and animals by selecting those genotypes which suit human needs of the time and the environments in which the plant and animal products are to be produced; where genetic manipulation through breeding is not feasible, foreign species have been introduced

¹⁵⁰ Hung Ling-Chi (1793)

¹⁵¹ Gutkind, E.A. (1946)

¹⁵² Eberhard, E (undated)

¹⁵³ Turpin, M. (1771)

¹⁵⁴ Rajadhon, P.A. (1989).

- improving the efficiency of human management techniques in the areas mentioned above in order to gain higher efficiencies of utilisation of limiting resources.¹⁵⁵

Each of these approaches has been practiced globally from hunting and gathering stages, through opportunistic forms of food production leading to early agriculture, through to the traditional agricultures of recent centuries, and into the modern areas of molecular biology and substantial manipulations of land, water, atmosphere, and nutrient regimes. If swidden agriculture was the first system devised by humans to manage the production of food and other requirements from forested areas in which hunting and gathering had taken place, one might expect some inherent environmental management values to have passed into early agriculture and perhaps even be recognisable today. Likewise, specific beliefs of such tribes as the Tai in their close association with the development of wet rice agriculture might be expected to include environmental management principles of value in the today's quest for sustainability. Clues to such values exist in the myths, ceremonies, and practices of Tai agriculture; some may be reinvented for a modern socio-cultural context as part of national identity building, while others may claim such traditional origins to encourage sound environmental management practices in accordance with Western perspectives.¹⁵⁶

The significant historical impact of irrigated rice agriculture can easily overshadow the viability of swidden agriculture which allowed experimentation with new techniques in a reliable food production system capable of adjusting to changing climatic conditions. At low population densities, swidden agriculture represents a relatively balanced ecosystem in which human populations can exist in relative harmony with the natural environment.¹⁵⁷ Swidden cultivators often encouraged the re-establishment of forest by scattering tree seeds, yet as with all forms of agriculture, the range of plants encouraged was much narrower than that occurring naturally, culminating in the tiny diversity of major food crops in evidence today.¹⁵⁸

The beliefs of Thai hill tribes, themselves mainly recent immigrants, provide interesting insights as to what may have been once absorbed into the wider belief structure. Invocation of spirits to assist with epidemics, ants and other pests which exceed human powers of intervention in the swidden agricultural systems of hill tribes today contrast with labour intensive efforts to exclude rats by dead fall traps, snares, fences, and diversions, and wind and water powered noisemakers to scare bears and wild pigs away from crops.¹⁵⁹ Abandoned swiddens allow reasonable grazing for cattle which complement income production and provide for roles of religious sacrifice, wealth, occasional pack or draft power, and status.¹⁶⁰ However, in the case of Thailand, the dominance of the wet rice culture means that any vestiges of environmental ethics from other agricultural systems are probably to be found in beliefs associated with irrigated

¹⁵⁵ Falvey, L. (1996)

¹⁵⁶ Harris, I. (1995)

¹⁵⁷ Harris, D.R. (1969)

¹⁵⁸ Tribe, D.E. (1996)

¹⁵⁹ Kunstadter, P. et al (1978)

¹⁶⁰ Falvey, L. (1980)

rice.

The harmony between the rice production environment and the Thai peasant farmer indicates the evolution of the system over centuries. Responses to seasonal or other environmental change are undertaken in a familial manner using knowledge passed on through traditions enhanced over time to become an unwritten, and largely unteachable, environmental management practicum aimed at ensuring a reliable harvest of rice. That these practices appear more environmentally suitable than those more recently introduced reflects the time-frame over which practices have been assimilated within the environment and the human needs. Tai irrigated rice production may therefore be seen simply to have been a stable ecosystem based on an evolution of biological, physical, and cultural variables over successive centuries.¹⁶¹ While this view does not preclude the development of new sound environmental practices, it removes much of the mystique surrounding traditional practices.¹⁶²

Man's association with nature can be separated into; domination, subordination, or neither. The last relationship is an appropriate interpretation of Tai agriculture where plants and animals were viewed as components of life and a successful person as one who lived in harmony with nature.¹⁶³ Folk beliefs and ceremonies which linked agriculture, living, and working in the environment, with religious ceremonies and beliefs, included Tai myths of genesis through the breaking of a ripe gourd, and of good harvests through the propitiation of the rice goddess *Mae Phosop*. Spirits which inhabit plants, particularly large trees, and animals, the planting and raising of auspicious plants and animals according to their appropriate location for houses and community facilities, and dietary rules and weather forecasting associated with plants and animals, have been claimed to show a special Tai relationship with the natural environment. However, such similar beliefs and attitudes are common.

It is more likely that Tai peoples did not have any special ethic about the natural environment. The absence of specific words for nature in Tai languages, and the negative connotations of words used for forest are suggestive of the need modify then to create value. Such an attitude fostered a separation between the natural and the human-created environment. Tai perceptions of beauty were expressed in human-created terms, even when applied to the natural environment. By the time of Sukhothai, this perception is clear in the Ramkamhaeng inscription which described forests, farm lands, residential areas, and orchards as being as beautiful as if arranged by man.¹⁶⁴ Even allowing for the cosmological landscape architecture of the Khmer at that time, the Tai view of forests appears to be one of conversion to fields, in common with most other major agricultural communities.

Before the Tai assumed Buddhism, embodying their animistic practices within it, religious observance seems have occasionally dominated practical agricultural axioms.

¹⁶¹ Geertz, C. (1959)

¹⁶² Falvey, L. (1996)

¹⁶³ Kriengkraipetch, S. (1989)

¹⁶⁴ Khanittanan, W. (1989)

Black Tai beliefs in Vietnam of recent times concerning the aspect of cities and buildings echo those of the Ramkamhaeng inscriptions at requiring approaches to landscape to suit spirits. Tai groups across the region always settled near a forest which assumed a utilitarian role retained in Assam Tai description of their traditional toilet as 'going to the forest'. The Ahom also held tree planting ceremonies, unlike other Tai groups.

A further indication of Tai Buddhist relations to the environment may be gained from the Tai of Sipsongpanna in southern China. This includes the introduction of cultivated plants associated with Buddhism (Table 3.1), a conception of holy hills linked to forests, and cultivating of fuel wood. Consolidated in 1180, Buddhism was enhanced through contact with other Tai groups, which led to, for example, plants being categorised as Buddhist ritual plants. Fruit trees and ornamental species, many of which derive from this Tai area, were carried into Southeast Asia.¹⁶⁵ Trading routes established during the Han dynasty as the Old Silk Road linked to the maritime trading route through the area of Sipsongpanna¹⁶⁶ and Thailand provided a corridor for exchange of cultivated plants between Tai and other Theravada Buddhists.¹⁶⁷

Table 3.1 Plants of Southeast Asia Cultivated in Sipsongpanna Temples¹⁶⁸

Botanical Name	Sipsongbanna Tai Name	Use or Significance
<i>Accacia pennata</i> (L.) Willd.	Songbai	Dye for making the sutra more readable
<i>Aleurites moluccana</i> (L.) M.A.	Maiyao	Seed oil used as lamp oil
<i>Areca catechu</i> L.	Gema	Fruits used as offering
<i>Bixa orellana</i> L.	Gemaxie	Flower used as an offering and as a dye
<i>Crinum asiaticum</i> L.	Linuolong	Flowers used as offering
<i>Dipterocarpus turbinatus</i> Gaertn.	Mainamanyan	Resin used as lamp oil
<i>Ficus altissima</i> Bl.	Maihongnong	Held sacred by Buddhists
<i>F. glomerata</i> Roxb.	Gelei	Bark used for making paper
<i>Gmelina arbora</i> Roxb.	Maisuo	Wood used for sculptures
<i>Livistona saribus</i> (Lours.) Merr.	Geguo	Offering
<i>Streblus asper</i> Lour.	Gehui	Bark used for making paper
<i>Tectona grandis</i> L.f.	Maisa	Wood used for sculptures
<i>Citrus grandis</i> (L.) Osb.	Mabu	Shaddock

Holy hill remnants have been found at archaeological sites in Thailand, probably complementing paddy fields, home gardens, and cultivated fuelwood forests as a naturally forested area. The maintenance of such a forest, assumed in Thailand to be associated with fuelwood, could have served an ancient purpose of maintaining pristine forest as part of a traditional ecosystem (Figure 3.2), and as a toilet area. The preferred fuelwood species of Sipsongpanna is that of *Cassia siamea* LAM., a native of Thailand.

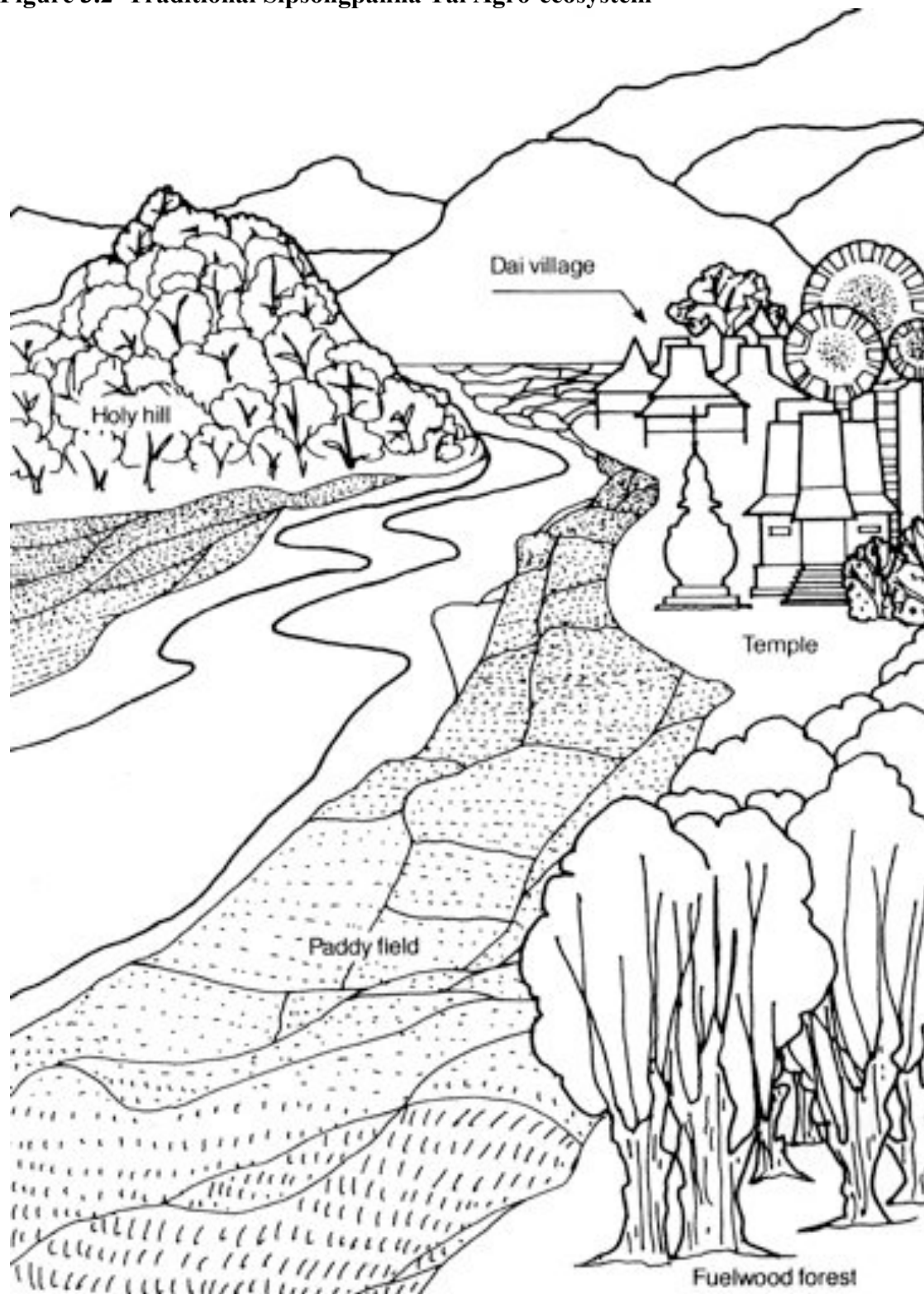
¹⁶⁵ Sheng-ji, Pei (1985)

¹⁶⁶ Needham, J. (1956)

¹⁶⁷ Sheng-ji, Pei (1985)

¹⁶⁸ Sheng-ji, Pei (1985)

Figure 3.2 Traditional Sipsongpanna Tai Agro-ecosystem¹⁶⁹



¹⁶⁹ Sheng-ji, Pei (1985)

With the rise of Tai Buddhist States, religious concepts such as impermanence inspired early Tai literature. Whereas Western literature romanticised the natural environment, traditional Tai literature expressed aesthetic wonderment about its permanence. Respect and gratitude for nature and its agricultural bounty are thus perhaps the best indication of unique Tai environmental beliefs. Later Thai literature was corrupted by foreign influence which rendered it largely indistinguishable from Western environmental romanticism.¹⁷⁰ The impact of Tai agriculture on the environment in an era of low population density was very minimal; after assuming power over larger Kingdoms, agricultural practices became less environmentally benign.

Tai and Buddhist Environments

Absorbing the Mon-Khmer culture, led Tai to clearing of lowland forests for rice fields and city development on a scale which rendered the retention of the small holy hills and forests insignificant. Extensive bunding to create paddy fields changed the soil and water relationships by slowing drainage rates, retaining silt in paddy fields, and undercutting river banks. Changes in soil fauna and flora, in combination with the anaerobic environment of paddy fields, led to changes in soil chemistry.¹⁷¹ Seen by agricultural scientists as a fortuitous development which led to a sustainable production system, its very success caused its wide application and hence irreversible impact on the natural environment.

As they developed this productive agriculture, the Tai merged their traditions with those of other cultures to produce a range of ceremonies which were protected under the broad veil of Thai Buddhism. Some such beliefs and ceremonies include:¹⁷²

- The *Naak Hai Nam* system of measuring water use related to agriculture such that a year of abundant water may be said to have up to seven *Naak (Naga)* present, a belief deriving from the widespread *Naga* and water association across the region.
- Protection of the soil by *Phra Mae Thoranee* and water by *Phra Mae Khongkha* lead to their worship until today.
- Eighteenth and nineteenth century practices of *Pharajaphithi Lai Ruea* and *Pharajaphithi Lai Nam*, meaning 'boat chasing' and 'chasing the water' respectively; during periods of flood, the King and his entourage were to face the waters on the royal barge to prevent it rising to levels which would affect the rice harvest.
- During periods of drought, the *Pharajaphithi Phirunsat* was to be performed based on Brahman rituals from the Sukhothai period in association with Buddhist and Brahman monks, with requirements for the King to remain chaste and to be continually bathed.
- *Bang Fai*, a ceremony which continues particularly in the Northeast, is traced to a Khmer King firing a huge sky-rocket to ensure rain; today practiced in conjunction with the Buddhist sacred day, *Visakha Bucha*, the ceremony has been combined with other monastery rituals; decorative carving of rockets may be a phallic link to *Naga* as provider of the water of life and hence temporal fertility.

¹⁷⁰ Rutnin, C.L. (1989)

¹⁷¹ Van Liere, W.J. (1989)

¹⁷² Sriwatanapongse, S. (1997)

- *Songkran*, the traditional Tai New Year celebration practiced widely across the region is associated with bathing of Buddha images, sprinkling of water, parading of floats, and ingenious water driven devices which mimic the Hindu-Buddhist cosmology of Mount Meru as the centre of the universe and origin of the seven major rivers of Asia; vigorous participation in the Songkran festival in the past, as today, is associated with ensuring good rainfall in the imminent rainy season.
- *Pharya Mae Phosob*, the rice goddess whose spirit is invited to dwell within the rice prior to each planting season and whose encasement within harvested rice creates the feeling of respect for rice which remains evident among Thai people today.
- Links between the rice spirit and Buddhism terms which suggest the co-origination of rice and Buddha, and hence an association of rice with transcendent virtue.¹⁷³

By ensuring satisfactory conditions for agriculture, the King was linked to the religion in a manner which adopted the God-King model of the Mon-Khmer system while allowing the organisational hierarchy of the Tai irrigation system to both become integral parts of the combined culture. The names of the future cities of Ayutthaya and Bangkok both reflect this heritage in the first word of their official titles, *krung*, which originates from a Mon word meaning 'river' or 'canal' and carries the connotation that whoever controls the river is *defacto* occupant of the royal seat. The respect accorded Thai forest monks which derives from their purer Buddhism, is now mixed with broad environmental statements. Emphasised as an indication of a continuing Tai or Thai environmental ethic, such tenuous arguments retain emotional appeal when lapses in social behaviour highlight the benefit of common-sense values. As the repository of Tai and other cultural beliefs, Thai Buddhism contains a mix of beliefs which are foreign to the origins of the religion, yet may suit an emerging Thai environmental ethic, as described in a later chapter.

Historic associations between religion and agriculture in India have also influenced Thailand through Buddhist, Brahmanic, and Hindu rituals, now modified as Thai Buddhism. Tracing the statements of Indian philosophers from 400 BCE to 1300 CE, and their similarity to and links with ancient Greece, regional agricultural practices have been shown to predate those of China, and to warrant reconsideration of agricultural history.¹⁷⁴

While it is difficult to specify a unique Thai environmental management, the culture contains fortuitous mechanisms for establishing strong linkages between culture, history, environmental management, and agriculture. However, the next stage of Thai agricultural history was predominantly one of expansion as Sukhothai assumed a Thai face, and as a separate Tai group consolidated power around Ayutthaya, as detailed in the next chapter.

Summary

Key points pertinent to Thai agriculture which may be elicited from this discussion of Tai agriculture and environmental attitudes include:

¹⁷³ Conway, S. (1990)

¹⁷⁴ Nene, Y.L. (1999)

- From lowland wet rice growers in China more than a millennium ago, the Tai brought in their southward migration, glutinous rice associated with their *muang fai* irrigation technology, which with refinement proved sustainable into the twentieth century.
- Integrating with the Mon-Khmer system, the Tai widened their agricultural capabilities and administrative system to respectively breach larger northern Thai rivers while evolving a complex blend of animism and Buddhism which incorporated traditional ceremonies of the cultures blending to form the Thai.
- Despite modern searches for Tai historical environmental values, no unique Tai ethic is evident; rather, modification of the natural environment was paramount although retention of holy wood lots and fear of spirits may have provided a higher level of interest in forests than might have been expected in scattered settlements.

Chapter 4

Expansion of Thai Agriculture - from 1200 CE

As Tai power over local States grew, what may now be considered Thai agriculture began. The bounty of the lands which Tai, Khmer, Mon and others had settled inspired civilizations to flourish under the protective prosperity of easy and guaranteed food supply. The usual ebbs and flows of human success led emerging Tai communities to assume control of Mon-Khmer cities producing a new culture that was a portent of Thai approaches to external ideas. Just as the people of Thailand today reflect diverse ethnic origins, so do the technologies that the culture identifies as its own. First among the technologies are those related to agriculture, and in particular wet rice cultivation.

Agricultural Organization

The political success to the Tai is sometimes traced to civil organizational skills learnt from the Nan Chao Kingdom, although much about the Kingdom is conjectural. Later Tai adoption of Mon-Khmer systems broadened such skills. Such analysis belittles the organizational skills demonstrated by the Tai over centuries in the annual and perennial construction, maintenance, and use of the *muang fai* irrigation systems. These relied on strong community organization,¹⁷⁵ including water rights and pricing systems, and the recognition of the water manager as the leader of the area served by a scheme. The community strength which derived from almost total reliance on such a social organization, with associated legislation for equitable and sustainable use of the system, provides an alternative means of understanding Tai abilities which led to their succeeding the Khmer at the margins of the declining Empire.

Considered from this perspective, the role of the King as the ultimate water manager and societal representative to propitiate water controlling spirits is as much a logical extension of the social system of the Tai *muang fai* as it is the Mon-Khmer systems. The Burmese Kyaukse¹⁷⁶ river-tributary based irrigation system, the Khmer dam and canal system, and Tai weir and community-based irrigation technologies were precursors of irrigation systems that eventually tamed the Chaophraya environment. Their combination is both an indication of the strong assimilative character of the Thai, possibly adopted through mixing with the Mon, and the underlying role of agricultural organization in forming the Thai culture. When this fundamental ethic of secure food production was neglected, the society foundered, as may have occurred in the frenetic monument building in the last decades of the Angkor Kingdom when siltation of irrigation schemes seems to have been uncontrolled, or uncontrollable.¹⁷⁷

Agricultural Administration

¹⁷⁵ Attwater, R. (1998)

¹⁷⁶ Taylor, K.W. (1992)

¹⁷⁷ Rogers, P. (1996)

The centrality of water control in agricultural development in the region led to the evolution of central governance to manage reliable food surpluses; this in turn allowed political development in religious and/or military guises. The wealth generated from agriculture and related industries enhanced trading interest that fueled external contact and ideas, some of which related to agriculture. The Javanese design of a U-shaped dyke across a river constructed in eleventh century Angkor territory is indicative of religious and trading contact, as well as a long tradition of international technology transfer in agriculture.¹⁷⁸

Possibly the major engineering influence in Thai water management derives from the reservoir and canal systems of the Khmer. These were centered on reservoirs which were either dug out or built above the ground and served by an aqueduct connected to a stream, and by rainfall. Over time, technologies evolved to manage sedimentation and water losses; for example, canals around the inner edge of reservoirs that could be readily dredged, and around the outer edge to collect seepage waters. The earliest known example of this system dates from the seventh century at the Wat Phu ruins in southern Lao-PDR.¹⁷⁹

Later integration of roads, bridges, and rivers created the broad mandala that is understood today as Khmer architecture. These developments appear to have occurred long before any major influence of the Tai on engineering works, and the ongoing problem of sedimentation in the Khmer systems which led to the breaching of larger streams to access more water for reservoirs, likewise speaks little of Tai influence. At these times, the Tai continued to favour sites adjacent to reliable watercourses, or on well watered plains where they refined social systems and technologies that could ultimately blend with the evolving, yet unsustainable, Khmer system.¹⁸⁰

Integrating Irrigation Systems

The conventional Thai historical viewpoint of Sukhothai as the first site of Tai domination is convenient for discussion of agricultural development. Sukhothai and its near neighbour, Srisatchanalai, were archetypal Khmer cities; their origins, governance, the raising of cosmic symbolism above utility in architectural and landscape designs including in the use of water, are all common to Khmer cities. Square block fields, temple ponds, the large *barai* reservoirs, and even an artificial mountain in the case of Sukhothai, are Khmer developments which were maintained by the Tai.¹⁸¹ Managing the Khmer system was complex for the aquatically disposed Tai, and sedimentation increasingly affected the viability of Khmer sites. This probably led to increased reliance on Tai agricultural techniques to produce rice on the lower flood areas in contrast to the Khmer supplemented rain-fed system on naturally raised terraces. Hence integration of agricultural systems probably began as much out of necessity, thereby contrasting with

¹⁷⁸ Dumarçay, J. and Smithies, M. (1995)

¹⁷⁹ Dumarçay, J. and Smithies, M. (1995)

¹⁸⁰ Dumarçay, J. and Smithies, M. (1995)

¹⁸¹ van Liere, W.J. (1989)

social arrangements where the trappings of civilization from the Khmer appear to have been adopted unquestioningly by the Tai .

However, the reasons for Tai rejection of the Khmer management system for water may have other explanations. Perhaps the management of the rainfall and flood recording systems, surveying contours, operating sluice gates and siphons, and the constant maintenance of reservoirs and canals exceeded Tai capabilities of the time.¹⁸² Alternatively it may reflect a belief that the system was unnecessarily elaborate for rice production when Tai techniques allowed similar levels of reliability of production from more sustainable and less labour-intensive systems based on simple river weirs and canals.

Tai assumption of the Khmer mantle may have tempered rice production culture. The intricate association with cosmology in the architecture of the Angkor civilisation has oriented modern interpretations of the water diversion systems to be similarly associated with the religion. The thousand lingas through which the Siem Riep River flowed before the waters were to be used by the city at Angkor is interpreted as a religious hydrological system.¹⁸³ However, the societies which created this culture relied on a continuous supply of rice and such diversion systems would more likely have originated as small interventions to serve agriculture and the city, and have been attributed a religious significance to protect their integrity. As the society became more refined, mundane reasons for religious associations may have been subjugated to the expansive religious architectural work that increasingly deified the King. The pragmatic organization of the usurping Tai tribe rejected the inferior and labour inefficient rice production systems of the Khmer while blending other trappings of power including ceremonies, the role of the King, and gods associated with water and sites with their own Buddhist and animist beliefs.

Learning from the Sukhothai experience, the Thai developed hydraulic skills for irrigation which complemented their essentially aquatic skills derived from life in flooded environments, and with their simple and resilient *muang fai* system. Larger rivers were tapped by the *muang fai* system until, by the Ayutthaya era, another emerging Tai power built the largest Tai Kingdom on the security of modified main river flooding.¹⁸⁴ The combination of the technologies gained by the Thais over centuries is evidenced in these systems and the construction of the first storage irrigation system in 1633 at Ayutthaya,¹⁸⁵ an echo of the Khmer storage *barai*, and the comparatively tiny *muang fai* systems of the traditional intermontane Tai.

Tai of the northern Lanna Kingdom enjoyed a relatively stable lifestyle within the periodic vicissitudes of warring States. As the last stronghold to fall to the colonizing Thais after they had conquered the delta environment, the chink that weakened the Lanna Kingdom, appears, as with the Khmer six centuries earlier, to have been a neglect of the

¹⁸² Jumsai, S. (1997)

¹⁸³ Siribhadra, S. (1999)

¹⁸⁴ van Beek, S. (1995)

¹⁸⁵ Arbhabhirama, A. et al (1987)

underlying agricultural economy. An ambitious building program consumed many resources created from rice surpluses, thereby leaving the Lanna Kingdom vulnerable to infiltration and attack.¹⁸⁶

The agricultural system of the North, based on *muang fai* irrigation, remained viable long after Lanna's fall to the Thai, further indicating its suitability to produce continuing surpluses. By this time, the Ayutthaya Thai had codified water control works to reduce floods, supplement rainfall to create a known environment for rice cultivation, and even to grow off-season rice crops.¹⁸⁷ Not to be confused with today's systems, these early delta irrigation systems delivered the requisite water from an inundation *khlong* with simple control systems that could fail completely if a season was overly wet or dry. However, the extensive delta and its relative under-population ensured that there was always an area from which sufficient rice could be harvested.

The evolution of Tai water management and rice production techniques reflect Thai cultural evolution.¹⁸⁸ Traditional Tai agriculture used broadcasting of seed to plant rice in flooded swamps and river overflows, whereas the Khmer agriculture on elevated sites required transplanting to maximize use of scarce water. Transplanting was later adopted by the Thai as they intensified production systems. The Tai staple of glutinous rice remained important for local consumption, particularly in the Northeast and the North, while non-glutinous varieties predominated overall through higher yields and international demand. As irrigation systems became more complex, organizational systems that could manage continued success in agriculture, were developed, emerging over more than fourteen centuries as modified forms of the ancient administrative units of *ban*, *muang*, and *nakhorn*.

The *ban*, *muang*, and *nakhorn* of the Central Plains are mainly located facing rivers, reflecting original transportation systems for rice production and all communication. Expansion from rivers was along canals dug to improve irrigation, or to open new areas to irrigation. Thus *muang* developed where river tributaries joined a main river, and *nakhorn* where navigable rivers and land or sea routes intersected. By contrast, the Northeast *ban* and *muang* reflect the expansion of a community to a neighbouring naturally-raised area surrounded by swamps in which rice was cultivated. In the South, agricultural and trading settlements developed along sand dune ridges and at river mouths, with the administrative units reflecting trading importance or population density. In the mountainous North, the interconnection of separate *ban* on a river where the *muang fai* irrigation system was practiced, created an affinity which continues today;¹⁸⁹ *muang* consolidated a group of *ban* in a valley or geographical contiguous area, with *nakhorn* being the major trading centres in larger valleys of the North. This administrative system, still largely in place today, reflects the agricultural history of the Thai. From a society civilized by agricultural surplus, expansion to control a wider

¹⁸⁶ Penth, H. (1994)

¹⁸⁷ Donner, W. (1978)

¹⁸⁸ Ishii, Y. (1978)

¹⁸⁹ Vallibhotama, S. (1989)

region relied on agribusiness trading, and judicious use of agricultural wealth to create a nation.

Agricultural Domination

Fuelled by secure rice surpluses, a Thai identity emerged around the thirteenth century. The wisdom of modifying the naturally flooded environment for rice production rather than creating an environment for rice on elevated terraces, points to a sound understanding of the environment in agricultural terms. This rise of the Tai may be related to two factors of continuing importance; an embracing culture which rapidly internalizes useful innovations from elsewhere, and insistence on rice production, albeit an apparently less demanding task than food production in most other regions of the world. The adaptability of the Tai is evidenced not only in the usual Sukhothai story, but also in other contemporary Tai centres such as at Chiang Mai, and what was to become Ayutthaya, each based on adoption of agricultural technologies suited the particular environment.

Varying interpretations of the capabilities of the Tai have been offered. Their tribal origins, the apparent absence of an internally generated script or an organized State, might suggest that they were simply adequate farmers who travelled rivers, but had not developed skills in the large scale hydraulic irrigation of their neighbours.¹⁹⁰ Other interpretations suggest large-scale migration from Yunnan provoking confrontation with the Khmer Empire. Most likely is that the Tai communities which had formed from migrating over centuries¹⁹¹ had, by association with the Sukhothai Khmer outpost and through their population reaching a level which allowed rebellion, inevitably rose to dominate. Whatever the mechanism, control over rice was central to political success. A unifying view of Tai history prior to the fourteenth century resonates with rice-field numbers in the names of various Tai States, such as northern State of *Lanna* and the autonomous region of Xishuangbana in Yunnan province of southern China *Sipsongpanna*.¹⁹²

Control of rice fields and their resident tax paying population provided the three resources of food surpluses, revenue, and manpower for military expansionism. Through this mechanism, the Tai gained control over smaller, sometimes other Tai, States, and absorbed them into their own.¹⁹³ That the Tai successfully expanded, suggests an understanding of reliable rice agriculture with associated organizational systems. Skills may well have included; agricultural and land administration, taxing systems for rice, and military expansionist approaches learned from other Kingdoms as Tai groups worked within them in their slow southward migration.¹⁹⁴ However, details of pre-Sukhothai Tai systems, with the exception of the irrigation-based organizational system, are sketchy and later institutional creation of a Thai national identity has clouded perspectives on the era.

¹⁹⁰ Rawson, P. (1967)

¹⁹¹ Wood, W.A.R. (1959)

¹⁹² Schultze, M. (1998)

¹⁹³ Credner, W. (1935)

¹⁹⁴ Thompson, V. (1967)

Nevertheless, expansion led eventually to conversion of the last available lowland area to rice; the Central Plain, once rejected by the Tai and others as too wet and difficult to manage, was drained, and managed as the culmination of Tai expansionism and rice production.

Tai to Thai Agriculture

Under the influence of commercial success in trading, the South attracted increasing Tai interest and eventual dominance.¹⁹⁵ Agriculture of the South relied on rice as elsewhere, and used techniques of the influential trading groups including Indians, Persians, and Chinese. Tai power was slow to arise and less absolute than elsewhere in Thailand as indicated for example, in the diversity of rice harvesting techniques, even today. As distinct as the Khmer stream and reservoir system to supplement rainfed rice on elevated terraces was from the Tai *muang fai* system, so is the southern harvesting of only the rice raceme distinct from the usual harvesting of the whole plant elsewhere in Thailand. Eventual Tai success of the South involved absorbing such practices notwithstanding the presence of large numbers of Tai persons from the Central Plain and the North, including those captured in a Sukhothai attack on Chiang Mai in 1390 and removed to three southern and one eastern province.¹⁹⁶

The security of rice production provided security of a Kingdom that then required skilled political management to grow. A pinnacle of Tai culture and its *muang fai* irrigation system, the Lanna Kingdom of the North generally prevailed against invaders over seven centuries. Yet it was eventually defeated by other Tai who had by that time absorbed new technologies and cultures that allowed them to control the delta region for rice production, provided they had access to labour resources. Reliance on the balance between manpower and rice production for political security fuelled military expansionism and development of democratic rice production systems. Since before the time of Ayutthaya, an early democratic approach to ownership of the productive capability had been institutionalized as *sakdi na* or 'field power', whereby an area of rice fields was allocated according to a persons social level, with use of this right in the settlement of legal disputes.

The power which control over consistent rice surpluses created is increasingly well documented from the Ayutthaya period.¹⁹⁷ For example, fourteenth century Chinese travel accounts note Siam as an exporter of aromatic woods, rattan, and beeswax, with abundant fauna providing rhinoceros horn and kingfisher feathers, from a culture secure in its production and trading of rice while supporting local crafts and importing fine cloths, paper products, and precious metals.¹⁹⁸ From such a base, other communities might have moved to a wider trading role using their security and power to control trade routes. However, the limited trading involvement of the Thai reflects a weaker position compared to major trading powers of the era, such as the Middle East, India, and China,

¹⁹⁵ Taylor, K. V. (1992)

¹⁹⁶ Wyatt, D, K. (1984)

¹⁹⁷ Ishii, Y. (1971)

¹⁹⁸ Terwiel, B.J. (1991)

and increasingly Portugal, the Netherlands, and Britain. It may also reflect an insularity which assisted continuing expansion of rice production, as indeed occurred through the Ayutthaya period.

The contrasting inward yet assimilatory culture that the Tai inherited, is consistent with the centrality of a wet rice as the source of the civilisation. It fuelled expansion to the whole Chaophraya basin and some adjacent areas in a manner which proved more politically durable than that of Tai cousins in Burma, Lao, and Vietnam. Even in the Assam culture, where Tai attained local power, they largely lost contact with their original culture. In Thailand, the mixed culture and races retain much of what was Tai in a powerful agricultural exporting country, while other perhaps ethnically more uniform Tai groups have been subsumed into other cultures, or in the case of Lao, are economically dominated by Thailand and other neighbours.

Development of the delta was not achieved until after twentieth century at what is now seen to be significant environmental cost. The floods common to large parts of the delta required new approaches to water control. In part of the current Ratanakosin period, between 1831 and 1967, four floods have fully destroyed, and eight have seriously damaged, a rice crop, and in another 40 seasons water shortages have affected rice production significantly.¹⁹⁹ Such variability in the water environment throughout the earlier period of Tai expansion into the delta, explains original views about the difficulty of the environment; its development is a testimony to the perseverance of a culture which knew its success relied on always producing a rice surplus. If a Tai approach to food production is defined through the period leading up to a Thai identity entering the world's awareness, it would be one of managing the natural environment to produce a rice surplus for security and trade from the lowest human inputs possible. Thus agricultural life determined a large part of the Tai, and later, Thai culture.

Agricultural Life

Intensification of agriculture increased impact on the natural environment. The simple life afforded by Tai and Thai agriculture included practices that today would be termed unsustainable, as may be said of most of the world's systems that supported low populations over millennia. Providing abundant yet, until relatively recently, simple fare, agriculture changed over time with the culture, leading to an exotic complex of animism, Buddhism, and other Indian religions to include special agriculturally associated beliefs.

Up to the Khmer period, food production was conducted on small areas surrounded by vast forests. Environmental variations were constant. The rainfall regime is often assumed to have been even, the river flows to have been predictable, and soil fertility to have been replenished annually by natural silt deposition;²⁰⁰ but none were constant over these centuries and the environment required modification to suit rice agriculture. In addition, each successive year of population increase led to higher environmental pressure culminating in the major impact of reservoirs, stream and river diversions, and

¹⁹⁹ van Beek, S. (1995)

²⁰⁰ Sagarik, R. (1989)

ponding of rice soils. Nevertheless, the traditional wet rice cultivation system remains one which belies the maxim that sustainable agricultural systems are those which have minimal impact on the natural environment.

Tai diet was a combination of rice supplemented with meat from small animals such as frogs, fish, and to a lesser extent insects, with occasional meat from hunted animals of the forest, including gaur, deer, and bear. Naturally occurring vines, trees, and aquatic plants provided variety according to season with some species being encouraged in early kitchen gardens.²⁰¹ The diversity of the diet increased with external contact, particularly the contact afforded with the Mon-Khmer, Indian, and other traders until about the fourteenth century, and then particularly with the Portuguese and other western traders. In the Khmer period, the diet is recorded as being predominantly rice and fish supplemented with milk from cows and goats, meat from pigs as well as from deer and other forest animals, and fruits including mango, lychee, papaya, and oranges.²⁰²

The simplicity of the Thai diet at the time of early Western contact is indicated in descriptions²⁰³ of rice, fruits, dried fish, and water as being common fare for all levels of the social hierarchy,²⁰⁴ within a custom of not over-consuming at any one meal. Killing of domestic animals seems to have been forbidden by the religion while killing of wild animals was known, if infrequent.²⁰⁵

Now eulogized as a lifestyle consistent with nature while providing for all, the continual development of new technologies and political expansionism ensured that a return to the past was impossible. New agricultural technologies met at least one of the two criteria of:

- reducing labour inputs consistent with the ethic of reliably producing food with minimal human input
- meeting the demands of a rising population.

Thus the Khmer system of Sukhothai was modified to control water from larger rivers and the traditional *muang fai* system was blended with the reservoir system of the Khmer, such as constructed at the complex at Srisatchanalai. Over the same time, the environment was also changing naturally at a rate faster than that caused by humans. The site of Ayutthaya, originally have been chosen for its coastal proximity, is today not only distant from the coast, but one of the most fertile rice producing areas of Thailand.²⁰⁶ Thus Thai food production systems both modified the natural environment, and capitalized on and enhanced natural changes in the environment for human benefit.

Agriculture defined lifestyle and subsequently law, war, and religion. Rice was the chief cause of civil litigation in Khmer and succeeding Tai Kingdoms. Wars of the era

²⁰¹ Ramitanondh, S. (1989)

²⁰² Murray, S. (1996)

²⁰³ Gervaise, N. (1688)

²⁰⁴ Caron, F. and Schouten, S. (1671)

²⁰⁵ Buri, R. (1989)

²⁰⁶ Moore, E. et al (1996)

frequently which seem to have been indecisive to analysts today are made intelligible when it is recognized that they were conducted between rice growing seasons. Returns to the battlefield depended on successful rice harvests, themselves increasingly dependent on the valued spoil of war, labour.²⁰⁷ An association with Buddhism is claimed to have made the Thai more empathetic with the natural environment,²⁰⁸ although such links often prove tenuous with the analysis presented in a later chapter. Animistic practices maintained in parallel with Buddhism were accepted in association with donations of rice fields, draft animals, and slaves to temples.²⁰⁹

Prescriptions about the auspicious siting of plants around houses,²¹⁰ propitiatory rites associated with rice gods, and rain-creating ceremonies each found their way into the Thai view of Buddhism. The development of the religion, as with agriculture, shows an attitude of absorbing new practices to blend with traditions. Animist beliefs about the natural environment arising from fear of its power and uncertainty were reduced by technology which modified nature to suit humans; this initiated a trend of natural resource exploitation long before external contact.²¹¹ Such dualism continues to be reflected in the tension between the Thai Sangha and the forest monks today²¹² with the interesting outcome that the latter are often unwillingly pitched against the official religion when development conflicts with conservation of the natural environment.

The influence of agriculture on Tai life up to the time of Sukhothai established cultural norms which have been centrally fostered in the developing of the nation which became Thailand. To belittle the links between wet rice culture and Thai culture leads to an erroneous interpretation of the motivations behind agricultural and developmental change, and even the Thai world-view. Sukhothai provides a convenient metaphor to explain the importance of rice in Tai and Thai history; it remains relevant whether Sukhothai was a precursor to Ayutthaya, or simply one of many Tai *Muang*²¹³ of the time, of which one, Ayutthaya, rose to dominate the whole of Thailand. Likewise, the popularly quoted Ramkhamhaeng Inscription ascribed²¹⁴ to the era consolidates the agricultural wealth of the Thai culture in its words ... *in the water there is fish, in the fields there is rice* ... and in its praise of bountiful forest products and rice surpluses for trade. From such a background, agriculture seemed assured of a continuing central role in Thai thought.

Summary

Key points pertinent to Thai agriculture that may be elicited from this period of Tai agricultural history include:

²⁰⁷ Thompson, V. (1967)

²⁰⁸ Buri, R. (1989)

²⁰⁹ Vallibhotama, S. (1989)

²¹⁰ Sukwong, S. (1989)

²¹¹ O'Connor, R.A. (1989)

²¹² Phongpaichit, P. and Baker, C. (1997)

²¹³ Kasetsiri, C. (1976)

²¹⁴ Wyatt, D. (1991)

- Rice has been central in; community formation, development of civil leadership from water managers, and forming the foundations of the administrative structures of Thailand.
- An embracing and pragmatic nature has facilitated discriminate absorption of technologies and cultural elements in an ongoing cultural evolution that has produced a resilient dualism in production of domestic and export/urban rice varieties, and religious beliefs associated with agriculture.
- Traditions of environmental modification and social adaptation to changing environmental conditions has enabled Tai agriculture to continually produce significant surpluses from minimal human inputs in a society which favoured a simple cuisine.

Chapter 5

Emerging Agribusiness: Ayutthaya to the Early Twentieth Century

Consolidation of the Thai agricultural knowledge is most evident from the period of Ayutthaya, partly due to availability of historical opinions. Development to this time had followed trends of Southeast Asia, where the ecological fragility of cleared rainforested areas, and traditions of most ethnic groups, had restricted population expansion to alluvial riverbanks and volcanic loam soils. Alluvial areas benefited from silt deposition to maintain a level of fertility along the Mekong, Chaophraya, Irrawady, and Red River plains.²¹⁵ With the emergence of Tai groups as controllers of rice surpluses, significant States arose, including Chiang Mai, Luang Prabang, Sukhothai and Ayutthaya. Expansion of international trade from around the fourteenth century then contributed to economic growth that further consolidated power of the better located States.

The period of Ayutthaya through to the first quarter of twentieth century contains major changes in the role of agriculture and Thai approaches to environmental management. Continued dependence on military capture of labour resources dominated politics and warfare in a region which was predominantly hinterlands with few, small States and settlements in favourable lowland areas. This economic base remained essentially the same from the fifteenth century through to the late Ayutthaya period, when the Thai small-holder became a central economic figure; the Crown favouring the opening of new lands gave small-holders sufficient encouragement to begin the conversion of the natural environment to agricultural fields. The frontier mentality so created assisted in an early form of democratic development as self-sufficient small-holders in remote areas sought independence from central power and taxation. It also contributed to an approach to environmental exploitation through land accumulation that continues to the present day.

Ayutthaya may have been a contemporary power with Sukhothai if it had the benefit of a similar existing infrastructure developed under Khmer rule. Certainly its influence overlapped with that of Sukhothai, and was possibly constrained or halted in its development by a major epidemic,²¹⁶ and the effects of significant changes in rainfall patterns.²¹⁷ In terms of agricultural techniques, the Ayutthaya community differed from that of Sukhothai in being able to thrive in the aquatic Chaophraya flood plains; at Sukhothai, the high costs of maintaining a State system including ritual water supply systems appears to have exceeded the management capabilities of that new Tai State. At Ayutthaya, a strong orientation to wet rice led to forested areas being regarded as ungovernable and inhabited by persons should be persuaded to join the Crown-controlled wet rice lands.²¹⁸ The sparsely populated land is described in the Sunthorn Phu *nirat*;²¹⁹

I see villagers sinning as fishermen;

²¹⁵ Steinberg, D.J. (1987)

²¹⁶ Terwiel, B.J. (1997)

²¹⁷ Reid, A. (1992)

²¹⁸ Geswick, L.M. (1976)

²¹⁹ Umavijani, Montri. (1986)

*they ensnare birds and hunt animals besides.
Where ricefields stand against a background of woods,
these forest villagers erect their houses.*

Through the development of the Ayutthaya Kingdom, and especially from the seventeenth century, Thai texts seek to separate the Kingdom's history from that of Buddhism, in common with the preferred historical perspectives of other regional States at that time;²²⁰ hence there remain conflicting views of the strength and technological capability of the realm. Consistent with this creation of a national history was a gradual drift to assume sustainability of the Kingdom and rice harvests with rice no longer attaining primacy in governance concerns. Periodic weakness in political affairs has been linked to variation in morality of the Kingdom deriving from or evident in poor resource management, including both human and natural resources. Community and leadership lapses from religious principles have been associated with poor agricultural practices, and consequent domination by the Burmese.²²¹

The rise of Ayutthaya in an aquatic and changing environment defined subsequent agricultural development, particularly agribusiness trading. The Kingdom's demise, likewise confirms the central role of agriculture; neglect of food production leads to economic and political vulnerability. Consistent with cyclical worldviews, the fall of Ayutthaya prophesied at the height of its prosperity by a late seventeenth century poet, possibly King Narai, was apparently fulfilled a century. Pali writings of a Buddhist monk of that time describe persons wandering in search of food and dying of starvation, both uncommon views of the Thai identity.²²²

The combined effects of Western contact, international trade, the continual development of new legislation to meet new developments, expansion of rice growing and associated agribusiness, and neglect of the management of resources both natural and human, contrived to finally and irreparably weaken the Kingdom. In its demise, the Thai learned the importance of ensuring adequate manpower for rice production, and the central importance of a firm foundation in agriculture on which to build other Crown developments. A wider world then influenced subsequent agriculture through immigration, trade, and modernisation that created the Kingdom of Siam of the early twentieth century.

Agriculture, Environment and Morality

Economic development relied on expertise in wet rice production. The Ayutthaya Kingdom was established on modified water recession from flooded areas on the delta; minor earth-works slowed natural drainage according to the stage of rice maturity. Supplementary water was drawn from some canals that served agriculture after their primary transportation purpose and symbolic functions that recalled something of the Mon-Khmer traditions.

²²⁰ Andaya, B.W. (1992)

²²¹ Kathirithamby-Wells, J. (1992)

²²² Wyatt, D.K. and Woodside, A. (1982)

The Tai attitude to the natural environment, one of fear of the unknown non-rice producing areas, included willing manipulation of the natural environment to create paddy fields, weirs, dams, and canals. However, the impact of such a production system on the environment was minimal due to the low population pressures and the vast extent of the unused forested and upland areas. With Western contact, views about the natural environment derived from the Buddhist religion, if extant, would have been seriously challenged. Western colonialists brought technologies and a desire to exploit forests among other resources. This provided a welcome stream of income to the Crown and contributed to a rising interest in trade above agricultural production.

The small ice age of the seventeenth century, which created famines in Europe, was only experienced in Southeast Asia in the form of reduced rainfall; teak tree ring analyses from 1514 to 1929 in Java²²³ indicate that the years 1645 to 1672 each received less rain than the average of the four centuries. With such longer dry seasons, crop failures were common and populations declined in many Asian communities. In Ayutthaya, the ease of moving closer to the river in dry years and of exploiting gradients rising away from the river to ensure at least some production, provided advantages over the swamp and lake wet rice systems. Nevertheless, the Kingdom experienced some hardship, which reinforced the centrality of agriculture in its security and prosperity. While European agriculture through this period shifted from cash to food crops²²⁴ until food security and confidence was regained,²²⁵ Ayutthaya maintained some export of rice throughout.

By the 1840s, settlements were small core communities or States with small outlying provinces, all in the lowlands where rice culture required minimal effort and provided greatest reliability. Even the delta Kingdom of Ayutthaya extended complete influence only some ten kilometres until the early nineteenth century, when the population was estimated to be three million for the whole of what is now Thailand. Estimates of population in the period 1820 to 1840 indicate around 500,000 persons in the delta area of Bangkok and surrounds, with the next most populous centre being Chiang Mai with some 30,000, and other centres on rivers and along the coast supporting populations of 5,000 to 15,000.²²⁶

Forests dominated the landscape. A herd of wild elephants roamed and resided in the area of Bang Kapi even up until the last quarter of the nineteenth century.²²⁷ Traditional Thai medicines were based predominantly on herbs until foreign demand introduced markets for such products as rhinoceros and deer horns, gall bladders of wild animals, and tiger bones, teeth, claws, and pizzlies.²²⁸ The environmental impact of Thai agriculture remained low as did population density; this was to change quickly with the expansion of agriculture in response to international trade.

²²³ Lamb, H.H. (1977)

²²⁴ Reid, A. (1992)

²²⁵ Sternstein, L. (1993)

²²⁶ Terweil, B.J. (1989)

²²⁷ Sukwong, Somsak. (1989)

²²⁸ Buri, Rachit. (1989)

Manpower had long been a preoccupation of the Burmese and Thai Crowns, and the ultimate demise of Ayutthaya may be traced to moral decline²²⁹ causing a failure to maintain a labour force for rice growing and military action, rather than a failure of administrative systems alone.²³⁰ Thus the Mon conquest of 1752, and Ayutthaya's own weakness in the period 1733-1767 associated with a decentralisation of power to Phitsanulok, Sawanakhalok, Nakorn Sri Thammarat, Phimai, and Chantaburi, probably reflect declining control over agricultural labour and hence rice surpluses.

Western contact brought a view of technological dominance of the environment²³¹ that contrasted with views of small-holder farmers²³² more than with the Palace classes involved with trading. In any case, teak forests attracted the interests of colonial groups to the extent that by the nineteenth century, western political ends were subjugated to trading benefits gained from guaranteed access to valuable forests. Prior to this time, teak had been less valuable as the Chinese market required relatively little timber for construction, the Indians had their own sources of teak, and Western powers controlled the forests of Burma and Laos. As a resource of the Thai Crown, taxes on Thai teak were imposed when neighbouring States became less desirable sites for Westerners.²³³ Beginning in the late period of Ayutthaya, large scale forest exploitation continued into the twentieth century. Numerous reports imply the rapid demise of not only teak forests, for example, the area from Bangkok to Ayutthaya was noted to be all forest in 1690.²³⁴

Thai administration of environmental management is sometimes traced to the licensing of teak concessionaires in the nineteenth century. In fact, effective forest protection legislation is only a very recent occurrence.²³⁵ British, French, and Danish domination of the teak industry stimulated the Crown to assume greater control, notwithstanding the substantial revenue it received from these efficient concessionaires. The motivations to establish the Royal Forest Department in 1896, which seem to have been fiscally driven, led to British foresters serving as the first three Directors General who were succeeded by British-India trained Thai foresters. The establishment of the Phrae Forestry School and the Kasetsart University Faculty of Forestry, similarly seems to have been oriented to enhancing revenues derivable from logging.²³⁶

In reestablishing the Thai power at Thonburi after the fall of Ayutthaya, King Taksin re-established rice exports, drained marshes, and introduced double rice cropping into hitherto untamed flood plains. By 1780 the Thonburi Kingdom was exporting rice to China. The reformation of the Thai State again relied on sound agricultural policy although the cash crops that helped independent Siam to maintain an economic parity of sorts with its colonized neighbours had definitively moved Thailand into international

²²⁹ Wyatt, D.K. (1967)

²³⁰ Wyatt, D.K. (1984)

²³¹ Croll, E. and Parkin, D. (1992)

²³² Tanabe, S. (1994)

²³³ Thompson, V. (1967)

²³⁴ Kaempfer, E. (1727)

²³⁵ Sadoff, C.W. (1992)

²³⁶ Ramitanondh, Shalardchai. (1989)

agribusiness,²³⁷ with its continued demands on expansion. Notwithstanding agricultural successes, one poor rice harvest in 1821 was sufficient to precipitate a crisis.

Until the end of the nineteenth century, rice and fish continued to be the main Thai foodstuffs, and houses continued to be constructed of wood, bamboo, attap, grass, and wooden and earthenware tiles, all of local origin. Agricultural and domestic implements supporting economic and social life were likewise all of local construction. Imports consisted of small lengths of Indian cloth, Chinese silk, porcelain, and jewellery for aristocrats. Thailand was characterised as a frugal country that supplied rather than demanded trade. Even the Dutch East India Company's factories were small compared to those in neighbouring countries, and monopolies extended by the Crown probably impeded expansion of trade. Inevitably demand for foreign items rose. With rice being the continuing source of export income, production rose to pay for foreign manufactured goods demanded by the privileged classes. The natural canals that formed with expansion of the delta facilitated expansion of rice with minimal investment, while the drier hill regions supporting teak forests similarly proved an attractant of export income.²³⁸

Expanded rice production from the river and coastal basins was complemented by the gathering of valuable items from the hinterland to provide industrial, nutritional supplement, and medical products for lifestyle and export. Thus the Ayutthayan economy represented the arrival of Thais as international producers and traders of primary commodities. Limited in expansion by regular wars and diseases of the forested lands, the rise of the Kingdom required an innovative taxation system supplemented by regular and successful military action to harvest additional manpower resources. Governance of Ayutthaya reflected these needs of warfare, trade, and labour management, and began to overshadow agriculture that was assumed to be catered for through labour inputs and trade outlets.²³⁹ Such a change in attitude in a period of international contact led to agriculture inevitably being affected by foreign approaches to cash cropping and environmental management. Rama I's response to this changing world confirmed a new direction for Thai agriculture.²⁴⁰ Nevertheless, rice remained the primary focus as the staple.

Export Rice

During the Ayutthaya period, rice gradually changed from a solely domestic, to an export crop. Under colonial influences, trade stimulated widespread city expansion in Asia fed from the granaries of Thailand, Burma, and Indochina. In Thailand, the requisite incremental manpower increasingly came from Chinese immigrants. By the 1930s, around 80 percent of the Thai population were engaged in some aspect of rice agribusiness, and rice constituted about 60 percent of exports.²⁴¹

²³⁷ Kathirithamby-Wells, J. (1992)

²³⁸ Van der Heide, J.H. (1906)

²³⁹ Phongpaichit, Pasuk. and Baker, C. (1995)

²⁴⁰ Wyatt, D.K. (1982)

²⁴¹ Phongpaichit, Pasuk. and Baker, C. (1998)

Rather than represent a new period of international influence in the agriculture of Thailand, this followed an established trend of trade, exchange of technologies, and development of market demand that spanned centuries. Nakhon Si Thammarat has long been a consolidation and trading point for agricultural and other commerce.²⁴² Cambodia exported cotton to Pattani in the fifteenth century. Sugar cane processing was introduced from China in the seventeenth century, transforming a chewing confectionery to a saleable product via Chinese and Dutch traders to Japan. Rice from Pattani was sold to other southern centres via foreign traders from the sixteenth century.²⁴³ The two significant changes in the Ayutthaya and early Bangkok period were, the increasing involvement of the Crown in trade as a revenue raising activity, and a further shift in the ethnic composition of the Thai population with a concomitant increase in trading skills.

Expansion of rice production and introduction of other cash crops took place on accessible sites of an apparently endless supply of arable land. Opening an undeveloped area to agriculture solved problems of small-holder landlessness or inheriting a poor lot. Reasonable security of tenure was provided by the slow introduction of a land administration system in the Kingdom, which rendered the mercantile classes unwilling to speculate in property that they could not demonstrably own. However, farmers were limited in their access to capital, new technologies, and additional labour. Chinese middlemen provided many of these services at margins appropriate to financial risks while serving as links to international markets.²⁴⁴ Such a system might have been more precarious to objectives of national independence had not the agricultural bounty²⁴⁵ of the Thai soil made it attractive as a trading partner and host to favourable foreign investment. The slow rate of population increase in this late-settled region of Asia similarly assisted Thailand to avoid the civil conflict which gripped the erstwhile home of the Tai along the Yangtse region in the mid 1800s.²⁴⁶

From the North with its durable *muang fai* irrigation system, to the Indian-influenced rice production systems of the South, to the rainfed and receding swamp systems of the Northeast, and the rivers and flood plains of the delta, Thai rice agriculture came of age in the nineteenth century. Adequate production for domestic requirements in all but exceptional years, is echoed in the numerous reports which emanated from the exploring, proselytising, and trading Europeans.²⁴⁷ Tai technologies of these times can still be observed in some regions of Lao, including labour intensive and higher yielding seedling production in nurseries for transplanting, and broadcast sowing in areas where labour is more limiting than land. Rice varieties have changed as a result of diffusion of high yielding types, although local variations are retained, particularly for glutinous types cultivated without chemical fertiliser or pesticide inputs. However, such areas are few, remote, and disappearing as each country in which Tai reside seeks to modernise

²⁴² Wyatt, D.K. (1968)

²⁴³ Reid, A. (1992)

²⁴⁴ Phongpaichit, Pasuk. and Baker, C. (1998)

²⁴⁵ Neale, F.A. (1852)

²⁴⁶ Evans, L.T. (1998)

²⁴⁷ Ingram, J.C. (1971)

agriculture. Such was the rice culture of Thailand through the nineteenth century until it was perceived that declining average yields should be addressed through improvements to irrigation and varietal selection. The need to open up new lands of lower general fertility was offset partially through such technological innovations. With a demonstrated Thai preference to produce rice rather than engage in other economic pursuits, non-agricultural wages in Thailand were relatively higher than in other countries.

Through the period 1870 to 1934, rice exports increased 20 fold, the population doubled, and the area planted to rice rose several fold.²⁴⁸ Such increases indicate much more than an economy seeking to export occasional surpluses of its staple. Indeed the influence of foreign traders in freer trade through the 1855 Bowring Treaty encouraged the production of a surplus as a means for Crown revenue raising through taxation to purchase more readily available foreign goods. However, the decision to expand production was ultimately made by the individual rice farmers themselves, and it would seem that the ending of the mild form of Thai indentured-slavery, debt-bondage, and forced labour allowed small-holders to focus on their main preoccupation, rice production. Having introduced these freedoms, it took the Crown some time to develop new effective means of collecting revenues from the small-holders, during which period the rural population increased and dispersed widely.²⁴⁹

Rural expansion proceeded along the rivers and swamps lands, and eventually into the uplands where earth tanks could hold supplemental water. Areas missed previously were developed through small canals and contour barriers to facilitate drainage on a small scale.²⁵⁰ At first these developments were primitive and temporary in the manner of frontier agriculturists, but successive generations and migrants improved these systems to their full capacity under a human and draft animal powered agriculture. Crown instigated poll and land taxes remained collectable only in near major centres as they were widely resented as an unfair impost on the risks, work, and limited rewards of the frontier agriculturists. Thus taxes stimulated further movement to and development of remote areas producing over the 150 years to 1950 some 20 million hectares of new agricultural land.

Based on low technology,²⁵¹ exports seem to have been dependant on assured domestic supply of rice up to about 1850 when rice represented less than three percent of the Kingdom's exports. This had risen to 41 percent by 1867 and 78 percent by 1888²⁵² with concomitant increases in farm sizes for those oriented to export production. Farms in the Central region were, on average, four times larger and produced cash incomes more than three times higher than those of the Northeast in the 1930s,²⁵³ probably reflecting a higher degree of parity than existed in the nineteenth or century.

²⁴⁸ Sukwong, Somsak. (1989)

²⁴⁹ Wyatt, D.K. (1984) my ref 71

²⁵⁰ Phongpaichit, Pasuk. and Baker, C. (1998)

²⁵¹ Gordon, R. (1891)

²⁵² Owen, N.G. (1971)

²⁵³ Silcock, T.H. (1970)

Famines induced by war-time burning of rice crops and labour losses in the 1700s had been mitigated by the simple production systems which spilled much grain during harvest and allowed the modified swamps to grow rice without tending in the subsequent year.²⁵⁴ With increasing sophistication in agriculture, such natural assistance could not be expected; prescriptive tax collection systems could intensify the effects of poor harvests.²⁵⁵ Tax collection was improved through King Taksin's foreign awareness in the early Bangkok era when reserves and foreign assistance were used to assist the populace through the 1768 famine.²⁵⁶ Notwithstanding such events, the food production capacity of the country exceeded domestic demand through most periods. However, reliance on rainfall and simple supplementary irrigation reached a limit for an export production systems; rainy days variations of up to 30 days, and rainfall of up to 1000 mm in the Central plain and 500 mm in the Northeast, indicated a need for a new era in Thai water control.²⁵⁷

Cash Crops

Trade which stimulated rice export led to the introduction of other cash crops, which were controlled primarily by the foreign trading interests.²⁵⁸ The Bowring Treaty facilitated such foreign trade and investment in crops introduced from neighbouring colonised countries. The separation of rice from other cash crops between the Crown and foreign trading powers led to differing development paths. Rice at first glance appears to have suffered from a constrained view of agricultural technology and irrigation investment on the part of the Crown,²⁵⁹ although conservative views of the domestic role of rice and variations in the international market may have been a more significant influence.²⁶⁰ Allowing foreign control of exported crops other than the national staple is the type of policy which, combined with favourable external circumstances, allowed retention of an independent Kingdom between the competing colonial interests in the region.²⁶¹

Other cash crops introduced in this period included rubber, teak, sugar, and a range of minor crops. In the case of rubber, Thailand began production outside the Stevenson Plan and expanded plantings whenever prices were high. Subsequently joining the Plan, Thailand appears to have followed a system maintained until recent times of periodically seeking special considerations to its own advantage as it grew to dominate world production.²⁶² The teak industry developed from Chinese sawmills to large-scale extraction using Burmese workers under European colonial control, while sugar was to lose various parties' investments over successive decades. Tobacco, chillies, onions,

²⁵⁴ Turpin, F.H. (1771)

²⁵⁵ Terwiel, B.J. (1991)

²⁵⁶ Wyatt, D.K. (1984)

²⁵⁷ Tanabe, S. (1984)

²⁵⁸ Yuthavong, Yongyuth. (1997)

²⁵⁹ Feeny, D. (1982)

²⁶⁰ Manarungsan, S. (1989)

²⁶¹ Farmer, E.L. et al (1986)

²⁶² Ingram, J.C. (1971)

pepper, cotton, dried fish, timber other than teak, pickled tea, and opium were all traded in small amounts through the period.²⁶³

While the country modernised, pockets of the older forms of agriculture continued, and in the case of shifting cultivation, increased among marginalised immigrants in the northern highlands.²⁶⁴ A sustainable system under low population densities even on the granite derived soils of Mae Hong Son which have been continuously used for more than 100 years, sedentary shifting agriculture was ignored through the period except in terms its valued opium crop.²⁶⁵ Even hunters and gatherers survived in remote locations, although the seeds of uniformity in agriculture were already sown through Crown policies of modernisation in the face of foreign influence.

Foreign Influence

Europeans followed the Persians²⁶⁶ and Chinese who had established influential roles in the growing Ayutthaya Kingdom, with Chinese influence being enhanced in an unpredicted manner through trading and cultural assimilation. The development of the Kingdom relied on the inputs of these foreigners; in accepting this developmental approach, Thai approaches to agriculture and technology transfer were consolidated. In agriculture, the significant shift was from national interest in food production to trading. New technologies which entered agriculture were often coincidental benefits rather than conscious technology transfers in this trade oriented world, although small-holder Chinese agricultural skills infiltrated with the entry of some Chinese to fruit and vegetable production. Foreign ownership of new crops led to new technologies being deliberately introduced.

Of the foreigners who arrived in Ayutthaya by sea, it was the Chinese who were to have the largest influence on the Thai State. The first European awareness of the Kingdom appears to be in 1502,²⁶⁷ and the first European written reference is a letter from the Portuguese Governor of India in 1510, after which the Portuguese monopolised European trade until the rise of Manila in 1565.²⁶⁸ Drawing on such information as Marco Polo²⁶⁹, Nicolo Conti²⁷⁰ and Vasco de Gama, the Portuguese preceded the English, Dutch, and Danes by a century. Arabic references to the region also contain records of traders from Thailand frequenting a port in the Persian Gulf²⁷¹ where contact with Portuguese and Spanish was likely. However, Portuguese contact effectively began with a conquest of Malacca in 1511 when Albuquerque sent an ambassador to the King of Ayutthaya. A subsequent ambassador was commissioned to document the merchandise, dress, and customs of Ayutthaya, and by 1518 the Portuguese sought a pact allowing trade. The

²⁶³ Silcock, T.H. (1970)

²⁶⁴ Bessaint, W.Y. (1981)

²⁶⁵ Kinke, P.J. et al (1978)

²⁶⁶ Ibrahim, M. (1972)

²⁶⁷ Mouhet, M.H. (1864)

²⁶⁸ Lourido, R.A. (1996)

²⁶⁹ Yule and Cordier (1903)

²⁷⁰ Major, R.H. (1957)

²⁷¹ de Campos, J. (1940)

Portuguese, in treating the Monarch according to his elevated station, maintained cordial relations.

With the Dutch entering Thailand in 1604, the English in 1612, the Danes in 1621, and the Spanish like the French delayed until the 1660s through their assistance to the Cambodians in their attacks on Siam, European influence began to be conspicuously dualistic; mercantile and missionary.²⁷² A period of rapid technological and cultural transfer continued until the demise of Ayutthaya at the hands of the Burmese. High level European influence from that date of 1767 until the ascent of King Rama II in 1809 was minimal. Once again the first significant input was from Portugal through the Portuguese Governor of Macau who sent an envoy in 1818. Portuguese language had been retained among descendants who had stayed in Thailand and the subsequent European group to reestablish a presence was French missionaries. Relations with Britain were resumed in 1822 through the British East India Company establishing their first treaty in 1825 which was recorded in Siamese, English, Malay, and Portuguese languages because neither the English nor the Siamese understood the language of the other. American missionaries arrived in 1828 to work with immigrant Chinese, and assisted in the printing of Siamese language utilising an East Indian Company employee's invention of a Siamese character printing device.

Portuguese, French, Dutch, Greek, and other nationalities were involved in the active foreign life that developed around the main city of Ayutthaya,²⁷³ reflecting a preference for this Kingdom as a trading centre above other local possibilities including Vietnam.²⁷⁴ The arrival of Europeans is associated with a marked increase in the documentation about the country, in both Thai and European languages, in the western style of recording trade, exploits, and accomplishments. Some romantic views of Thai origins and national development²⁷⁵ may be traced to this period when the aristocracy, as the emerging Thai intelligencia, assimilated and promulgated such histories.

Also associated with European contact was a sharp increase in population growth rate. Prior to 1600, labour requirements for the Crown and periodic wars limited the number of children that could be cared for while working in the fields, and post-partum amenorrhoea probably extended through late weaning.²⁷⁶ The trading era freed labour from corvee and indentured slavery, producing widespread economic opportunities. By the time of the fall of Ayutthaya, the population probably which exceeded one million, was reduced to around 10,000 through casualties, refugees, abandonment of the site, and capture of labour by the Burmese.²⁷⁷ The loss of labour and guaranteed food supply preoccupied the successors who would reestablish the next Thai State.

²⁷² Rajanubhab, Damrong (1925)

²⁷³ Hutchinson, E.W. (1940)

²⁷⁴ Anon, (1884)

²⁷⁵ Freeman, J.H. (1910)

²⁷⁶ Reid, A. (1992)

²⁷⁷ Donner, W. (1978)

During the Ayutthaya period, the culture contained three classes; commoner rice growers, noble bureaucrats, and foreign traders. Skilled management of these groups is evident in the symbiotic relations that pervaded the era. Observing the shift of power in capital accumulation that trading caused, the Crown sought to increase its tax and trading revenue.²⁷⁸ Any ambiguity with erstwhile advocacy of Regal frugality was easily accommodated with the same dualistic tolerance which the Ayutthaya Kingdom had demonstrated in its expansion; a factor absent in the Pagan Kingdom which crumbled from unmanageable cultural diversity. This Thai characteristic²⁷⁹ may be inherited from the Mon or even owe something to Persian influence in religious, fiscal, and moral matters in the court.²⁸⁰

Chinese influence is mentioned less in European accounts of Ayutthaya. With major concentrations in Batavia, Manila, and Ayutthaya at the time, Chinese maintained access to markets, trade routes, and supplies. In the case of Ayutthaya they became the deputised traders of the Crown. Such influence was to become evident in the resurrection of the Thai Kingdom at Thonburi under the leadership of Taksin, the son of a Chinese trader from Chaozhou.²⁸¹ King Taksin rectified gross labour shortages by importing poor Chinese males. Thus the early Bangkok period, beginning in Thonburi, differed from the Ayutthaya period in the expanded role of the Chinese, which influenced agriculture markedly through contact between Thai and Chinese small-holder farmers, notwithstanding the primary role of Chinese small-holders in providing labour for Crown projects. With 6,000 to 8,000 Chinese immigrants each year about half of whom stayed, orchards, agro-processing, and livestock enterprises, among other aspects of agriculture advanced considerably.

By 1890, European observers were outspoken about the unrealised potential of Thailand compared to Burma due to lack of investment in agriculture and transportation infrastructure.²⁸² However, administration of the taxable small-holder farmer was a continuing concern of the Crown, and infrastructure development had to suit this primary revenue raising orientation to gain priority.

Administering the Small-holders

The administrative system of Ayutthaya began with a more autocratic approach than is claimed for the Sukhothai State. Chiefs of province became hereditary lords who were required to swear allegiance to the King twice each year,²⁸³ and to expand the taxation net of the Crown as small-holders, given relative freedom to open new lands to agriculture, created surpluses. However, tax collection was only effective in accessible areas around the capital. Later in the 1890s, Bangkok completed the tax and registration system by using local headmen as agents, as part of a program that also included

²⁷⁸ Tingsabadh, Charit. (1989)

²⁷⁹ Taylor, K.W. (1992)

²⁸⁰ Wyatt, D.K. (1974)

²⁸¹ Andaya, B.W. (1992)

²⁸² Gordon, R. (1891)

²⁸³ Donner, W. (1978)

introduction of a standard central Thai language across the country, and uniform religious activities.²⁸⁴

Land ownership was vested in the Ayutthaya Crown with usage rights granted on the basis of near continual cultivation. Abandoned plots reverted to the Crown in an uncontested system until land gained value with the expanding trading market. Small-holders in the areas surrounding the capital were required to pay tax at about 10 percent of their rice crop to feed the royal household, while those in the provinces were taxed to create supplies for military campaigns. Labour contributions of up to six months per year was also required for royal projects; war captives used to supplement labour received no access to land or social advancement. While labour was deployed to extract forest products for export, the Crown preferred taxation in kind through provincial Lords to whom King judiciously dispensed honours and military spoils. Agriculture was the preserve of the small-holder.

The hierarchical system *sakdina* linked ‘power over fields’ to status, although land was not the limiting input, rankings simply institutionalised the King as the principle controller of labour, the most valuable resource. From such an administrative orientation, the Ministry of Interior was created to oversee Palace administration, agriculture, the capital, and treasury functions. Meanwhile, in the northern Lanna Kingdom, a similar revenue system had evolved,²⁸⁵ perhaps predating and providing a model for Ayutthaya legislators,²⁸⁶ as a convenient means of apportioning revenue collections, and assessing the relative strengths and tributary obligations of principalities.

Building on this administrative system in the Bangkok period favoured taxation over investment in agricultural infrastructure. Excluding irrigation, which was supported in a piecemeal manner, new agricultural technologies were to await the emergence of a generation of more internationally aware Thai in the early 1900s. Agriculture in neighbouring countries at this time was already benefiting from such inputs through colonial governments. Such observations fuel the view that the Thai State has seldom been the source of technological innovation.²⁸⁷ Nevertheless, the faster growth of the Burmese economy for example, proved to be unstable politically while the gradual pace of development of Thailand appears to have provided longer term benefits.²⁸⁸ By contrast, the hierarchical system of rights, while creating a security of place in society, proved to be the foundation of inequities which were exacerbated through the period of modernisation of Rama V.²⁸⁹

An earlier influx of Tai from Lao, added the Northeast to areas largely beyond the governance of the Ayutthaya administrative system. Local rulers acted as agents of the King, as in outlying areas of the Central Plain, while in the North and South, tributary

²⁸⁴ Phongpaichit, Pasuk. and Baker, C. (1998)

²⁸⁵ Wyatt, D.K. (1984)

²⁸⁶ Wyatt, D.K. (1984)

²⁸⁷ Brown, I. (1988)

²⁸⁸ Johnston, D.B. (1975)

²⁸⁹ Wyatt, D.K. (1984)

arrangements remained largely symbolic as Ayutthaya failed to extend its influence. The taxation orientation of the Crown, combined with limited direct control suggests that the purveyors of new ideas in Thai agriculture were traders in the new crops, and small-holder initiatives. Minority groups in the Central Plain were absorbed as Thai through a process of appeasing local leaders until their demise when the standard taxation system on labour and rice was applied.²⁹⁰ So the Thai nation was slowly being formed on an agricultural base which was assumed to be capable of ever expanding international trade and taxation.

Exiting from trading in favour of taxation to raise revenue, the Crown appointed collection agents with rights to also collect their own compensation. Such rights extended across fishing, gardens, coconut oil, opium, pepper, cotton, tobacco, molasses, sugar, pork, poultry, beans, and rattan. Promotion of new crops such as sugar was closely tied to the raising of Crown monies through taxes on products, and shipping. However, large-scale plantations were prohibited in contrast to developments in colonially dominated neighbouring countries. Teak concessions were confined to specific areas. The role of foreigners in the Bangkok period was limited in much the same way as in Ayutthaya after initial freedoms, with the eventual outcome that foreign investors in agriculture preferred to allocate their resources elsewhere. The taxation net extended with the Kingdom's authority, and included exceptions on new lands in acknowledgement of small-holder risks.

Small-holders had enjoyed the right to use land without the ability to mortgage or sell it. With the introduction of a Department of Survey in 1883 and the first issuance of titles in 1890, land was expected to assume value; this proved erroneous until the value of associated infrastructure such as irrigation and roads was realised. The first land auction was held in 1912 by the Ministry of Finance,²⁹¹ reflecting policies associated with the wave of modernisation which aimed to create a powerful Monarchy and independent small-holders financially linked through a taxation system. However, by the 1930s, large-landlord and tenant relationships dominated land tenure in intensively developed areas such as the Rangsit irrigation scheme. In areas with less security over water, small-holders expressed concern over more than just the ubiquitous risk of varying rice prices. Small-holders were no longer the sustainable agriculturists of the thirteenth century; they required income, not the least to meet financial taxation obligations to the Crown.

An experimental farm at Khlong Rangsit led to the formation of a Bureau of Agricultural Science in 1923 to assess insects, fertilisers, soils, and implements; a foreshadowing of the green revolutionary changes that would later impact on Thai agriculture. Production of the agricultural journal *Kasikorn* by Prince Siddhorn in 1928 heralded a new era in governmental approaches to agriculture. The Ministry assumed a role in combating animistic associations of crop pests with spirits, and a research department was planned until budget cuts forced closure of the Bangkok Noi Fruit Farm and cessation of tobacco research in Chiang Mai. Other infrastructure supportive of agricultural reform had also been introduced in the form of farmer cooperatives, in that case in response to rising

²⁹⁰ Phongpaichit, Pasuk. and Baker, C. (1998)

²⁹¹ Thompson, V. (1967)

indebtedness.²⁹² Departments of Forestry and Lands were established in 1896 and 1901 respectively. An extensive irrigation plan drawn up by the Dutch expert van de Heide attracted attention and praise, before finally being rejected as too expansive and expensive, although much of it was subsequently implemented on a project by project basis.

The economic and social wellbeing of Thai small-holders in the nineteenth and early twentieth centuries appears to have been less than the popular view of a happy, egalitarian subsistence economy protected by the aristocracy. Rather it was probably a struggle for subsistence within a highly stratified rural populace requiring hard work and conformity with complex patterns of exchange.²⁹³ Small-holder rice production systems yielded poorly throughout the period. Notwithstanding the eulogised fertility of the Thai environment, yields had not previously been a preoccupation in the emerging subsistence economy when enforced labour was applied to extend areas under production. Entering a rice trading marketplace with a defined land rights system meant that small-holders and landlords sought to maximise returns to land rather to labour. In the period from 1860 to 1900, output per capita increased by some 10 percent, reflecting increased efficiencies in the production of traditional rice stalky varieties, and perhaps use of fertiliser.²⁹⁴ Privy Purse Bureau investment in the rice sector at this time reflects interest in the possible higher returns associated with such new technologies.

The period's conflicting objectives of national security and economic development²⁹⁵ on the one hand, and between the private sector, elite decision makers, and social objectives on the other,²⁹⁶ were to pervade Thai policy through to the 1970s. Increased administrative efficiency in agriculture from Ayutthaya times was necessary and reflected internationalisation of the Thai State. However, administrative organisation for agriculture served the Ayutthaya and Bangkok attitudinal shift from production to taxation. In common with many other countries, the separation of the small-holder farmer from the Crown was a by-product of the nation's first steps to becoming part of an international world. In this scenario, Crown investment in infrastructure was oriented to enhancing taxation revenues or national security.

State Irrigation Development

Wet rice cultivation had, until the expansion into the delta, been restricted to those areas naturally suited to water retention and recession, and areas made thus by supplementary irrigation. The delta required drainage works before it could be reliable for rice production because the wet season caused these low lying flood plains to become lakes and seas. Canal building technology lent itself to the task, with Ayutthaya's construction expertise from communication canals providing a by-product of drainage and communication to remote lands for new rice fields adjacent to canals. By the 1850s canal

²⁹² Thompson, V. (1967)

²⁹³ Bowie, K. A. (1992)

²⁹⁴ Phongpaichit, Pasuk. and Baker, C. (1998)

²⁹⁵ Feeny, D. (1983)

²⁹⁶ Feeny, D. (1979)

developers, frequently nobles, were assuming usage rights over such lands and reallocating them to their wider families, thereby perpetuating an aristocratic control over a critical economic resource.

Floods had rendered rice production tenuous prior to the Bangkok drainage innovations. Rice shortages occurred following major floods, such as those of 1785 and 1831.²⁹⁷ These shortages were not the result of rice export policies as rice storage was legislated and the extent of rice cultivation, even at that time, would have been much less without the stimulus of the rice export market. After the 1831 flood, a stone pillar was erected at Ayutthaya to measure water levels, and has indicated that subsequent floods have not been as severe despite their major impacts; a flood in 1917 destroyed more than 450,000 hectare of rice, equivalent to 21 percent of the crop.²⁹⁸ Subsequent floods may have reached lower peaks but with rising population and rice production intensity, the damage caused continued to rise through the twentieth century. That floods and their associated risks and costs were tolerated in a country dependant on rice exports even beyond the period when abatement technologies were being applied widely throughout the world, highlights the extent to which investment in agriculture had been allocated a low State priority.

The postponement of major irrigation and drainage works in Thailand limited overall development.²⁹⁹ Advice that water control works were critical was overshadowed by other priorities. Ayutthayan water technologies had been a simple extension of those practiced elsewhere in earlier centuries with small-scale embankments and canal works and storages added to suit isolated aquatic environment of the flood plain. In the nineteenth century, trunk canals from the Suphanburi River were constructed and the new Ministry of Agriculture dredged the Khanomehin canal. Such works opened new areas and enhanced communication while, in some cases, impeding drainage from other low lying areas.³⁰⁰

The Rangsit Project of the 1890s was designed to expand rice production in the depression areas near Bangkok. The first comprehensive irrigation scheme, it included 1,600 kilometres of waterways and large mechanised dam gates to control water flows (Figure 5.1). A monopoly was granted to a Thai and Italian group registered as the Siam Land, Canals, and Irrigation Company to develop, use and sell the agricultural land created by the scheme.³⁰¹ By 1900, the government rescinded the monopoly that was in fact determining settlement patterns around the capital. Prior to this scheme smaller versions had shown the power of tradeable land rights created by such developments, thereby stimulating legislation enabling the Crown to oversee all such developments. By beginning with a private monopoly, it is unsurprising that the problems of those recent

²⁹⁷ Thompson, V. (1967)

²⁹⁸ van Beek, S. (1995)

²⁹⁹ Ingram, J.C. (1971)

³⁰⁰ van der Heide, J.H. (1903)

³⁰¹ van Beek, S. (1995)

decades would persist, even if the Privy Purse Bureau was a significant investor in the Company.³⁰²

Figure 5.1 Overview of the Rangsit Irrigation Project of the 1890s³⁰³

The formation of the Royal Irrigation Department in 1903, under the name of the Department of *Khlong*, reflected the primary function of canals in its charter to maintain inland water ways for transportation, and to also plan irrigation projects. To this department came the Dutch expert, van der Heide who conceived the comprehensive barrage system for the Chaophraya River. Rejected officially due to its cost, it may have represented an excessive emphasis on agriculture when the Crown preferred modernisation of transport away from water to rail in order to widen access across the country. Droughts in 1911 and 1914 stimulated a review of the irrigation proposal for Chainat which, while affirming its viability, led to no action. The Department changed its name to the Water Diversion (*Thod Nam*) Department and in 1927 changed again to its present name, the Royal Irrigation Department.³⁰⁴ An indication the low investment priority accorded agriculture is the Ministry of Agriculture's primary focus not on technical or economic matters, but ceremonial tasks, such as enactment of a Brahmin the Ploughing Ceremony.³⁰⁵

Van der Heide presented three plans over the more than six years that he worked on irrigation designs for Thailand, the latter two being scalings down of his initial comprehensive plan. None were accepted at any stage, with the most consistent reason given being the lack of population to utilise the new agricultural lands that the scheme would create.³⁰⁶ Following floods in 1912 and 1913, the Minister of Agriculture appointed a British adviser who accommodated criticisms and strengths of the van der Heide scheme to produce an acceptable plan that was partially implemented. Opponents to further irrigation schemes continued, notwithstanding the banning of food exports in response to the 1918 floods and the 1919 drought. Rejecting expansion of rice area and security of production when it was the primary source of critical foreign exchange to modernise the country, in a period of rising global financial uncertainty, suggests significant ideological discrepancies within government in the first quarter of the twentieth century.³⁰⁷

Ayutthaya began with a reliance on captured labour and evolved to a system of taxation of trade without major investment in the sector producing the taxed wealth.³⁰⁸ By the early Bangkok period, Chinese labour proved a more valuable resource for Crown schemes such as canals than the outmoded corvee system.³⁰⁹ Thus Thailand emerged as a

³⁰² Phongpaichit, Pasuk. and Baker, C. (1998)

³⁰³ van Beek, S. (1995)

³⁰⁴ Arbhabhirama, A. et al (1987)

³⁰⁵ Thompson, V. (1967)

³⁰⁶ Brown, I. (1988)

³⁰⁷ Phongpaichit, Pasuk. and Baker, C. (1998)

³⁰⁸ Chakrabongse, Chula. (1967)

³⁰⁹ Phongpaichit, Pasuk. and Baker, C. (1998)

country espousing modernisation while harbouring fantastic views of its global economic role and the quality of life of its small-holders. By the dawn of the twentieth century, the country had built only two dams; one in the thirteenth century west of Sukhothai, and another in the seventeenth century near Phra Buddhabaht, Lopburi.³¹⁰ Traders and business were determining the agricultural scene of Thailand more than the State.

Traders and Early Agribusiness

As foreign contact rose, demand for forest products and rice expanded and eventually led to the introduction of cash cropping and associated processing and marketing. Services for agriculture developed by foreigners willingly filled local voids in the agribusiness sector, including credit, transportation of produce, establishment of mills and storage facilities, and forward contracting. The Crown sought to balance external forces and to raise revenue from taxes on these entrepreneurs, while continuing to tax small-holders through rice prices. As the Chinese moved to dominate domestic fields of agribusiness such as credit and consolidating goods for export, Europeans moved to dominate the full chain of non-rice processed agricultural products. Success attracted the concern of the Crown, but periodic policy reversals generally failed to attract the full benefits sought, as the technology, markets, and expertise essential to this new era of agribusiness relied on foreign inputs.

In political terms, the era began with the Lanna Kingdom surpassing the strength of Ayutthaya, and the less developed Lang Xang Kingdom identifying more with Lanna than Ayutthaya.³¹¹ Ayutthaya rose over Lanna after it had been vassalised by Burma, although the trading advantages offered by the Ayutthaya site may well have led to the same end without the Burmese intervention. The economic strength of the sea port with its own rice production capability, and a penchant to integrate with foreign cultures, produced a Kingdom that could easily dominate the smaller river valley States of the north. Through periods of turmoil for the Thai Crown, internal coherence was maintained by withdrawing from international commerce and reasserting bureaucratic control over agriculture.³¹²

Regional trade continued throughout the period in the form of valuable forest products including animal parts, herbs, barks, hides, resins, timber, thatch, spices, and ritual items. Control of trade in these products as well as a secure domestic supply of rice determined economic power. Trade routes linked Chiang Mai, Luang Prabang, and Kengtung to coastal trade through major centres at Vientiane, Sukhothai, and Ayutthaya, thereby providing Ayutthaya with the major market force for much of the hinterland. By the beginning of the Bangkok period (1782), hinterland trade was waning in importance as the influence of sedentary agriculture across the delta impacted. However, the trade was later revived under Bangkok control with markets in China, which in turn encouraged a new influx of Chinese as traders.³¹³

³¹⁰ van Beek, S. (1995)

³¹¹ Taylor, K.W. (1992)

³¹² Reid, A. (1992)

³¹³ Phongpaichit, Pasuk. and Baker, C. (1998)

Forest product exports to China dominated trade until the market collapsed in the 1840s in response to the Chinese opium wars. The growing trade with European ships seeking sugar, pepper, tobacco, and rice for colonies whose economies had shifted from food to cash crop production replaced the China market in significance. The Chinese in Bangkok seeking other means of economic survival, found niches in money lending for crop expansion and in taking the risk of accumulating product for transport to market from remote regions. Chinese migrants also were brought to meet the growing demand for wage labour and expertise in these exportable food crops.

By 1850, exports were estimated to total some 4.3 million baht against imports of 5.6 million baht. Major export items were; sugar; hides, horns and skins; raw cotton, sapan wood, sticklac, tin, fish, cotton products, iron, birds' nests, rice, lard and fat, cardamom, dried meat, oil, tobacco, agilawood, pepper, ivory, and gamboge.³¹⁴ Before the cost of sea transport fell with new European ship technology, high value per weight items were the major income earners. Rice was primarily a regionally traded commodity with Ayutthaya being the major, and in terms of quality, preferred supplier to the major trading centre of Malacca,³¹⁵ and considered at the time to be second in production capacity only to Bengal.³¹⁶ Annual rice exports at this time were of the order of 15,000 tonnes having risen from almost nothing 50 years earlier, and were similar to the levels exported three centuries earlier from Ayutthaya. Exports continued to rise through to 1935. With a decline in receipts from many products in the 1860s as colonies of wealthier countries competed for a slower rising demand, rice and teak became Thailand's main agricultural exports, to which rubber was later added.³¹⁷ Rice once more proved itself the centre of the Thai economy, to the extent that pressure on rice producers to increase exportable surpluses may have even caused periodic reductions in local consumption levels.³¹⁸

With the final domination of the northern Kingdom in the 1880s, the rail link to Chiang Mai from Bangkok was completed in 1921, and rice exports increased markedly as the North contributing nine percent of exports. Agribusiness boomed through rice mill investment and expansion of middlemen credit and crop consolidation services while in the central plain, Chinese rice businesses had built up enormous commercial power.

The first steam-powered rice mill in mainland Southeast Asia was an American built machine erected in Bangkok in 1858. It was followed by British versions installed in Rangoon and Bangkok in 1869 and 1870,³¹⁹ and by 1900 there were some 50 rice mills and 20 sawmills in Bangkok, mainly associated with the port and Chinese labour.³²⁰ Rice

³¹⁴ Ingram, J.C. (1971)

³¹⁵ Wyatt, D.K. (1984)

³¹⁶ Cruford, J. (1828)

³¹⁷ Terwiel, B.J. (1991)

³¹⁸ Ingram, J.C. (1971)

³¹⁹ Owen, N.G. (1971)

³²⁰ Phongpaichit, Pasuk. and Baker, C. (1998)

exports as a proportion of total production varied through the period 1907 to 1935 from 39 percent in post war five year period to 50 percent in 1907 and 1935.³²¹

Other primary exports, mainly teak, rubber, and tin, were important in terms of value but relatively less important in socio-economic terms than rice. Rubber grew from its small beginnings in the 1920s to 13 percent of exports by 1935. Teak varied in contribution according to official figures, providing between six and 18 percent of exports over the period 1867 to 1935 with a low in 1903 and a high in 1935; however, such figures omit teak floated down the Salween River into Burma, and the Mekong into Indochina. Three overwhelming characteristics of Thai exports at this time were:

- primary commodities were exported without value-added processing
- exports relied on a narrow base of four major commodities; rice, teak, rubber, and tin
- trade of rice, and the overall conduct of the other three major export industries, were largely in the hands of foreigners.³²²

With the exception of rice, these were new industries for Thailand. Domestic industries such as textiles had suffered a slow demise under pressure from Chinese and other imports since the seventeenth century, despite small exports of silk and cotton cloth from the North and Northeast.³²³ Processes were simple and slow and yields were low, and imported cloth appealed more for its colours and versatility, if not durability.

The Thai sugar industry, on the other hand, was a direct product of the Bowring Treaty, which had emphasised the potential for the crop. Attracted by the natural advantages of Thailand's environment, foreign investment stimulated an industry that in 1859 exported some 204,000 piculs. Steam-powered mills were built through the 1860s and investors negotiated large tracts of adjacent lands for plantations. Some government reductions in duties also favoured the industry, but these factors were insufficient to halt the industry's demise with a 60 percent fall in world sugar prices, and an overall higher tax regime than those of competing colonial countries, particularly the Philippines and Java. By the 1880s, exports of sugar were negligible and sugar lands had been converted to rice which was experiencing a rising market price. A revival of sugar in 1921 led to outputs of about half the 1859 peak and the industry continued with government support, never meeting domestic demand. Traditional sugars from palmyra and coconut, and crude cane sugar industries continued on a small scale throughout.³²⁴

The Chinese had proven innovative in providing essential service in trade and government, obtaining monopolies and engaging in barter arrangements which placed them in a better position than the colonially oriented Europeans. In particular, tax collection agencies provided Chinese with not only income, but contact with the production base of the country and control over local trade. Provision of both credit to produce a crop, and acting as the purchaser, gave power to Chinese middlemen who accepted the lack of small-holder security over land. In and around Bangkok, the Chinese population exceeded 10 percent of the total and dominated retail and rice trading,

³²¹ Ingram, J.C. (1971)

³²² Ingram, J.C. (1971)

³²³ Bowring, J. (1857)

³²⁴ Ingram, J.C. (1971)

and became an essential resource in plantations, market gardens, mining, and the urban workforce.³²⁵ Denounced by the King in 1915, the Chinese again adapted to the environment becoming Thai in the process.³²⁶

Agribusiness made its entry to Thailand through trading, processing, and vertically integrated industries, and was always associated with or controlled by foreigners. Through the period to 1932, major European firms such as the Borneo Company, Windsor Redlich, Markwald, Arracan, and Franklin Blake thrived in the Thai economy. Chinese agribusiness captains dominated rice processing and trading until the 1920s when the major players failed in an attempt to regulate trade and prices, and became post-war and depression casualties. By the 1930s, a new type of Chinese family company emerged to dominate the rice trade in the form the Thai-integrated grandchildren of mid nineteenth century immigrants, as distinct from the old tax collector, middleman, and merchant fortunes. These groups were and are known by the family names of; Wanglee, Lamsam, Bulasuk, Bulakun (later Mahboonkrong), Iamsuri, Setthapakdi, and Bunyarak.³²⁷ Such European and Chinese groups came to dominate the export economy and influence development of the country through schemes like the Rangsit Project, the introduction of new industries, and in providing the base for the Crown's own tax collection. The openness of the mainly agriculturally based Thai economy to foreigners was essential, unique and related to the country's political, but not economic, independence.

Summary

Key points pertinent to Thai agriculture that may be elicited from the period from Ayutthaya to 1932 Bangkok include:

- Notwithstanding floods and droughts, and an association between rice agriculture and the security, development of a Thai State isolated small-holders from the Crown's primary focus on war, labour, and later, trade, and gradually relegated rice to an exportable and taxable commodity to fuel expansion of the State.
- Small-holder agriculture expanded under market forces and relaxed labour laws and produced a shift from returns to labour towards returns to land area, with environmental costs, as land assumed a value around the turn of the century.
- The Chinese and European domination of the narrow export base of raw agricultural commodities led to agribusiness development being left to foreigners with minimal State interest in technology transfer, and to an environmental exploitation ethic which encouraged small-holder opening of new agricultural lands for rice and widespread harvesting of timber.

³²⁵ Trocki, C.A. (1992)

³²⁶ Vella, W.F. (1978)

³²⁷ Phongpaichit, Pasuk. and Baker, C. (1998)

Chapter 6

Agriculture and Politics: From the 1930s

Agriculture and rural development had long ceased to be central to policy before the new modern views and a constitutional monarchy of the 1932 revolution arrived. This may seem unlikely, considering reliance on agricultural exports and expansion of small-holders throughout the Kingdom. However, reliance on a dualistic policy of foreigners marketing rice and producing, processing, and marketing other cash crops, while using taxation as the principle means of funding State development and repaying debt, required no long-term vision for agriculture; experience had taught that surpluses could be reliably expected from minimal State investment. The policy made the Kingdom easy to manage economically while stability and expansion of Bangkok influence was a primary focus, provided markets remained strong and foreign investors favoured the country.

Agricultural Policies from 1932

Post-World War I price reductions for agricultural commodities had exacerbated the effect of inappropriate exchange rate policies until an adjustment in 1923 allowed an improvement in exports. The essential lesson for an agricultural commodity exporting country that prices should reflect global trends had been offered to Thailand, although it would need to be offered several times subsequently. Later for example, World War II introduced further policy challenges when imports were restricted and production incentives introduced. Incentives included a 39 times increase in the price of sugar over the 1937-1940 average, and a 29 times increase in grey cotton yarn; such policies increased inflation much more than production.³²⁸

The role of the small-holder farmer was little appreciated, notwithstanding the crusade of Prince Sithiporn Kridakara and his journal *Kasikorn* from 1927, and his emphasis of the need for policies which encouraged agricultural research and a wider understanding of the unique role of agriculture in Thai society. Part of an increasingly vocal intelligencia, such voices were subsumed in the constitutional change precipitated by the confluence of wider interests, and the 1930s depression.

The 1932 reaction to financial crisis was a reduction in civil service positions and a token, against the 60 percent reduction in their cash incomes, 20 percent reduction in land tax for small-holders; mercantile and noble classes remained lightly taxed. Small-holders left exposed to the depression reverted to self-sufficient farming. Still liable to pay tax, some rice destined for home consumption was sold at the prevailing low prices. No peasant rebellion resulted, probably because provincial leaders had been tied to the central administrative system, and no alternative leadership structure had arisen. Nevertheless, thousands of small-holders petitioned the King for aid.³²⁹

³²⁸ Ingram, J.C. (1971)

³²⁹ Wyatt, D.K. (1984)

Politics remained the preserve of a small elite ruling and development policies were funded by taxing a subsistence rice economy which was shifting to market production. Peasant politics thus remained unformed until the 1960s, when tenancy issues in the poor Northeast encouraged expansion of the long established yet small Communist Party.³³⁰ Thus, only in the 1960s did the economic plans espoused in the rhetoric of new 1930s³³¹ constitution begin to be implemented. For example, attempts at land resource laws through the 1930s, 1940s, and 1950s that included survey, registration, titles issuance, allocation systems, and State lands management all suffered under benign civil service inactivity until the introduction of the First National Economic Development Plan in 1961. That Plan included a land allocation policy which acknowledged for the first time, the issue of landless farmers.³³²

Notwithstanding this slow rate of change, the 1932 revolution highlighted unfair trading arrangements embodied in import substitution and other policies. In particular, the period fostered a platform for concern documented in the Pridi (Bhanomyong) Plan which used the plight of the rural poor to propose a socialist solution to the problems of landlessness, poor prices, middlemen, and poor State welfare.³³³ With Government ownership of lands, he proposed that peasants become State employees receiving fair wages derived from open trading of product. Quashed by the aristocracy, the draft legislation of the Pridi Plan was exiled with Pridi. Revisions of foreign trade agreements, replacement of foreign with domestic entrepreneurs, and ensuring a sacrosanct role for the expanding bureaucracy, each produced forces against the Pridi Plan.³³⁴ A revised plan omitting contentious land ownership aspects, while retaining the essence of government infrastructure and support services, reflected the intent if not action of the decade.

The thirty years from the 1930s may be seen as slow preparation for adoption for more foreign ideas; in fact foreign education of a generation of new leaders through the period ensured this direction. Links across the period are evident for example, in the first systematic study of Thai soils, the Pendleton Provisional Map of 1935, being updated from the mid 1960's³³⁵ when Thai expertise assumed much of the task.

Policies Post-World War II

The clearest indication of agricultural policy objectives of the period are reflected in the roles allocated to agricultural agencies prior to the 1953 establishment of a modern Ministry of Agriculture. These roles were:

- to improve Thailand's competitive position relative to other rice production countries through increased production and system efficiencies
- to introduce multiple cropping with rice and other new crops
- to promote livestock production

³³⁰ Cheong, Yong Mun. (1992)

³³¹ Vella, W.E. (1955)

³³² Arbhabhirama, Anat. et al (1987)

³³³ Landon, K.P. (1939)

³³⁴ Phongpaichit, Pasuk. and Baker, C. (1997)

³³⁵ FAO (1972)

These objectives have remained relatively consistent over a period of 50 years,³³⁶ with limited effect. By 1992, rice mono-cropping was still the norm for nearly half of farmers, crop diversification within individual farms was unusual,³³⁷ and livestock other than those controlled by multinational contract farming systems languished as draft animals were assumed by many to be an inevitable casualty of agricultural modernisation.

The lot of the small-holder farmer was to change again as powerful commercial forces transformed rice marketing arrangements and government shifted its own role. Government no longer sought to regulate merchant exploitation of small-holders, instead it consorted with merchants to enhance expansion of the rice production economy. Small-holders were to become commercial farmers or wage labourers. Rice plantings rose by some 68 percent from the 1950s to the 1980s as a result of this approach, with expansion including the now populous, yet agriculturally less productive, Northeast.³³⁸ This period introduced a new philosophy of development which assumed that the adoption of Western models would lead to economic development.³³⁹ Under this rubric, Thailand progressively demoted agriculture in favour of industrial development, on a basis which was essentially similar to nations with less, or even limited, agricultural potential.

Policies of the period since World War II built on controlled inflation and enhanced agricultural exports. However, the absence of a mechanism to share foreign exchange income with producers was effectively a tax on producers, as was regulation of domestic rice prices to offset some post-war adjustment among the urban classes. Promotion of rice expansion inadvertently led to forest destruction as new lands were opened faster than ever before through the 1960s and 1970s. In the Central Plain, rice began to benefit from pieces of the van der Heide master irrigation scheme implemented through the 1950s with the arrival of green revolution varieties and practices.³⁴⁰ Roads, built by government, facilitated sale of produce which stimulated further expansion of cropping, particularly maize, kenaf, and cassava. Subsidised by government, commercial sugar investors expanded. Rubber planting expanded in the South. Through this important period of expansion, agriculture was critical in two ways:

- agricultural growth created the overall growth of Thai economy
- agriculture absorbed most of the rapid rise in population as a *de facto* welfare program.

Through the 1970s, higher food prices than earlier decades spurred further expansion of agricultural lands, leading to Northeast cassava production doubling each four years and rice plantings outstripping irrigation capacity. However, other agricultural exporting countries also increased production and thus price competition. Remaining forested lands in Thailand were less suited to agriculture than those already opened. When global prices fell in the 1980s, the effect was passed to producers with minor reduction in taxes. Thus

³³⁶ Poapongsakorn, Nipon. et al (1995)

³³⁷ Siamwalla, Ammar. et al (1992)

³³⁸ Phongpaichit, Pasuk. and Baker, C. (1997)

³³⁹ Yunthavong, Yongyuth. and Wojcik, M. (1997)

³⁴⁰ Siamwalla, Ammar. (1996)

occurred the first increase in the incidence of rural poverty since statistics were first collected. An unexpected boom from 1986 occurred when oil prices fell and a favourable change in exchange rates produced growth rates above ten percent year on year. Promotion of manufactured goods led many to assume that the engine of the economy had shifted from agriculture.

Industrial growth was almost exclusively urban and peri-urban, even when agricultural prices were low and rural hardship widespread. Agricultural productivity was stagnant, probably because larger infrastructure investments, particularly in irrigation were not pursued, and smaller replacement schemes were of variable benefit. Conspicuous wealth in the city and increasing hardship in rural areas caused migration of labour to the city. Throughout the four decades including the 1980s, new technology was introduced in the time honoured way of adopting, and sometimes adapting foreign innovations, with the Thai education system playing a facilitating role. Agricultural research and education continued to fail to reflect the role of agriculture in the overall economy,³⁴¹ which effectively continued to be the funder of growth and social support.

Agro-Social Change

The abundance of new land for agricultural expansion was a hallmark of Thai agriculture in contrast to many countries. It explained the historic export capabilities of the Kingdom extending into the present day, despite a large increase in the population. The social atmosphere prior to the expansionary period of the 1950s was cohesive, compared to later land tenure and indebtedness issues. Population increase may have even provided a period when labour for agriculture was oversupplied, an historically rare occurrence, and soon overshadowed by the demands of forest clearing to open new lands.³⁴² The attitudes of the small-holder agriculturists once shaped by an ability to feed their families, opportunities to improve their lot, and minimal external interference, were to change. While family food availability was threatened in only a minority of cases, from the 1960s, opportunities for economic and social improvement were often negated by both indebtedness and external interference.

The costs of technological change over next three to four decades to 2000 affected the culture of the small-holder agriculturist. Owning one's farm became expensive. Participation in the international agricultural economy introduced social costs; for example, improved rice seeds are now offered as two or three varieties where farmers used to maintain a suite of thirty or more varieties to cover differing seasons,³⁴³ microenvironments, and tastes. The rationale that higher yielding varieties were introduced with a package of improved irrigation and fertiliser regimes which limit seasonal and micro-environment variations, introduced other risks, both environmental and social in terms of foreign ownership of seeds, for example. The aspects are discussed further in later chapters.

³⁴¹ Siamwalla, Ammar. (1996)

³⁴² Donner, W. (1978)

³⁴³ Moerman, M. and Miller, P. (1989)

Higher inputs modified the environment in a manner yet to be understood. Certainly, lifestyle elements, including diverse foods such as crabs and fish in paddy fields, have changed from these agronomic advances. Changes have also been introduced in terms of reduced livestock numbers and changed functions for working animals. Ownership of large ruminants is now likely to be concentrated in a few persons compared to each family seeking to own at least one draft animal; tractor tillage introduced further demands on the cash needs of farming. Economic progress measured by crop outputs have neglected the roles of large livestock as banks, companions, status accoutrements, and accepted cultural currency for traditions which date back centuries, and the poorly understood yet emotive benefits attributed to biodiversity. Against such drawbacks, Thailand consolidated its presence as one of the world's major agricultural exporters.

With the State's hope of introducing widespread commercial farming came a final successful assault on land rights. Financed by the World Bank and founded on the assumption that small-holders would act more commercially if they had a tradeable land title, certificates of ownership and occupancy were issued covering 20 million rai (3.2 million hectare) in the Central Plain by the late 1970s. Improved irrigation facilities, fertiliser regimes, and rice varieties now allowed the growing of two or three crops per year across much of the Central Plain. By 1990, 22 percent of the Central Plain was double cropped, and across the whole Kingdom some eight percent, compared to virtually none in 1960.³⁴⁴ Encouraged to participate in the credit-based green revolution, small-holders were placed in the invidious position of risking their very security of production, the family plot. Indebtedness caused the sale of 20 percent of Central Plains farms by 1969, mainly those under 15 rai (2.4 hectare) in area, thereby creating a new tenant class of agriculturist.³⁴⁵

Tenancy arrangements were tempered by share cropping agreements, although the rising proportion of tenants increased the bargaining power of landlords. From tenant to landless was a simple step as wage labouring in agriculture grew from the 1950s leading to probably around 20 percent of families in rural areas relying totally on wage labour.³⁴⁶ Of perhaps similar importance to rural culture was the growth in off-farm employment to supplement inadequate incomes from agriculture; Thai farmers had joined the new world agriculture where the majority of farmers earn a substantial proportion of their income off-farm, although without the lifestyle connotations common to developed countries. The huge social change introduced an ongoing association between rural dwellers and poverty, which was expressed in terms of disparities in income, information access, education, health care, and associated accoutrements of the culture which the modernisation ethic promised.

The proportion of persons living below the poverty line was estimated at 61 percent in rural areas, and 38 percent in urban areas in 1963; 60 percent of poor villages were in the Northeast. At this time, new commercial approaches to agriculture were lauded for their output efficiency. Wage labouring was highly seasonal and minimum pay rates were

³⁴⁴ Phongpaichit, Pasuk. and Baker, C. (1997)

³⁴⁵ MOAC (1969)

³⁴⁶ Phongpaichit, Pasuk. and Baker, C. (1997)

officially were below those of urban areas. The migration of rural workers, particularly from the Northeast, to urban work sites reflect cultural change including the demise of off-season activities of the past, such as crafts and the manufacture of utilitarian items which were replaced by cheap factory-made alternatives.³⁴⁷

The culture of the rural Thailand approximated the romantic national image. While values of co-existence with all life, self-sufficiency, and hospitality are easily ascribed to most non-urban groups, Thai origins were probably more broadly represented in the rural than the urban areas. The absorption of such ethnic groups as the Phu Thai, Lao Phuan, and Lao So, whose lifestyle was far closer to that of the Tai and Thai of past eras, as new areas of the Central Plain were opened provided recent reminders. However, the gap between the rural and city cultures was already wider than realised when the government sought to integrate rural and urban areas in the 1960s.³⁴⁸ It was not until economic adjustments of the 1990s that interest in traditional rural values and the inequities of unchallenged imported philosophies were to gain currency.

As the uplands were developed for cash crops in response to three decades of high commodities prices and the access provided by roads built with assistance from the USA, agricultural research was broadened to include new crops, with some spectacular successes such as a new maize variety, Suwan.³⁴⁹ The expansion of upland agriculture was faster and on a grander scale than the previous expansion of wet rice across the whole delta; from 1950 to 1990, the area of upland crops rose from 43 to 130 million rai (seven to 1.6 million hectare). Initially rice was the cash crop, then kenaf expanded for production of rice sacks when the jute crops in Bangladesh failed. Maize area expanded from 0.25 to nine million rai (0.04 to 1.4 million hectare) between 1950 and 1980 while sugar, assisted by government banning of imports, increased to some five million rai (0.8 million hectare) by 1990. Cassava dominated upland cropping systems when kenaf demand waned, and enjoyed strong demand for European stock feed; from 0.8 million rai (0.1 million hectare) in the mid 1960s, cassava expanded to cover eight million rai (1.3 million hectare) by the late 1970s. Pineapples in peninsula Thailand expanded into an export industry from the late 1960s, eventually making Thailand was the largest exporter of canned pineapple. With these and other products, including soya beans, cotton, oilseeds, mung beans, sorghum, tobacco, rubber, fish and prawn farms, and commercial forests,³⁵⁰ Thai agriculture appeared to be diversified at last by the 1980s. However, frontier areas remained in the North.

Highland Agriculture

Expanding Thai agriculturists in the North eventually met hill tribe ethnic groups yet to assimilated into the Thai culture. Some integration resulted but most cultures and agricultural practices remained separated by altitude.³⁵¹ At lower altitudes, spring-fed

³⁴⁷ Phongpaichit, Pasuk. and Baker, C. (1997)

³⁴⁸ Hewison, K. J. (1993)

³⁴⁹ Tribe, D.E. (1994)

³⁵⁰ Phongpaichit, Pasuk. and Baker, C. (1997)

³⁵¹ Hirsch, P. (1990)

wet rice agriculture of the Karen and Lua ethnic groups³⁵² adopted techniques from Thai neighbours. However, Thai knowledge of the highlands remained patchy in terms of the integrity of forests in shifting agricultural systems.³⁵³ In itself this confirms the wet rice orientation of the Thai; land expansion reduced in the 1980s, not because no further land was available as is commonly claimed, but because the more labour intensive agriculture of highland areas was unappealing. Certainly elsewhere in Asia, inferior land had long been farmed. A greater onslaught into the highlands might have resulted if the population had continued to rise at the rate of earlier decades; however, Thailand proved to be a model case for effective population control.

Highland agriculture changed markedly from the 1980s through roads and government services. Consumer items were introduced and subsistence gave way to the growing of wet rice in tiny valley floors to provide a small surplus until alternative crops were proven.³⁵⁴ Policies which aimed at reducing silting in lowland dams, securing border regions and demonstrating global citizenship perpetuated uninformed views of shifting agriculture which have recently revised to:

- while being widespread across the tropics, it varies and is in fact a group of several distinct approaches to agriculture³⁵⁵
- being a system in itself rather than a development stage between primitive agriculture and a surplus oriented system
- being environmentally sensitive and sustainable when practised as a complete system, unimpeded by external or population pressure
- being technologically as sophisticated as other systems of tropical agriculture
- being practiced by groups historically indistinguishable from their mono-cropping compatriots except in recent times when access to trade through foreign contact has spread a western view of development.³⁵⁶

In fact, two years of planting in a ten year cycle³⁵⁷ with fixed rotations and rights in a territory³⁵⁸ indicates a permanent form of agriculture which implies more attention to sustainability than modern mono-cropping systems.

The demise of shifting cultivation in Thailand appears to be by intent rather than a result of rising population. Opium, long an income earner for government and eventually monopolised under Rama IV providing more than 20 percent of revenues at times, had been outlawed and reinstated periodically,³⁵⁹ until in 1957 it was finally made illegal. This stimulated covert plantings as well as alternative crop projects sponsored in many cases by interested foreign governments.³⁶⁰ Projects met with minor successes until roads made perishable and bulky alternative crops economic, and facilitated policing,

³⁵² Kunstadter, P. et al (1978)

³⁵³ Thompson, V. (1967)

³⁵⁴ Kunstadter, P. and Kunstadter, S. (1980)

³⁵⁵ Spencer, J.E. (1966)

³⁵⁶ Rerkasem, Kanok. (1997)

³⁵⁷ Conklin, H.C. (1957)

³⁵⁸ Grandstaff, T.B. (1980)

³⁵⁹ Thompson, V. (1967)

³⁶⁰ AIDAB (1976)

albeit within a corrupted system.³⁶¹ The expansion of opium and rise of population led to uncontrolled fires, expansion of grasslands,³⁶² and large changes in highland vegetation,³⁶³ which contrary to some accounts was not almost bare in the 1940s.³⁶⁴ The lack of knowledge about sustainable agriculture in the highlands is further illustrated by late interest in native tea of the region despite its use in neighbouring Yunnan province, its ecological suitability for development,³⁶⁵ and the existence of a related industry producing a chewed fermented tea product.³⁶⁶ Viable yet neglected, highland agriculture was quite the antithesis of the growth of Thai agribusiness and government interests of the day.

Agribusiness and The State

The agribusiness of European traders investing in Thai infrastructure³⁶⁷ and processing, and in particular, entrepreneurial activities of Chinese at all levels, was checked through the 1930s depression and Thai political changes in 1932. The definite arrival of a new agribusiness sector is clear from the late 1930s when the subsistence-plus-surplus farmer was overshadowed by policy emphases on commercial chains controlled by agribusinessmen and, to an extent, State enterprises. State enterprises were created as a post-1932 mechanism to control perceived dominance of European business in the mood of Thai economic nationalism.³⁶⁸

Large rice exporting businesses of Chinese groups evolved to control the rice trade using networks of up-country Chinese and other traders to extract product from rural areas with increasing efficiency. Government condoned the approach through building of communication systems to suit the network which in turn allowed traders to consolidate their middleman role in buying and selling paddy, lending money, renting land, selling consumable items, and crop-futures trading. Relying on this system, government sought larger surpluses from agricultural areas to fund urban and industrial development through the 1950s. By this time, government had nationalised rice trading and taxed production, ostensibly to meet World War II reparation responsibilities payable as rice. The tax on producers to fund the free rice proved easy to retain after the reparation period, thereby providing windfall income from the diverging procurement and export prices. Administratively simple, the tax produced 32 percent of government revenue by 1953.³⁶⁹

Challenging European trading houses, Chinese established local production facilities for utilitarian items including; ice, bottled water, soap, cooking oil, processed foods, matches, cigarettes, animal feed, beer, textiles, and household equipment. Entrepreneurs originated among migrant Chinese who had gained knowledge, contacts and confidence

³⁶¹ McCoy, A.W. (1972)

³⁶² Falvey, L. (1981)

³⁶³ Santisuk, T. (1988)

³⁶⁴ Thompson, V. (1967)

³⁶⁵ van Roy, E. (1971)

³⁶⁶ McCarthy, J. (1902)

³⁶⁷ Owen, N.G. (1971)

³⁶⁸ Terwiel, B.J. (1991)

³⁶⁹ Phongpaichit, Pasuk. and Baker, C. (1997)

in the changing system, and who commanded strong local community support for financing, market development, and expansion. As they grew in confidence, they lobbied government in subtly acceptable ways to assist agricultural industries, with the expectation, and result, that this was nationally important. While commercial groups had been largely silent through the 1932 revolution, the result suited their purposes, as some later indicated by retrospectively loyal contributions. In rural areas, middlemen promoted development more effectively than government programs as they controlled virtually all inputs and markets for the only viable products. In the Northeast, for example, they advanced future crop receipts to settlers, allocated new lands, and supplied essential tools and inputs for cassava for which they invested in drying floors, warehouses, processing facilities, and trading networks.³⁷⁰

Roads essential to this agribusiness boom were built by government and USA military related assistance; paved roads rose from less than 1,000 kilometres in 1950 to more than 22,000 by 1980, often in association with malaria eradication programs which allowed uninhabited uplands to be brought into production. Upland cash crops highlighted the private benefit able to be captured by a few trading networks, and inevitably led to government concern about middlemen. One response was the Bank of Agriculture and Agricultural Cooperatives, created in 1966 when green revolution technologies created increased demand for credit to fund pesticides, fertilisers, and tractors and other small equipment. Commercial banks were required to allocate five percent of lending to agriculture in 1975 and 13 percent in 1979, further favouring larger producers and those with clear land titles. The profile of rice farmers changed from small owner-operators; for example, in the Central Plain by the 1980s, independent cultivators comprised about 40 percent of rice producers with lots of 15 to 40 rai (2.4 to 6.4 hectare) in a mixed commercial and subsistence system, non-farming landlords with tracts exceeding 40 rai (6.4 hectare) comprised 30 percent, and landless labour and small-holders who relied on off-farm income comprised 30 percent.³⁷¹

Chinese agribusinessmen adapted to military and government assumption of their monopolies. Creating their own processing facilities, the military promoted a benevolent Thai face of assisting rural dwellers. To assist the process, Chinese immigration was restricted, the Thai Rice Company was formed to operate rice mills to which middlemen were required to send their paddy, and distribution mechanisms such as the Thai *Niyom Panich* company were established. From this era, government-owned and run abattoirs, tobacco, sugar, cassava, and kenaf sack processing organisations came into existence forming part of the complex agribusiness tapestry of today. Pridi, after exile necessitated from his post-1932 economic plan, used his expertise in capital formation for the government to joint venture with Chinese business houses while the military pursued its economic nationalism approach. The agribusiness groups, Wanglee, Lamsam, and Bulasuk, for example, became integral to government agribusiness activities with a small and public elite being represented on the boards of major national assets.³⁷² As power shifted to the military in 1947, board memberships shifted from Chinese businessmen to

³⁷⁰ Phongpaichit, Pasuk. and Baker, C. (1997)

³⁷¹ Douglass, M. (1984)

³⁷² Phongpaichit, Pasuk. and Baker, C. (1997)

generals, although the military retained business arrangements with, and respect for, the Chinese businessmen.

Of the Chinese groups which enjoyed commercial success, the seed, fertiliser, and general agricultural input importer Charoen Pokaphan (CP) emerged as a giant. Expanding into animal feed milling in the 1960s, it joint-ventured with the USA poultry group Arbor Acres to introduce parent stock to the Thai chicken industry in the 1970s.³⁷³ By 1973 it deftly assumed slaughter and processing control from the government's monopoly, and introduced a CP-controlled contract farming system. CP supplied chicks, purchased and processed grown birds, and marketed chicken meat products. The approach was extended to pigs, and markets were extended into Asia particularly Japan, Indonesia, Singapore, Taiwan, Malaysia, and latterly China where it emerged as a force similar to the USA agribusiness giant Cargill. Diversifying into communications, transport, finance, and convenience stores among other ventures, the conglomerate maintained close connections with government line agencies and politicians.

A case study in agribusiness, CP also indicates the source Thai wealth, agriculture. Through recent economic setbacks, the group has returned to this principle generator of wealth to cover losses in other sectors. In some ways, CP as a surrogate for the evolved Chinese-Thai agribusiness groups, can be viewed as a quasi-arm of government, and certainly a critical part of Thai agriculture. However, this viewpoint highlights a need for equitable distribution of benefits across the sector, which remains a role of government rather than agribusiness.

The State and agribusiness have been linked through various mechanisms since the 1950s. Interpreted by some foreign observers as a corrupt system, it may better be seen as a continuation of the Thai approach of co-existence, easy integration of foreigners to become Thai, and a means of using available expertise in a developing economy. It may also be seen as a continuation of a long term approach of harvesting resources from rural areas where marginalised producers increasingly are forced into environmental unsound practices to the increasing concern of Thailand's trading partners. However, a primary focus of environmental concern has been dams and water distribution systems.

The Culture of Irrigation

The recently renamed Royal Irrigation Department began its post 1932 works in the North. The Mae Faek Dam on the Ping River was completed in 1935 followed by three others in the area to irrigate some 50,000 hectares, about 30 percent of the Chain Mai-Lampun valley. By 1939, ancient wooden weirs built on the Tai *muang fai* system were abolished to assist the new irrigation system's overall function.³⁷⁴ The limits of the old system had probably been reached with the continuing push to irrigate more land and to double crop. Nevertheless, the new integrated irrigation system was part of an ecologically costly package of high chemical applications, and major interruption of aquatic environments.

³⁷³ Phongpaichit, Pasuk. and Baker, C. (1997)

³⁷⁴ van Beek, S. (1995)

The demise of traditional systems through the post-1932 modernisation is an indication of global forces and the willingness of the State to utilise new means to ensure continued flow of revenue. The Peoples' Irrigation Act of 1939 attempted to replace older social and water management structures with water-user groups, although it was unsuccessful until embodied in the National Irrigation Act of 1942. In fact, traditional *muang fai* and national systems worked side by side in the North until the 1960s, when pressure to conform became overwhelming in the face of limited water-use choices for small traditional schemes surrounded by the national system. By then the high maintenance and replacement costs of the traditional weirs was also a disincentive. The baby of millennia-old cultural practices was thrown out with old irrigation water in a generational change in beliefs observances, myths, and locally enforced rules. Government officials assisted this modernising influence through irrigation committees where their status transcended the traditional path of to local power for villagers from water manager to headmen of the *tambol*.

Meanwhile in the delta, government invested in irrigation from the 1950s following an FAO/World Bank plan reminiscent of the van der Heide plan of 1906. Solving the ancient Ayutthaya bugbear of flooding was invoked as one the benefits of the investment.³⁷⁵ The northern delta Chainat Dam completed in 1957 was key to the plan, although its impact was low until canals were dug and the multi-purpose Bhumibol and Sirikit Dams built in 1964 and 1971 respectively.³⁷⁶ Multilateral assistance for these dams was part of the green revolution requirement for a managed aquatic environment for high yielding rice varieties. In the event, Thailand was able to maintain a less intensive agriculture than its neighbours as a result of its land availability and surplus production, as well as government's distraction by industrialisation. The environmental impact of agriculture in Thailand warrants further research.

Environmental Change

The rapid technological change from 1932 through the 1980s has caused higher environmental impacts than the less intensive systems of earlier eras. However, there has been no sudden green revolution attack on the natural environment. Trends well established from Ayutthaya and earlier would have created at least similar impact under rising population and production demands. The example of the sustainability of shifting agriculture systems under low population density regimes is apposite; wet rice produced under small scale irrigation schemes is apparently sustainable until greater outputs are required from the system. Even the millennia-old *muang fai* irrigation system exceeded environmental tolerance under the production demands of 1975 when a flood necessitated a *fai* replacement cost of 8,000 trees for poles³⁷⁷ from declining forest reserves.

However, small-holder agriculturists did not destroy the Thai forests; they were simply pawns to agribusiness, government, military, and associated influential persons'

³⁷⁵ van Beek, S. (1995)

³⁷⁶ Arbhabhirama, Anat. et al (1988)

³⁷⁷ van Beek, S. (1995)

aspirations. Such forest losses are the common environmental indicator of the past five decades in Thailand. Competing policies indicate the overriding primacy of nation building and political stability through the period such that even to the 1960s, insurgent groups resident in forests were controlled by road construction which in turn facilitated further illegal logging. Forest concessionaires required to replant forests in return for 30 year cutting rights in the 1960s exacerbated an existing problem, delaying any possible solution until the 1990s. Once associated with forests, but now increasingly with agriculture, fire is also a significant influence in changes to the atmospheric environment.³⁷⁸

The environmental impacts of the period include:³⁷⁹

- large scale conversion of forest to crop land
- chemical and physical decline of upland soils, demonstrated through declining yields especially in the first two years after clearing
- expansion of the area covered by the fire resistant rhizomatous grass, *Imperata cylindrica*
- soil compaction from the introduction of tractors, especially on waterlogged soils
- widespread planting of highly efficient nutrient extracting crops, such as cassava, on poor soils
- erosion in the highlands, uplands, and along water courses
- increased management by fire in lowland, upland, and highland agriculture, with resultant loss of nutrients and organic matter, and increased air pollution
- changes in the water harvesting and releasing characteristics of watershed, with higher peak river flows and flooding, and lower dry season flows and a greater need for dams
- sedimentation of dams
- loss of biological resources through adoption of high yielding variety for crops and habitat destruction
- groundwater pollution from fertilisers and pesticides.

All of these impacts are common to other countries. Some of the solutions will come from the same foreign sources, although there are few extractable financial benefits associated with remediation and research specific to a local environment. These remain a major challenges of the Thai government. This modified environment, and Thailand's human resources form the base for today's Thai agriculture.

Summary

Key points pertinent to Thai agriculture which may be elicited from consideration of the post-1932 period include:

- Expansion of agricultural lands supported rapid population increase and agricultural output until accessible easily farmed land was expended and world agricultural prices fell; subsequent increases in agricultural output were achieved through intensification using green revolution technologies including irrigation which, with forest disappearance, raised environmental concerns.

³⁷⁸ Kaosaard, Minsarn. and Rerkasem, Benjawan. (1999)

³⁷⁹ ADB (1999)

- New agribusiness forces emerged, which aligned closely with government to assist national objectives of increased revenues from agriculture to fund industrialisation policies that caused a continuation of policies that assumed small-holder resilience to tax and isolation from the social and economic benefits of progress, with agriculture providing a welfare role as it increasingly became associated with rural poverty.
- Thailand emerged as one of the world's few agricultural exporting countries, with agricultural receipts funding national development and redeeming the economy in times of crisis, while being decreasingly understood by national decision-makers in terms of inherent benefits of the country, past sustainable systems, and emerging social and economic issues in a sector inextricably linked to the global economy.

Chapter 7: Thai Agriculture to the 1990s

Agriculture in Thailand has been assumed to be of declining economic importance, a view belied by its continued support of rural dwellers, its ongoing role as the engine which powers the Thai economy, and the failure of rural industrialisation policies. Production-agriculture continues to grow, albeit at a pace slower than that of the young manufacturing and industrial sectors; it also makes demands on the natural environment in common with those other sectors. However, the broad sector of Thai agriculture and agribusiness today is a component of global agribusiness which is far more diverse than the wet rice of its origins. The social and economic roles of agriculture were revealed during the high economic growth 1980s and 1990s and the subsequent recession which was softened by agriculture's reliable foreign income earning capacity, and its social buffering effect in the absence of welfare programs. However, production-agriculture has now become synonymous with rural poverty, suggesting its ability to subsidise urban lifestyles and other developing sectors has been exceeded, thus negating a fundamental assumption of Thai development planning.

Thailand is an agricultural country. In 1990 more than 23 percent of exports were primary agricultural commodities, falling to 16 percent in 1995. Similar figures for the Philippines and Malaysia were 15 percent and 11 percent, for Indonesia 11 percent and 12 percent, China eight percent and six percent³⁸⁰. Thailand's principal agricultural export markets in 1994 were Japan (22 percent), Europe (19 percent), East Asia (12 percent), United States (10 percent) and China (10 percent) and for agriculturally related imports were Europe (25 percent), United States (19 percent) and China (six percent).³⁸¹ Thailand is the world's largest rice exporter, exporting around 60 percent of production, the world's largest producer and exporter of canned pineapple, natural rubber, and black tiger prawns, and a major producer of sugar, and fruit and vegetable production including canned products. In addition to economic ties to agriculture, Thailand depends on agriculture as a social welfare system with farming continuing to employ nearly 50 percent of domestic labour.³⁸²

Thai agriculture of the 1990s is the product of history and recent policies. Preceding chapters have chartered that history. While post-war development bore some similarities to Japan,³⁸³ central planning and foreign influence in policy combined with rapid agricultural expansion in the 1970s, created a uniquely Thai outcome which has inadvertently produced high rural social and environmental costs. The intent and omissions of agricultural development policy are evident in the national planning process which began in 1959.

Agricultural Planning Context

³⁸⁰ The Economist (1998)

³⁸¹ FAO (1996)

³⁸² Stoeckel, A. et al (1998)

³⁸³ Boonma, Sawai (1974)

Foreign development theory applied to Thai planning began with an economic emphasis through National Economic Development Plans to which the word 'social' was added in a later decade. Through five year plans 1 to 8, agriculture is assumed to underwrite development in other sectors. Policies, programs, and projects derived from these plans articulate cohesive approaches including agricultural development in conformity with the art of writing development plans. However, implementation of all eight plans has emphasised certain programs over others to the detriment of agriculture. A derivative approach, planning did not necessarily try to build industrial growth on comparative advantages in agriculture, notwithstanding Thailand's unique position. Rural social and environmental issues would probably have received a higher profile in such an approach.

Reduced economic emphasis on agriculture is clear in 1950s and 1960s gross domestic product figures (Table 7.1). Through this period exports remained overwhelmingly agricultural and about 80 percent of labour was consistently employed in the sector, although the ratio of income per capita from agricultural compared to non-agricultural activities averaged 1:9 when ratios in countries with more consistently successful economic records average from 1:4.3.³⁸⁴ This could indicate the higher proportion of product sold on the export market, an underestimation of the contribution of agriculture to GDP,³⁸⁵ or even the centuries-old policy of harvesting resources from rural areas.³⁸⁶

Table 7.1 Change in Share of Gross Domestic Product 1951 - 1968³⁸⁷

Sector	1951	1968	Change
Agriculture	50.1	31.5	-18.6
Industry	18.3	31.1	+12.8
Services	31.6	37.4	+5.8

Regular export income and cushioning in times of recession have long assumed a subsistence option for farmers.³⁸⁸ This simple approach has allowed Thailand to avoid balance of payment crises common to food importing countries where shortages, inflation, and disorder commonly follow recession. Thai technocrats who initially advocated agriculture led growth strategies were enticed by the success of newly industrial countries from the 1960s investments in industry. Advantages in the production of rice³⁸⁹ were overshadowed by diversification policies³⁹⁰ which, by the 1980s, had made the Thai economy dependent on the global agricultural and agribusiness community.³⁹¹ Once the low-cost agricultural land-expansion had ceased, policy emphasis overtly mimicked the industrialisation paths of high-growth Asian economies.

³⁸⁴Ingram, J.C. (1971)

³⁸⁵Silcock, T.H. (1970)

³⁸⁶ Phongpaichit, Pasuk and Baker, C. (1998)

³⁸⁷ Ingram, J.C. (1971)

³⁸⁸ Phongpaichit, Pasuk and Baker, C. (1998)

³⁸⁹ Tinprapha, Chatri (1979)

³⁹⁰ Mekong Secretariat (1979)

³⁹¹ Douglass, M. (1984)

The quest for industrial and manufacturing growth appeared to have been fulfilled by the early 1990s (Table 7.2).

Table 7.2 Proportion (%) of GDP by Sector, 1970-1993³⁹²

Year	Agriculture	Industry	Manufacturing	Services
1970	27	25	16	48
1980	21	31	22	48
1990	14	36	25	50
1993	12	38	26	50

Low investment in agriculture between 1850 and 1940 has been explained in terms of the conflicting objectives between national security and economic development³⁹³ on the one hand, and between the private sector, elite decision makers, and social objectives on the other³⁹⁴. Agricultural policy in the 1940s was largely without form although a prescient United Nations' report identified needs for improved rice production, irrigation, rinderpest control, forest management, agricultural statistics, and support services.³⁹⁵ The subsequent agricultural wealth created with irrigation in the Chaophraya Delta³⁹⁶ resulted from such foresight.

Planning History

The first of the major texts on Thai agriculture³⁹⁷ identified the three constraints to agriculture as; under-population, poorly developed credit and marketing systems, and lack of a technical system for development and promotion of industrial knowledge. Seven decades later population and credit are readily available while the need for improved research and technology adoption continues.

From a tradition of rurally funded national development,³⁹⁸ and of innovation and leadership coming only from the highest levels,³⁹⁹ Thailand appeared to have a basis for economic development. Requirements to stimulate industrial development through directives to the bureaucracy suited the popular planning approaches of the 1950s. Initially a mere collection of departmental activity programs, the planning process quickly evolved to a sophisticated application of planning techniques, often barely tested elsewhere, based on generic developing country assumptions which under-emphasised Thailand's unique agriculture.

³⁹² Bank of Thailand (1995)

³⁹³ Feeny, D. (1983)

³⁹⁴ Feeny, D. (1979)

³⁹⁵ FAO (1948)

³⁹⁶ Takaya, Y. (1987)

³⁹⁷ Zimmerman, C.C. (1931)

³⁹⁸ Hong, L. (1984)

³⁹⁹ Ingram, J.C. (1971)

A functional environment for planning normally requires feasibility analysis of policy objectives and alternatives, evaluation of existing programs, economic and human resources, and broadly-based societal objectives, in order to formulate acceptable outcomes.⁴⁰⁰ Such a planning environment has been sought across the eight Thai plans, although limitations in legislative and enforcement systems and of educated human resources have hampered both planning and plan implementation.

Thai development planning dates from 1959 when Prime Minister Sarit Thanarat effected significant changes after close contact with USA economic advisers. The first five year plan spanning 1961 to 1966 aimed to consolidate political power through stability and economic growth. By the time of the second five year plan for 1967 to 1971, GNP had expanded by seven percent reflecting significant USA monetary and policy influence, and exceeding the first plan's target of six percent. The success of the first plan enhanced the power of concerned government institutions. The Office of the National Economic Development Board (NEDB) became responsible for macro- and micro-economic analysis while the Office of the Under Secretary to the Prime Minister became responsible for evaluation of administrative effectiveness, in cooperation with the Budget Bureau. These arms of government developed great influence; in one assessment of their effectiveness they appear as Western civil service styles.⁴⁰¹

Agricultural development⁴⁰² in the plans emphasised infrastructure through irrigation and research facilities during the first and second plans, moving into land consolidation, farm level irrigation and land titling in the third plan (1972 - 1976). Subsequent plans included; land reform and credit expansion in the fourth plan (1977 - 1981), rural development in designated poverty areas in the fifth plan (1982 - 1986), introduction of a market-led production and diversification system in the sixth plan (1987 - 1991), and efficiency of natural resource use, enhanced research and technology transfer, further market orientation development and agro-industry development in the seventh plan (1992 - 1996).⁴⁰³ The eighth plan aimed to redress social issues associated with inequitable growth in rural areas, thus reorienting agricultural production from an economic to a social sector.

Policies of the late 1970s and early 1980s were biased against agriculture,⁴⁰⁴ in order to subsidise industrial development.⁴⁰⁵ Agricultural exports were to maximise foreign income⁴⁰⁶ from assumed comparative advantages in crops, livestock, and fisheries.⁴⁰⁷ Foreign assistance⁴⁰⁸ and government ambiguously espoused agricultural diversification.⁴⁰⁹ Agro-processing based growth policies⁴¹⁰ were poorly linked to

⁴⁰⁰ Framingham, C.F. et al (1982)

⁴⁰¹ Changrien, Phaibul (1972)

⁴⁰² Sapatini, O. (1972)

⁴⁰³ Tonpang, Sopin (1988)

⁴⁰⁴ Siamwalla, Ammar et al (1986)

⁴⁰⁵ Jutsuchon, Somchai (1989)

⁴⁰⁶ Van der Meer (1981)

⁴⁰⁷ Siamwalla, Ammar et al (1989)

⁴⁰⁸ AIDAB (1991)

⁴⁰⁹ Siamwalla, Ammar (no date)

production agriculture producing such anomalous outcomes as textiles and clothing becoming a larger export earner than rice by 1985,⁴¹¹ while development of links to multinational textile houses were ignored. Likewise, policies for agricultural education were separated from those for agriculture through the 1960s,⁴¹² thereby affecting rural education and closing some opportunities in agriculture.⁴¹³ Policies followed unplanned agricultural land expansion,⁴¹⁴ itself driven by population growth and high global prices which masked agricultural input and local commodity pricing mistakes.⁴¹⁵ However, technology adoption by small-holders was slow as a reflection of perceptions of risks foreign to most planners⁴¹⁶ notwithstanding rhetoric associated with coups⁴¹⁷ and democratic changes of government. Persistent malnutrition and slow technology adoption compared to neighbouring food-deficit countries suggest the primacy ascribe economic over social development⁴¹⁸.

Foreign Fillips to Planning

Foreign aid became a significant influence in Thai development from the 1950s.⁴¹⁹ The USA provided approximately \$150 million in economic and \$222 million in military aid between 1951 and 1957 as part of its Vietnam Conflict expenditure. Economic aid including improvement of highway⁴²⁰ and rail networks in addition to technical assistance in agriculture, economic planning, education, and irrigation⁴²¹. An average annual addition of more than \$60 million to a Thai budget of about \$200 million, and outside parliamentary control, strongly influenced development outcomes. The many agricultural economic studies conducted through the 1970s⁴²² similarly provided intellectual foundation for planning.

Improved infrastructure integrated remote villages, completing nation creation objectives and facilitating implementation of education and health policies. Foreign aid substituted for government investment; reaching about one-third of development expenditure between 1955 - 1965.⁴²³ Evidence of this influence in agriculture remains in; irrigation schemes, plant breeding expertise which produced the maize variety Suwan, agricultural and applied economic education at Kasetsart University, and transport infrastructure which allows efficient product marketing,⁴²⁴ among many other examples.

⁴¹⁰ Muscat, R.J. (1984)

⁴¹¹ Suphachalasai, Suphat (1997)

⁴¹² Harold Freeman, H. (1965)

⁴¹³ Khoman, Sirilaksana (1993)

⁴¹⁴ Suthasupa, Paiboon (1982)

⁴¹⁵ Panayotou, T. (1987)

⁴¹⁶ Feeny, D. (1983)

⁴¹⁷ Girling, J.L.S., (1969)

⁴¹⁸ Panayotou, T. (1984)

⁴¹⁹ Muscat, R.J. (1990)

⁴²⁰ Conley, D.M., Vathana, Chamnong and Heady, E.O. (1978)

⁴²¹ Wyatt, D.K. (1984)

⁴²² Iowa State University (1979)

⁴²³ Corden, W.M. and Rachter, H.V. (1967)

⁴²⁴ Silcock, T.H. (1970)

Plans One to Eight

Foreign aid was soon brought within the purview of the national planners. Synergistic allocation of resources should have resulted although government institutions were unprepared for this Western approach. From the experience of the first National Economic Development Plan's simple collation of departmental activity plans, new institutional arrangements were seen as necessary. A Ministry of National Development was established which included the Department of Land Development and the Royal Irrigation Department previously within the Ministry of Agriculture. Dams without water distribution schemes resulted, for example, despite well-meaning intentions to increase regional programs through agricultural centres at Chainat and Khon Kaen.⁴²⁵

The first plan highlighted the limited power of the Office of the Under Secretary to the Prime Minister in coordinating government line agencies.⁴²⁶ It possibly widened cultural separation and increased rural dependence on urban centres partly through creating off-farm opportunities which fragmented the social infrastructure of the rural Northeast. Mechanisation and upland cash cropping further stimulated rural migration without consideration of longer term opportunities for displaced persons.⁴²⁷

The second National Economic and Development Plan was based on some analysis of market demand and resources, including manpower. Agriculture was addressed to meet domestic demand for fruit and vegetables while assuming continued mono-cropping of rice based on current techniques. Intentions to distribute the benefits of economic growth to agricultural producers was predicated on a fall in the proportion of the population engaged in agriculture, and a small improvement in equity occurred.⁴²⁸ However, the main benefit was for those farmers who exited agriculture to join the much better rewarded non-farm sector. The plan included investments in agricultural research and infrastructure development, and assistance to farmers in politically sensitive areas.⁴²⁹ State enterprises⁴³⁰ received less emphasis in favour of private import substitution and industry, which favoured the primarily Chinese-Thai ownership of such businesses.⁴³¹

The third National Economic Development Plan considered the difficult issues of agricultural land consolidation and allocation, distribution of water to farm level, and issuance of land title deeds, all aimed at introducing green revolution technologies.⁴³² Security of land title was to allow mortgage-backed credit to finance fertiliser and other inputs necessary to obtain the benefits from irrigation and land consolidation. The increased sophistication in such planning raised expectations of the approach which was then extended to include social objectives.

⁴²⁵ Silcock, T.H. (1970)

⁴²⁶ Changrien, Phaibul (1972)

⁴²⁷ Vallibhotama, Srisakra (1989)

⁴²⁸ Stifel, L.D. (1976)

⁴²⁹ Silcock, T.H. (1970)

⁴³⁰ World Bank (1959)

⁴³¹ Owen, N.G. (1992)

⁴³² Poapongsakorn, Nipon et al (1995)

The fourth National Economic and Social Development Plan used the Division of Agricultural Economics' new national crop model which was hoped to provide for annual modifications and subsequent five year plans. The crop model was based on crop incomes from rice and upland crops, under-employment and unemployment, availability of land, utilisation of agricultural inputs including fertiliser and new crop varieties, and the allocation of targets for the expansion of upland cropping.⁴³³ The issues considered in designing the agricultural component of the fourth plan included; high population and growth, the low average incomes of farmers, rising unemployment among agricultural workers, low agricultural productivity, low rates of technology adoption by farmers, limited availability of agricultural land, and farmer resistance to new technologies.⁴³⁴ Rural development attracted royal projects, foreign aid, a Bangkok Bank community development fund, and army development of irrigation schemes. Poverty alleviation became the national security priority through the fourth plan.

The fifth National Economic and Social Development Plan designated the poorest 12,555 villages in the country to receive special development funds. However, national security not welfare proved the more powerful motivation. Implementation of the program slowed in proportion to reductions in rural and border insurgency. By 1985, it was estimated that 30 percent of farmers had fallen below the poverty line, compared to 23 percent in 1981, as a result of poor implementation of plan when prices for upland crops declined. Studies of the period indicate that government export taxes stifled rice and rubber production.⁴³⁵

In the sixth National Economic and Social Development Plan (1987 - 1991), agriculture returned to its national economic role in a broader view of the global markets. The plan contained no specific chapter concerning agriculture, discussing it under headings of rural development and natural resources.⁴³⁶ From this period, the separation of agricultural crops into two categories became standard; products with excess supply and grown for export, including rice, maize, coffee, and cassava, and for which quality improvement appear feasible were separated from a second group comprised of domestic crops such as garlic, onion, shallot, palm oil, and coconut oil where market improvement, development of agro-industry and import regulations were seen as more important. A third group with insufficient supply such as soya bean meal, fishmeal and cotton were to be promoted through import restrictions. Attempts to introduce water usage fees, notwithstanding a past tradition of contributing both money and labour through the traditional *muang fai* system, confounded government investments and the economic benefit of large scale irrigation schemes. Analyses of such experience informed formulation of the seventh plan.

The seventh National Economic and Social Development Plan (1992 - 1996) included productivity enhancement and adding value to primary products. Couched in terms of modern Western agriculture, the plan listed five areas for action; efficient use of natural

⁴³³ Division of Agricultural Economics (1976a)

⁴³⁴ Division of Agricultural Economics (1976b)

⁴³⁵ World Bank (1980)

⁴³⁶ NESDB (1987)

resources, support for research and development, technology transfer, restructuring production to suit local conditions and market demand, development of agro-processing industries, and improved agricultural cooperative development.⁴³⁷ Programs or projects⁴³⁸ specific to each of these were compromised by; Thailand's limited influence on world prices, government's assumed better forecasting ability than farmers', uniform packages which ignored regional and individual variations, mis-orienting subsidy programs to wealthier rather than poorer farmers, and inadequate government services and inputs. Assumed 'trickle down' of rural wealth,⁴³⁹ the 1960s advent of farm labour,⁴⁴⁰ and pragmatic farmer responses to unintended incentives⁴⁴¹ led to uneven development⁴⁴² as Thailand accepted a price-taking role for exports.⁴⁴³ By the eighth plan, farmer debts from government programs, including inedible and unmillable red millet⁴⁴⁴ and infertile, expensive, imported cattle,⁴⁴⁵ had made small-holders cynical of government programs.

The eighth National Economic and Social Development Plan, developed before the 1997 economic crisis, sought stable economic growth, social equity, and improved public administration. Agriculture was considered within the development objectives of: improved child education and development; compulsory education to nine years rising to twelve and teacher training; upgrading industrial workers; assisting the underprivileged; reducing avoidable accidents; reducing the current account deficit and inflation; increasing domestic savings; improving regional and rural infrastructure; reducing poverty; preserving and rehabilitating forest areas; increasing awareness of sustainable alternative agriculture; and promoting investment in rehabilitation and protection of the environment.⁴⁴⁶ An adjustment to the plan post-crisis, discussed later, bridged the period to preparation of the ninth plan.

National development plans provide an insight to the aspirations of government. Unconscious creation of a disadvantaged rural sector is not uncommon in other countries, yet seems inconsistent with priority policy foci of political stability. The dual issues of rural poverty and environmental decline⁴⁴⁷ have been exacerbated through the planning period. This was not immediately evident in Bangkok in an overheating economy, or even earlier when agriculture was expanding by low-cost land expansion, and introduction of the simple green revolution technologies.

Agricultural Growth

⁴³⁷ NESDB (1991)

⁴³⁸ Poapongsakorn, Nipon et al (1995)

⁴³⁹ Moerman, M. (1968)

⁴⁴⁰ Moerman, M.H. (1964)

⁴⁴¹ Rogers, K.D. and Itharattana, Prasit (1977)

⁴⁴² Parnell, M.J.G. (1996)

⁴⁴³ Ramangkura, Virabongsa (1972)

⁴⁴⁴ Bangkok Post (1995)

⁴⁴⁵ Phongpaichit, Pasuk and Baker, C. (1998)

⁴⁴⁶ NESDB (1997)

⁴⁴⁷ Falvey, L. (1996)

From the 1950s, rapid agricultural growth fuelled Thailand's economy. Based on unused land and available population, the more than 80 percent of the population resident in rural villages expanded agriculture with governments tacit blessing.⁴⁴⁸ Discrepancies of up to 20 percent for rice production between figures from 1958 to 1968 of the Ministry of Agriculture and the National Economic Development Board⁴⁴⁹ reflect that knowledge of agriculture was mainly oriented to revenue collection. Thailand's unsurpassed land expansion capacity⁴⁵⁰ up to the 1980s⁴⁵¹ existed through absence of its neighbours' colonial conflicts, a rigid feudal system, or resistance to absorbing other cultures, in particular Chinese immigrants.⁴⁵²

Falling world prices and uncertain trade conditions associated with oil crises marked an end to the long post-war boom in primary products. EEC countries introduced import quotas, the USA protected its rice industry, and new competitors to Thailand emerged in China and Vietnam.⁴⁵³ More important to Thailand, was the success of the green revolution in rice importing countries.⁴⁵⁴ At the same time, agro-processing became a focus of planners. Captured under manufacturing and industrial statistics rather than agriculture, this component of the sector dealt with such products as frozen chicken, sugar, pineapples, cut flowers, fresh fruit and vegetables, pepper, coffee, and marine and aquaculture products. Rice, cassava, maize, some field crops, and vegetables declined in significance through the 1980s while rubber, sugarcane, soya bean, tree crops and flowers increased, government protection or subsidy assisting in the first three industries. Dairy products and other livestock showed the highest growth while the poultry sector had the highest added value share. By contrast, water buffalo, once a symbol of Thai agriculture, were being rapidly substituted by two and four wheeled tractors.⁴⁵⁵

Economic growth thus relied on exploitation of natural resources as the direct harvesting sectors of forestry and fisheries indicate; over the ten years from 1975 - 1985, the forestry sector grew from \$190 million to \$215 million dollars, and the fishery sector from \$231 million to \$304 million. Fishing expanded from a household industry to trawling, and then to motorised trawl-net fishing with consequent over-extraction. Forests shrank as loggers used security and expanding upland agriculturists as cover for effectively unregulated extraction of valuable timbers.⁴⁵⁶ However, the widest social and environmental impacts occurred through agriculture with expansion of cropping, fertiliser use, irrigation, and mechanisation.

Cropland Expansion

⁴⁴⁸ Phongpaichit, Pasuk and Baker, C. (1998)

⁴⁴⁹ Ingram, J.C. (1971)

⁴⁵⁰ Phongpaichit, Pasuk (1989)

⁴⁵¹ Phongpaichit and Baker, C. (1995)

⁴⁵² Silcock, T.H. (1970)

⁴⁵³ Phongpaichit, Pasuk and Baker, C. (1995)

⁴⁵⁴ CGIAR (1999)

⁴⁵⁵ Poapongsakorn, Nipon et al (1995)

⁴⁵⁶ Arbhabhirama, Anat (1989)

Government influence on agricultural production was mainly limited, although pricing policy, infrastructure development, and social programs created sometimes unintended agricultural outcomes. Crop pricing policy was used to regulate rice and maize production more effectively than for kenaf and cassava, and justified in terms of an expected shift of resources back to rural areas⁴⁵⁷. However, irrigation infrastructure probably provided the greatest stimulus to change in rice where transplantation substituted for broadcasting of seed in the Central Plains. In upland agriculture, swiddening was displaced by modern agricultural systems when widespread, logging, road development, and control of malaria occurred.

Logged areas were soon planted to corn which had been a minor crop since its introduction by Portuguese traders some 400 years earlier. Likewise the 1845 Portuguese introduction, cassava, expanded from an inter-crop between rubber trees to the less fertile Northeast. Soya bean, introduced to Thailand more than 200 years ago by Chinese immigrants, grew from a small upland crop to become widespread both in the uplands as an irrigated second crop after rice. Cotton expanded as an import-substitution crop until uncontrollable insect attacks (American Army Worm, *Heliothis armigera*) curtailed the industry. Other upland species included star apple, mango, longan, pomelo, and sweet tamarind, while fresh vegetables became an important commodity in irrigated areas.⁴⁵⁸ Crop expansion over this period, 1950 - 1967 is presented in Table 7.3.

Table 7.3 Average Annual Plantings for Crops ('000 rai)⁴⁵⁹

Product	1950 - 52	1958 - 60	1965 - 67
Upland Food Crops			
Maize	255	1,275	4,113
Mung Beans	221	289	808
Cassava	n.a.	371	777
Sugarcane	412	911	865
Oil Seeds			
Castor	76	172	265
Groundnut	448	661	759
Sesame	107	135	188
Soya beans	136	139	276
Coconuts	560	903	1,598
Fibre Crops			
Cotton	242	302	565
Kapok	n.a.	341	333
Kenaf	62	427	2,631
Jute and Ramie	30	23	57
Garden Crops	n.a.	317	1,021
Fruits	n.a.	528	1,646

⁴⁵⁷ Rogers, K.D. and Itharattana, Prasit (1982)

⁴⁵⁸ Silcock, T.H. (1970)

⁴⁵⁹ Ministry of Agriculture (1970)

Rubber	2,204	2,930	4,167
Tobacco	243	379	458
Total	4,996	10,103	20,518

Fertiliser

Green revolution technologies,⁴⁶⁰ combining irrigation, fertiliser, high yielding varieties and pest control in a closely managed production environment, was adopted slowly in Thailand. The Kingdom was not under the same imperative as food deficient countries in which green revolution research centres were located. Nevertheless, by the 1990s, Thailand had become a significant importer of fertiliser and pesticides, with a small local production capacity. Fertiliser distributed by the Marketing Organisation of Farmers to the four regions of the country (Table 7.4) indicates a nearly four-fold increase over the period 1992 to 1996, while local mixing capacities for chemical fertiliser rose by a factor of four over the period 1986 - 1995 (Table 7.5); fertiliser consumption over this period rose by a factor of 2.5.⁴⁶¹

Table 7.4 Quantity of Fertiliser Distributed by MOF by region, 1992 - 1996⁴⁶²

Region	Tons of Fertiliser				
	1992	1993	1994	1995	1996
Northeast	50,251	64,991	72,657	80,648	191,189
North	25,029	26,935	21,244	36,635	59,601
Central	20,428	32,184	33,957	56,951	108,474
South	12,070	16,789	5,696	33,259	24,404
Whole Kingdom	107,779	140,901	133,556	207,493	383,669

Table 7.5 Local Mixing Capacities (ton) of Chemical Fertiliser 1986 - 1995⁴⁶³

Year	Total	Plant Nutrients		
		N	P ₂ O ₅	K ₂ O
1986	287,000	44,828	32,851	21,776
1988	393,722	61,264	36,676	35,392
1990	439,890	69,080	47,885	41,760
1992	440,085	64,386	49,790	42,920
1994	422,495	63,953	47,122	35,043
1995	564,307	89,907	68,458	48,662

Fertiliser used in rice production rose from 660,000 ton in 1986 to 1.5 million ton in 1995⁴⁶⁴. Imported quantities of the other major agricultural chemicals, pesticides and

⁴⁶⁰ CGIAR (1999)

⁴⁶¹ Marketing Organization for Farmers (1997)

⁴⁶² Marketing Organization for Farmers (1997)

⁴⁶³ Ministry of Agriculture (1998)

⁴⁶⁴ Office of Agricultural Economics (1997)

herbicides are presented in Table 7.6, and the relative rate of adoption of green revolution technology by Thailand in comparison with neighbouring countries is indicated in Table 7.7. Expansion of Thai production has relied on natural endowments to a greater extent than the intensive technologies, thereby providing either, a buffer against the environmental costs of that technology, or scope for future economic expansion.

Table 7.6 Quantity and CIF Value of Imported Pesticides, 1995⁴⁶⁵

Type of Pesticides	Number Products	Quantity (kg)	CIF Value (baht)
Insecticide	85	10,559,540	1,644,159,884
Acaricide	8	519,760	91,657,394
Fumigant	2	50,094	10,659,173
Rodenticide	3	86,440	5,283,057
Fungicide	65	6,937,092	603,454,306
Herbicide	55	19,954,485	2,043,770,462
Plant Growth Regulator	13	610,798	100,649,987
Molluscicide	2	36,326	3,650,789
Total	233	38,754,535	4,503,285,052

Table 7.7 Total Fertiliser Consumption by Irrigated Area in Asia⁴⁶⁶

Region	Total Fertiliser Consumption			Annual Growth (%)	
	1975	1985	1995	1975-85	1985-95
Country					
Southeast Asia					
Cambodia	1.12	0.00	58.38	-1	41
Indonesia	125.41	458.56	558.17	13	2
Lao PDR	2.50	16.81	34.97	19	7
Malaysia	805.26	1,830.54	3,323.53	8	8
Myanmar	56.07	178.88	109.99	12	-5
Philippines	218.17	196.65	381.72	-1	7
<i>Thailand</i>	<i>74.47</i>	<i>113.44</i>	<i>311.64</i>	<i>4</i>	<i>10</i>
Vietnam	330.00	217.85	724.00	-4	12
East Asia					
China	160.17	378.00	713.67	9	6
Japan	568.05	689.02	609.26	2	-1
Rep. of Korea	677.76	609.06	714.73	-1	2
Mongolia	152.17	310.00	31.25	7	-23
South Asia					
Afghanistan	14.97	28.21	17.86	6	-5
Bangladesh	149.49	260.82	372.59	6	4
Bhutan	4.55	3.33	2.56	-3	-3
India	103.58	203.55	267.97	7	3

⁴⁶⁵ Ministry of Agriculture (1998)

⁴⁶⁶ FAO (1998)

Nepal	53.30	57.12	105.90	1	6
Pakistan	40.63	95.88	145.80	9	4
Sri Lanka	150.83	335.31	363.38	8	1

Irrigation, Mechanisation and Credit

Although Thai agriculture evolved from a wet rice culture, modern irrigation systems derived much from foreign technology. Large dam construction has aimed to increase rice area and production, and more recently hydropower, and industrial water supply. Since the Second National Economic Development Plan, medium-scale systems initiated in response to perceived needs for additional water have been most common.⁴⁶⁷ In some cases, this included essential works for large dams constructed earlier without adequate distributary and drainage systems which, for more than a decade, caused modern storage facilities to be linked to remnants of village-based distributary systems which were unsuited to the overall system design.

Initially less important to expansion,⁴⁶⁸ 1990s Thai agriculture is characterised by water issues within and between river basins,⁴⁶⁹ over quality,⁴⁷⁰ political and institutional rivalries,⁴⁷¹ and public concern about dam construction. Market failure caused by open access to irrigation has changed Thailand from a country with a self image of water abundance, to one of shortage. Now addressed legislatively for surface water, ground water, and water quality,⁴⁷² improved cropping efficiency, institutional strengthening, and water use⁴⁷³ may well reorient the agricultural sector.

Even in the 1960s, water concerns had been expressed in justifications for new dams.⁴⁷⁴ World Bank and other finance stimulated investment in conjunction with green revolution technologies, the success of which led to further water resource development. The extent and rate of irrigation expansion across Asia is presented in Table 7.8. Technical potential for further expansion in Thailand is indicated in the continued expansion rate to 1995 of 2.7 percent compared to an overall Asian average of 2.4.

Table 7.8 Percentage of Irrigated Areas in Arable Asian Croplands⁴⁷⁵

Country	Irrigated Areas ('000 ha)			Irrigated : Lands (%)			Annual Growth	
	1975	1985	1995	1975	1985	1995	1976-85	1986-95
Asia	121,165	140,792	179,013	27	29	35	1.50	2.40
Southeast Asia								

⁴⁶⁷ Poapongsakorn, Nipon et al (1995)

⁴⁶⁸ Siamwalla, Ammar (1987)

⁴⁶⁹ NREP (1990)

⁴⁷⁰ Horbulyk, T.M. and Flatters, F. (1994)

⁴⁷¹ Christensen, S.R. (1994)

⁴⁷² Christensen, S.R. and Voon-Long, Areeya (1994)

⁴⁷³ World Bank (1986)

⁴⁷⁴ Donner, W. (1978) 3

⁴⁷⁵ FAO (1998)

Cambodia	89	130	173	5	6	6	3.79	2.86
Indonesia	3,900	4,300	4,580	15	16	15	0.98	0.63
Lao PDR	40	119	177	6	14	20	10.90	3.97
Malaysia	308	334	340	7	6	4	0.81	0.18
Myanmar	976	1,085	1,555	10	11	15	1.06	3.60
Philippines	1,040	1,440	1,580	14	16	17	3.25	0.93
<i>Thailand</i>	<i>2,419</i>	<i>3,822</i>	<i>5,004</i>	<i>15</i>	<i>19</i>	<i>24</i>	<i>4.57</i>	<i>2.69</i>
Vietnam	1,000	1,770	2,000	16	28	30	5.71	1.22
East Asia								
China	42,776	44,581	49,857	43	46	52	0.41	1.12
Japan	3,171	2,952	2,700	62	62	62	-0.72	-0.89
Rep. of Korea	1,277	1,325	1,335	57	62	67	0.37	0.08
Mongolia	23	60	80	3	4	6	9.59	2.88
South Asia								
Afghanistan	2,430	2,586	2,800	30	32	35	0.62	0.80
Bangladesh	1,441	2,073	3,200	16	23	37	3.64	4.34
Bhutan	22	30	39	20	23	26	3.10	2.62
India	33,730	41,779	50,100	20	25	30	2.14	1.82
Nepal	230	760	885	10	33	30	11.95	1.52
Pakistan	13,630	15,760	17,200	69	76	80	1.45	0.87
Sri Lanka	480	583	550	25	31	29	1.94	-0.58

Associated with agricultural expansion and intensification was the introduction of machinery to Thai agriculture. From a low base in 1950, the number of wheel tractor imports in 1961 had risen sevenfold to 1,487.⁴⁷⁶ Full potential was estimated at 100,000 tractors, of which 20 percent was realised by 1967 when some 60 percent of wet rice cultivation in the Central Plain was conducted with tractors. Tractors were preferred to draught animals because the suited road transportation, powering of other agricultural equipment such as shellers, threshers, and pumps, and could plough to deeper levels. The social benefits of draught animals including companionship, self replenishment, savings, additional earnings, and association with traditional culture were lost to the Central Plain. But, as one tractor could plough in one hour between 24 and 36 times the area of one draught animal,⁴⁷⁷ mechanisation was as inevitable as large dams, high yielding varieties, fertiliser, and pesticides. Land expansion increased national production, now the green revolution was further increasing it through yield increases, albeit with much potential kept in reserve.

Agricultural mechanisation ranks seventh in an assessment of the top twenty greatest engineering achievements of the twentieth century, after electrification, automobiles, aeroplanes, water supply and distribution, electronics, and radio and television.⁴⁷⁸ Determined on the basis of increased efficiency and productivity, the comparison is made between 1900 ability of one USA farmer feeding 2.5 people, and the 1999 figure of more than 100, it is unsurprising that such benefits were demanded by countries such as Thailand. However, the markets which supported this revolution were not available to all

⁴⁷⁶ Ingram, J.C. (1971)

⁴⁷⁷ Inukai, I. (1970)

⁴⁷⁸ GreatAchievements (2000)

farmers in the world. Nevertheless, planning has been based on such indicators of development being associated with increases in agricultural production and efficiency.

Credit had long been widely available through a sophisticated informal system which essentially combined information and risk in its costs.⁴⁷⁹ With physical and information infrastructure development, lending rates reductions were possible, and government moved to assume the role through the Bank of Agriculture and Agricultural Cooperatives.⁴⁸⁰ Successful in many ways, the BAAC experienced difficulties in lending to the poorest of farmers in the absence of social trust approaches for small loans, as shown to be manageable in the Grameen Bank initiatives of Bangladesh and elsewhere.⁴⁸¹ BAAC met most obvious credit needs of mid-range farmers from the 1970s in parallel with other forms of credit including hire-purchase, hire-sublease, contract farming packages, and traditional middlemen. A positive externality of formalised credit systems was a heightened awareness of the inequities in security of land ownership and tenancy.⁴⁸²

Social Effects

Expansion of Thai agriculture has been described in terms of; government benevolence to assist rural dwellers, recognition that Thailand is primarily an agricultural country, and that Thai culture is tied to agriculture. Each of these impression contains fallacies which may be better understood in the context of the Ayutthaya shift to trade when rice became an exportable commodity. The tradition being followed in recent times was one of agricultural and naturally extracted products being the primary form of trade to generate revenue to support the State and city. Hence the 1950s plans sought agricultural export led growth as Thailand's response to the perceived post-World War II needs for rapid economic expansion. Even some of the excesses in which members of the elite engaged in the opium trade⁴⁸³ and predatory State attitudes to producers⁴⁸⁴ are consistent with the time-honoured approach of seeking a tradeable commodity unrelated to national social objectives. Hence the absence of specific rural social policies is better assessed against Thailand's own history than foreign mores.

Thailand was vulnerable to piecemeal protection policies and international price variations which caused a large economic readjustment in 1984 when financial reserves were effectively exhausted, together with the patience of creditors. Bank failures at that time provided an unheeded portent of post-1997 adjustments; by that time industry contributed twice that of agriculture to GDP and was growing at 15 percent while agriculture continued low growth rates.⁴⁸⁵ Agriculture was increasingly being considered a social sector associated with rural poverty.

⁴⁷⁹ Siamwalla, Ammar et al (no date)

⁴⁸⁰ Siamwalla, Ammar (1986)

⁴⁸¹ Siamwalla, Ammar (1993)

⁴⁸² Jutsuchon, Somchai (1989)

⁴⁸³ McCoy, A.W. (1972)

⁴⁸⁴ Sirirprachai, Somboon. (1998)

⁴⁸⁵ Phongpaichit, Pasuk and Baker, C. (1998)

Vacant land had provided a social buffer and the system seemed to suit independent peasants until agricultural prices fell in the 1980s and easily opened lands became rare. Rural to urban migration was slow due to the limited opportunities and the perceived limited skills of peasants, a view reversed during the building boom of the 1990s when they proved adaptable to many new tasks in cities. Urban incomes rose from 2.4 times that of rural incomes in 1976 to three times by 1998.⁴⁸⁶ Thailand moved from being seen as a country with high levels of equality to the eighth most inequitable in terms of income distribution.⁴⁸⁷ The long compliant and distant economic partners in the countryside who lived under quite different conditions from the modernising urban areas thus became the social problem of the 1990s.

Insecure land tenure had facilitated collection of agricultural commodities from the countryside. In some cases such as the North, overriding nation creation objectives led to long recalcitrant Chiang Mai nobles retaining large tracts of land such that, in 1975, 39 percent and 31 percent of lands in Chiang Mai and Lampang were under tenancy, and 20-30 percent of rural households were landless. National responses included a price support scheme for rice growers and a rural *tambon* (subdistrict) development scheme in what was perhaps the first real attempt at an equitable social development approach. Property rights were slow to be developed in upland areas and when introduced were confused and confusing with four government departments involved,⁴⁸⁸ producing conflicting figures of owner operated lands.⁴⁸⁹ This may have remained an unaddressed social equity issue had not access to credit for participation in intensive agricultural expansion been latterly added to the green revolution development packages.

Land rights were eventually clarified for all non-forestry upland and lowland regions. In highland areas, national security transcended social issues denying citizenship and land rights to many highland residents, with concomitant impact on their agriculture.⁴⁹⁰ Land reform intended to reallocate large private holdings to small-holders was delayed by inter-agency regulations and failed to enjoy the outcomes equivalent to elsewhere in Asia.⁴⁹¹ Less than 50 families received full land ownership and the area concerned amounted to less than 800 rai (128 hectare) over a 17 year period⁴⁹² while tenancy increased nearly three-fold, particularly the Northeast.⁴⁹³ Very small land holders (up to 5 rai or 0.8 hectare) increased to 33 percent of the agricultural population by 1984.⁴⁹⁴ Since 1976, land reform was seen as critical in social and economic terms,⁴⁹⁵ and yet implemented in a perfunctory manner, gains were reversed through subsequent rural land speculation. The function of Agricultural Land Reform Office was shifted from reform

⁴⁸⁶ Bello, W., Cunningham, S. and Kheng Poh, L. (1998)

⁴⁸⁷ World Bank (1998)

⁴⁸⁸ Feder, G. et al (1988)

⁴⁸⁹ Brannon, R.H. (1978)

⁴⁹⁰ Kunstadter, P. and Kundstadter, S. (1980)

⁴⁹¹ TDRI (no date).

⁴⁹² ALRO (no date)

⁴⁹³ Pongpaivoon, Somkiat (1991)

⁴⁹⁴ CUSRI (1989)

⁴⁹⁵ Lin, Sein and Esposito, B. (1976)

to tenure issues in public forest lands from which its claimed success in reallocating some 7.6 million rai (1.2 million hectare) derives.⁴⁹⁶

The fourth agricultural census of 1993 built on those of 1978, 1963, and 1950 and contained the objectives of better defining land-holdings, use and tenure, inputs, and crop and livestock statistics.⁴⁹⁷ Population had been rising rapidly, more than doubling between 1950 and 1990 with the majority being absorbed into the expanding agricultural land areas. With an end of land expansion, large reserves of under-utilised labour grew in rural Thailand. By the early 1990s, about one million of these persons had moved out of agricultural labour to manufacturing and construction, and another four million to seasonal agricultural employment.⁴⁹⁸ Land holding ceased to indicate employment as fragmentation and declining farm sizes resulted from inheritance customs, particularly in the North.⁴⁹⁹ Seasonal agricultural labour thus became an important definition in labour analyses⁵⁰⁰. By 1993 it was clear that non-farm income, mainly derived from agriculturally related activities, was the major source of cash income for rural households.⁵⁰¹ Farm gate rice price had long been a product of the export price less a government premium, exporter margin, milling fees, transportation costs, and middleman's margins. Small-holders linked this 15 percent cost⁵⁰² to government and merchants.

Drudgery in agriculture⁵⁰³ had determined changes in regional rural lifestyles across centuries. Thai agriculture absorbed labour through land expansion⁵⁰⁴ with the similar objective of enhancing lifestyle. Thailand had the second highest percentage (82 percent) of labour in agriculture in Asia by 1965 and the highest (76 percent) by 1973,⁵⁰⁵ dropping to 71 percent by 1980.⁵⁰⁶ Permanent arrangements for seasonal migrations to harvests rice, long a characteristic of Thai agriculture, succumbed to the first opportunity being taken⁵⁰⁷ in a labour market served by poverty.⁵⁰⁸ Labour drifted with crop diversification⁵⁰⁹ in response to financial incentives⁵¹⁰ and exploited the climatic variations of Thailand⁵¹¹ as outlined in detailed studies of the 1960s and 1970s.⁵¹² Additional labour allowed labour intensive crops to be grown; ground nuts required 165

⁴⁹⁶ Bello, W., Cunningham, S. and Kheng Poh, L. (1998)

⁴⁹⁷ National Statistical Office (1993)

⁴⁹⁸ National Statistical Office (1988)

⁴⁹⁹ Sompop, P. (1985)

⁵⁰⁰ World Bank (1980)

⁵⁰¹ World Bank (1983)

⁵⁰² Usher, D. (1967)

⁵⁰³ Durrenberger, E.P. and Tannenbaum, N. (1990)

⁵⁰⁴ Christensen, S.R. et al (n.d.)

⁵⁰⁵ World Bank (1985)

⁵⁰⁶ Siamwalla, Ammar et al (1986)

⁵⁰⁷ Chalamwong, Y. (1982)

⁵⁰⁸ Panpiemras, Kosit and Krusaunsombat, Somchai (1985)

⁵⁰⁹ Spoelstra, N. and Isarangkun, C. (1976)

⁵¹⁰ Chalamwong, Yongyuth and Khatikarn, Kanok (1985)

⁵¹¹ Norman, M.J.T. (1973)

⁵¹² Ho, R. and Chapman, E.C. (1973)

percent of the labour of single-cropped paddy rice, cotton 203 percent, sugarcane 182 percent, and rubber 158 percent.⁵¹³

Slow technology adoption challenged conventional development theory.⁵¹⁴ Apparent rural acceptance of rising differences between urban and rural lifestyles and insistence on utilising known techniques to produce family food with a small saleable surplus was interpreted as resistance to change. In fact it was a rational decision from the knowledge and experience base of the small-holder. Technically recommendations for post-harvest facilities, pest control, mechanisation, and improved water and fertiliser usage⁵¹⁵ ignored small-holder concerns. Recommendations to government for improved land tenure, soil management, increased cropping intensity and productivity, improved livestock breeding and production, enhanced farmer agricultural knowledge, improved efficiency of agricultural institutions, and enhanced information and education dissemination,⁵¹⁶ similarly assumed an equitable intent in underlying policies. Success stories in dairy production, fruit and vegetables, some rice technologies, and field crops, and spectacular failures,⁵¹⁷ provided clues to the need for equality of access to education, health, and other services. However, by 1982, agricultural and non-agricultural incomes were 2,041 compared to 15,422 baht per annum.⁵¹⁸

Declining export prices correlate with rising poverty incidences of between 27 percent and 37 percent through the 1980s. Over the period 1975 to 1989, the poor were characterised as; farmers (rising from 74 to 82 percent of the poor), village dwellers (84 to 91 percent), and those with only elementary education (80 to 82 percent). Assumptions that rice price increases could alleviate poverty were shown proved false⁵¹⁹. Poverty was clearly associated with inferior land, lack of access to irrigation, small land holding size,⁵²⁰ and lack of access to social services.

With poverty came increased environmental risks. Mutual causality between rural poverty and deforestation led to insightful social forestry projects.⁵²¹ Poverty alleviation programs in rice areas began to acknowledge regional and production system differences. Poor highland shifting agriculturists,⁵²² for example, could benefit through perennial fruit tree crop intensification which incidentally reduced land pressure. The confused legal and regulatory regimes⁵²³ of the Thai highlands limited bartering and small-scale commerce under conditions of relatively low availability of rice similar to parts of Lao-PDR.⁵²⁴ Conflicting with environmental objectives,⁵²⁵ slow action on highland

⁵¹³ Pongtanakorn, Chaipant (1987)

⁵¹⁴ Muscat, J. (1966)

⁵¹⁵ Sato, T. (1966)

⁵¹⁶ Patanapongsa, Narinchai (1983)

⁵¹⁷ Poapongsakorn, Nipon et al (1995)

⁵¹⁸ Phongpaichit and Baker, C. (1995)

⁵¹⁹ Siamwalla, Ammar (1992)

⁵²⁰ Siamwalla, Ammar (1991)

⁵²¹ Tongpan, Sopin et al (1990)

⁵²² Judd, L.C. (1980)

⁵²³ TDRI (1994)

⁵²⁴ Theerasasawat, Suwit (1998)

⁵²⁵ Bouahom, Bounthong (1997)

development options such as cattle development⁵²⁶ as a self-transportable product⁵²⁷ perhaps linking beyond localised demand,⁵²⁸ has increased poverty and environmental decline. Self-sufficient integrated crop and livestock systems of Lao-PDR⁵²⁹ differ little from past and marginalised systems of Thailand.⁵³⁰ The technical efficiencies of such systems⁵³¹ which exist even in poverty conditions are often only perceived once modern agriculture is introduced.⁵³²

Rural poverty may exceed official estimates.⁵³³ Its unintended aggravation by development plans⁵³⁴ has now caused agriculture to be considered in social terms, drawing on demonstrations of small-holder enterprises, including agro-industry, of Royal and other projects.⁵³⁵

Concerns of the decline in rural environments,⁵³⁶ unmatched by real costings of further urban development⁵³⁷ now fuel a possible reconsideration of social equity issues in rural areas. However, linking poverty to the environment can obscure Thailand's unique position; within Asia, Thailand had the second highest area of arable land per person in 1990, and by 2025 is expected to have the highest level. The success of Thailand's population control strategy has allowed the tradition of lower intensity agriculture to be maintained as an environmental buffer. No such social buffer continues to exist.

With a continuing need for improved rural and social policies, an education issue has emerged. Rural labour productivity and progressiveness have been shown to be correlated, particularly for adult education. Labour productivity benefits from early entry to school, visits to agricultural demonstrations and research stations, a higher level of education, study of some agricultural subjects in primary school, and participation in farmers groups.⁵³⁸ The future of Thai agriculture will depend on improved general and agricultural education.

Post-1997 Agriculture

As a relatively small and open economy, Thailand is highly exposed to external economic forces.⁵³⁹ Agriculture as a low yielding sector requiring long term and major capital investment was unattractive to the private sector and government alike during the pre-

⁵²⁶ Phonvisay, Singkham (1997)

⁵²⁷ Carson, S. (1997)

⁵²⁸ Warr, P.G. (1997)

⁵²⁹ Pravongviengkham, Parisak (1997)

⁵³⁰ Rerkasem, Kanok (1997)

⁵³¹ Falvey (1997)

⁵³² Cheva-issarakul, Boonserm (1997)

⁵³³ Warr, P.G. (1998)

⁵³⁴ Jutsuchon, Somchai (1989)

⁵³⁵ Industrial Management (1994)

⁵³⁶ Kunstadter, P. (1989)

⁵³⁷ World Bank (1980)

⁵³⁸ Buripakdi, Chalio (1971)

⁵³⁹ Sahasakul, Chaipat (1987)

1997 growth.⁵⁴⁰ Glimpses of the importance of agriculture to GDP can now be seen across the pre- and post-1997 crisis period (Table 7.9), as can its separation from the excessive economic activity prior to the crisis.

Table 7.9 Sectoral Contributions to GDP in Pre and Post Crisis Thailand⁵⁴¹

GDP Growth	1995	1996	1997	1998
Total	8.8	5.5	0.0	-5.5
Agriculture	2.5	3.8	3.0	2.8
Manufacturing	11.2	6.9	-0.7	-1.4
Construction	7.4	6.1	-12.7	-23.9

Just two decades earlier, farmers were encouraged through irrigation development to plant a second rice crop. By the 1990s, farmers were encouraged to plant crops with lower water demands as priority for water shifted from agriculture to electricity and metropolitan supply.⁵⁴² So much has changed that past assumptions of rural inequities being of little threat to political stability. Past policy biases against agriculture, apparent resilience to a poor regulatory environment,⁵⁴³ informed yet disadvantaged rural dwellers, a changed natural environment, and a continuing downward trend in commodity prices, are now increasing concern of instability in rural areas.⁵⁴⁴

The 1990s have highlighted different values between urban and rural Thai in a manner reminiscent of the descriptions of the Chinese and Thai differences of the 1930s,⁵⁴⁵ notwithstanding the latter's contributions to the private sector.⁵⁴⁶ The 1997 economic crisis affected most groups, although benefits of the preceding period were concentrated in the urban sector.⁵⁴⁷ For rural dwellers,⁵⁴⁸ high rice prices may have ameliorated some effects of the crisis if global markets and weather had been favourable;⁵⁴⁹ food manufacturing appears to be an exception.⁵⁵⁰ Export values for Thai manufacturing and agricultural products from 1990 to 1998 indicate a short term post-1997 increase in agricultural production and export;⁵⁵¹ in the first quarter of 1998, rice exports of 2.4 million ton were valued at some 34 billion baht, 240 percent more than the baht value of 1997 for the same period, more than compensating for devaluation of the baht.⁵⁵² The crisis has depressed Thailand's Asian markets affecting it more than other major

⁵⁴⁰ Bello, W., Cunningham, S. and Kheng Poh, L. (1998)

⁵⁴¹ Bangkok Bank (1998)

⁵⁴² Bello, W., Cunningham, S. and Kheng Poh, L. (1998)

⁵⁴³ Behrman, J.R. (1968)

⁵⁴⁴ Bello, W., Cunningham, S. and Kheng Poh, L. (1998)

⁵⁴⁵ Landon, K.P. (1940)

⁵⁴⁶ Timmer, C.P. (1991)

⁵⁴⁷ Warr, P.G. (1998)

⁵⁴⁸ Siamwalla, Ammar (1999)

⁵⁴⁹ Sarntisart, Isra (1999)

⁵⁵⁰ Sondergaard, L. (1999)

⁵⁵¹ Warr, P.G. (1999)

⁵⁵² Bangkok Post (1998)

agricultural exporters,⁵⁵³ although this is already changing and the long term decline in the contribution of agriculture to the economy⁵⁵⁴ has been temporarily interrupted. Labour productivity indices for agriculture of 0.26 compare to 2.0 for the manufacturing sector and 1.4 for the service sector, providing an indicator of the lower prices received for agricultural commodities and the higher population supported in rural areas⁵⁵⁵ while employment in agriculture continues a long-term downward trend.⁵⁵⁶ While development models might conclude that those who remain in agriculture must become more efficient and capital intensive, the need for a sound social policy remains an imperative for disadvantaged rural dwellers who continue as subsistence agriculturists, or who move out of agriculture.⁵⁵⁷

Post-crisis adjustment of the eighth plan produced an agricultural master plan to increase exports to drought affected markets, and lower farmer living costs through; integrated agricultural export zones, research and development, quality control, reorganisation of the Ministry of Agriculture and Cooperatives, reductions in the use of agricultural chemicals, improvements in land use and ownership, and establishment of weather risk sites.⁵⁵⁸ Issues of landlessness, income disparity, unemployment,⁵⁵⁹ and rural-urban relationships⁵⁶⁰ echo forecasts of the 1970s.⁵⁶¹ Small-holder cultivation, a critical social mechanism in Thailand, appears viable into the future under expected political conditions⁵⁶² possibly in association with off farm labour,⁵⁶³ and through an increase in status accorded to self-sufficiency.

A New Agricultural Paradigm

After a period of rapid growth and consolidation in agriculture, broader economic events can easily overshadow the successes and failures in the agricultural sector. Notwithstanding recent economic setbacks, the long term future of Thailand's natural resources continue to require both the attention of planners⁵⁶⁴ and the public. Issues of irreversible changes to the Thai landscape from rice and rubber agriculture, upland deforestation and coastal prawn aquaculture among other activities, changes in water regimes from agriculture and logging, as well as irrigation and uncontrolled groundwater extraction, are now complemented by environmental concerns relating to pollution from agriculture and agribusiness.

⁵⁵³ Poapongsakorn, Nipon (1999)

⁵⁵⁴ Coxhead, I and Plaugraphan, Jiraporn (1998)

⁵⁵⁵ Tantivadakarn, Cayun (1999)

⁵⁵⁶ World Bank (1987)

⁵⁵⁷ Poapongsakorn, Nipon (1999)

⁵⁵⁸ Bangkok Post (1998)

⁵⁵⁹ Rogers, K.D. and Itharattana, Prasit (1976)

⁵⁶⁰ Pakkasem, Phisit (1979)

⁵⁶¹ Fuhs, F.W. (1979)

⁵⁶² Girling, J. (1986)

⁵⁶³ Paxson, C.H. (1992)

⁵⁶⁴ Phantumvanit, Dhira and Sathirathai, Suthawan (1998)

Traditional retention of native trees by small-holders,⁵⁶⁵ and social-reforestation programs⁵⁶⁶ point to the environmental scope of rural projects in an era when value is ascribed to natural resources,⁵⁶⁷ and increased requirements for realistic environmental analyses and public accountability.⁵⁶⁸ Fertiliser and pesticide environmental flows and agro-industrial leakages⁵⁶⁹ are now scrutinised in a global and national ethic. One hopes that environment is not raised above social equity amidst this new fervour. The period of easy agricultural development has ended in the 1990s, as may have security and nation building priorities. In this new circumstance, an evolution into three types of agriculture for Thailand may well be indicated to government:

Agriculture Type	Government Inputs
Commercial	Improved education and research in environmental management and technologies
Self sufficient	Social safety-net policies; Environmental awareness activities; Rural agribusiness and off-farm opportunities
Mixed	All of the above plus freedom of lifestyle choice in agriculture and rural life varying over time

The major commodities of Thai agriculture and roles of government and agribusiness will be determined by practices of today which are discussed in terms of crops, livestock, forestry, and associated businesses and institutions in the following chapters.

Summary

Key points pertinent to Thai agriculture which may be elicited from consideration of the 1990s include:

- Decreased relative contributions of agriculture to GDP belied its importance in terms of employment, resilience in times of crisis, rural social support, and as a cultural basis for the nation, as it remained productive as a result of favourable environmental circumstance and long-suffering peasants when policies of recent decades reflected established views of agriculture as a productive coffer which required little investment.
- National planning focussed development and facilitated foreign inputs finally committing Thailand irrevocably to the global economy, although it adopted a generic planning approach which under-valued self-sufficiency aspects and investment needs of agriculture while it overstated industrialisation prospects in a poorly regulated institutional environment.
- The end of easy expansion of agriculture through opening of new lands, coupled with the planning approach to funding State projects, facilitated the adoption of green revolution technologies which have allowed continuous increases in production at a

⁵⁶⁵ Ingersoll, J. (1969)

⁵⁶⁶ TDRI (1989)

⁵⁶⁷ Sadoff, C.W. (1992)

⁵⁶⁸ Hirsch, P. (1998)

⁵⁶⁹ Kaosaard, Mingsarn and Kositrat, Nisakorn (1993)

relatively lower environmental cost than other countries, while rural poverty increased with uneven spread of economic benefits.

Chapter 8

Crops

The dominance of rice reflects both the natural environment of Thailand and the historical origins of its agriculture. Attempts to diversify have usually met with limited success until recent decades; the number of farms growing more than one kind of crop increased by only two percent and the area by five percent between 1978 and 1993, mainly in newly opened and unirrigated land. As diversification is conventionally associated with farmer risk aversion,⁵⁷⁰ the Thai case suggests that wet rice is locally perceived as low risk. This has been the lesson of agricultural history for the Tai and Thai. Perhaps the main form of diversification in recent times has been income from off-farm labour.⁵⁷¹ Hence rice remains the leader in Thailand's ten leading primary crops, others being; sugar, maize, cassava, oil palm, coconut, soy bean, mung bean, garlic, and groundnuts. The estimated value of major crop products received by farmers in 1996 is presented in Table 8.1; rubber is omitted from most tables of farmer crops and in the case of Thailand masks its leading producer status with one-third of the world's production returning an export income of some seven billion baht in 1997.⁵⁷² Thailand also leads in canned pineapple production.

Table 8.1 Estimated Value Received by Farmer from Principal Crop, 1996⁵⁷³

Product	Value Million Baht	Product	Value Million Baht
1. Rice	123,317	11. Tobacco	2,027
2. Sugar cane	23,122	12. Groundnuts	1,639
3. Maize	17,815	13. Shallot	1,583
4. Cassava	12,840	14. Chilli	1,214
5. Oil Palm	5,430	15. Cotton	938
6. Coconut	4,700	16. Kenaf	780
7. Soy bean	3,120	17. Sorghum	619
8. Coffee	2,582	18. Sesame	587
9. Mung bean	2,533	19. Onion	412
10. Garlic	2,397	20. Kapok	371

Major production areas are the irrigated and high-rainfall lowlands, mainly of the Central Plain and the South. The Northeast is affected by variable water regimes, and the North is highly productive, in its narrow river valleys. The northern highlands, once dominated by shifting cultivation⁵⁷⁴ with reducing periods of forest fallow,⁵⁷⁵ are tending towards perennial farming⁵⁷⁶ based on minimal tillage⁵⁷⁷ and leguminous trees such as *Gliricidia*

⁵⁷⁰ Binswanger, H. and Siller, H. (1983)

⁵⁷¹ Poapongsakorn, Nipon et al (1995)

⁵⁷² FAO (1999)

⁵⁷³ Office of Agricultural Economics (1988)

⁵⁷⁴ Zinke, P.J. et al (1978)

⁵⁷⁵ Kyuma, K. and Pairintra, Chaitat (1983)

⁵⁷⁶ Sanchez, P.A. (1982)

and *Leucaena*⁵⁷⁸ in socially sustainable systems.⁵⁷⁹ Concerns that hilltribes preferred to grow opium eventually abated as it became clear that their primary concern was a means to obtain sufficient rice.⁵⁸⁰

The opening of new uplands to non-rice crops caused the proportion of cultivated area allocated to rice to decline from about 77 to 55 percent (Table 8.2) in the thirty years from 1961. Over this period, assisted by the emphasis on central planning, agricultural statistics have improved in accuracy and timeliness;⁵⁸¹ such information as presented in the following three chapters is thus easily updated through the sources indicated.⁵⁸² Rice always comes first in Thailand.

Table 8.2 Proportion of Cultivated Area by Crop for each Region⁵⁸³

Rice Crop	Year	Northeast	North	Central	South	Country
Wet Season	1961	30.49	14.58	25.23	6.12	76.43
	1970	28.95	13.78	17.84	4.59	65.16
	1980	27.80	12.36	11.95	4.01	56.12
	1985	26.35	11.79	11.09	3.27	52.51
	1991	27.49	11.23	9.44	2.78	50.94
Dry Season	1961	0.01	0.05	0.08	0.00	0.14
	1970	0.01	0.13	0.69	0.03	0.86
	1980	0.15	0.35	2.61	0.07	3.18
	1985	0	0.39	2.78	0.17	3.52
	1991	0.61	0.98	2.48	0.08	4.15

Rice

Possibly originating in the southwest Himalayas,⁵⁸⁴ the first cultivation of rice may have been in southern China, Southeast Asia, or India and its first irrigation relatively recently in 780 BCE.⁵⁸⁵ Rice seed broadcasted into receding flood water areas was the earliest form of wet rice domestication⁵⁸⁶ in Thailand, which was an early prehistoric site regardless of archaeological doubts.⁵⁸⁷ Opportunistic harvesting had long given way to agriculture before Khmer and Tai times, although early Mon and Khmer influence⁵⁸⁸ probably began the rice revolution of Thailand⁵⁸⁹ by building on the agro-cities of the shallow and gentle floodplains. Khmer annual rice production of 38,000 ton of hulled

⁵⁷⁷ Greenland, D. (1975)

⁵⁷⁸ Falvey, L. (1982)

⁵⁷⁹ Grandstaff, T. (1980)

⁵⁸⁰ Grandstaff, T.B. (1979)

⁵⁸¹ Office of Agricultural Economics (1999)

⁵⁸² Office of Agricultural Economics (1999)

⁵⁸³ Poapongsakorn, Nipon (1995)

⁵⁸⁴ Vavilov, N.I. (1930)

⁵⁸⁵ Grist, D.H. (1959)

⁵⁸⁶ Wyatt, D.K. (1989)

⁵⁸⁷ Yen D.E. (1977)

⁵⁸⁸ Rogers P. (1996)

⁵⁸⁹ Van Beek S. (1995)

rice⁵⁹⁰ from some five million hectare⁵⁹¹ substantiated the region's huge potential. Migrating Tai wet rice cultivators⁵⁹² blended their unique *muang fai* irrigation with Khmer technology to control increasingly larger rivers until the flooding of the delta was controlled. Ayutthaya management of receding flood waters allowed rice export to begin, notwithstanding views that rice was only for subsistence prior to the 1850s,⁵⁹³ with entrepreneurial skills being found in Chinese middlemen⁵⁹⁴ as rice expanded along small canals and contour barriers.⁵⁹⁵ By the 1940s, *muang fai* had failed the demands of intensification⁵⁹⁶ and green revolutionary pressures finally persuaded government to implement a facsimile of the 1906 van der Heide plan to control flooding for an irrigation benefit,⁵⁹⁷ thereby firmly orienting Thai rice production to the world market.

Some 90 percent of the world's rice is produced and consumed within Asia, mainly in the country of production. Consistently the world's largest exporter, Thailand is the sixth largest rice producing country behind populous Asian countries (Table 8.3). It has enjoyed an era of disruption in the other traditional exporting countries of Myanmar and Vietnam, when, at the same time, green revolution technologies have enabled once rice importing countries to become self-sufficient.⁵⁹⁸

Table 8.3 Rice Production (Yield) for Selected Countries 1991 - 1995⁵⁹⁹

Country	Production (ton) and Yield (kg/rai)				
	1991	1992	1993	1994	1995
World Total	515,431 (561)	526,161 (570)	523,743 (578)	536,432 (590)	549,291 (591)
Asia	474,720 (575)	481,106 (586)	480,587 (592)	489,748 (603)	501,980 (604)
China	186,086 (902)	188,255 (927)	179,977 (937)	178,031 (933)	187,192 (963)
India	110,591 (418)	109,001 (419)	118,464 (451)	121,997 (471)	122,372 (461)
Indonesia	44,688 (695)	48,240 (695)	48,181 (700)	46,641 (695)	49,860 (695)
Bangladesh	27,377 (428)	27,510 (432)	27,062 (441)	25,248 (408)	24,659 (397)
Vietnam	19,622 (498)	21,590 (533)	22,837 (557)	23,528 (570)	24,000 (582)
<i>Thailand</i>	<i>10,400 (361)</i>	<i>19,917 (348)</i>	<i>18,447 (348)</i>	<i>21,111 (376)</i>	<i>22,016 (387)</i>
Myanmar	13,199 (462)	14,837 (470)	16,760 (489)	18,195 (507)	20,109 (497)
Japan	12,005 (937)	13,216 (1,004)	9,793 (733)	14,976 (1,083)	12,625 (962)
Philippines	9,673 (452)	9,129 (457)	9,434 (448)	10,538 (456)	11,002 (425)
Korea, South	7,293 (966)	7,303 (1,010)	6,507 (917)	6,932 (1,006)	6,519 (989)
Pakistan	4,865 (371)	4,676 (379)	5,992 (438)	5,170 (392)	5,714 (437)
Nepal	3,223 (365)	2,585 (328)	3,493 (384)	2,928 (330)	2,906 (340)
Sri Lanka	2,389 (483)	2,340 (489)	2,570 (501)	2,684 (479)	2,685 (479)
Korea, North	4,420 (589)	2,439 (600)	2,300 (567)	2,500 (615)	2,580 (635)
Others	8,889 (351)	10,070 (383)	8,770 (352)	9,269 (389)	7,742 (362)

⁵⁹⁰ Hall, K.R. (1992)

⁵⁹¹ Van Liere, W.J. (1980)

⁵⁹² Kato, K. (1998)

⁵⁹³ Poapongsakorn, Nipon (1995)

⁵⁹⁴ Phongpaichit, Pasuk. and Baker, C. (1998)

⁵⁹⁵ Phongpaichit, Pasuk. and Baker, C. (1998)

⁵⁹⁶ van Beek, S. (1995)

⁵⁹⁷ van Beek, S. (1995)

⁵⁹⁸ Haanant, Juanjai et al (1987)

⁵⁹⁹ Office of Agricultural Economics (1998)

Rice Policy

Thailand has been unique among less developed agricultural countries in its three implicit policies for agriculture of:

- maintaining low domestic prices for consumers
- minimising large fluctuations in domestic rice prices
- contributing significantly to government income.

The last separates Thailand from food deficit nations.⁶⁰⁰

Rice policy, as distinct from taxation, was not a focus of government until the 1950s. During the World War II, rice exports to Japan and a large unofficial trade⁶⁰¹ through Malaya confused statistics,⁶⁰² although Allied calculations that stocks totalled two million tons led to a 1946 war reparations demand⁶⁰³ of 1.5 million tons through a period of high world prices.⁶⁰⁴ Frequently renegotiated and managed through a specific office, the burden of producing free rice was transferred to growers, such that with reparation obligations met within two years, government maintained the policy. The differential between domestic and export prices became a major source of government revenue with the effective tax between 1947 and 1955 being about 30 percent; the approach was retained until recently to also subsidise domestic prices.⁶⁰⁵

Thai rice prices have been amongst the lowest in the region through such policies. However, implementation led to farmers being exposed to low world prices, for example in 1971, while consumers were protected through an export subsidy. Low government reserves precluded assistance to farmers although farmer price receipts rose with world prices at a rate above the consumer price index through the third and fourth plans (1972 - 1981). Rice contributed more than 11 percent of government revenues from 1955 to 1965, declining progressively to about two percent by 1975, about \$40 million per year.⁶⁰⁶

Objections to the rice premium have included:

- taxing cash-poor farmers is inequitable
- farmers in the Northeast and the North produce glutinous rice which is not traded globally
- adoption of modern technologies is hampered by low farmer receipts
- rice policy should not be separate from a comprehensive agricultural pricing policy.⁶⁰⁷

⁶⁰⁰ Brannon, R.H. (1978)

⁶⁰¹ Corden, W.M. (1967)

⁶⁰² Silcock, T.H. (1949)

⁶⁰³ Silcock, T.H. (1970)

⁶⁰⁴ Tarlang, N. (1978)

⁶⁰⁵ Rilston, R.A. (N.D.)

⁶⁰⁶ Siamwalla, Ammar (1975)

⁶⁰⁷ Wright, J. (1977)

Each objection was addressed through the late 1970s and 1980s, although policy revisions were then inseparable from the realisation that global agricultural prices would not remain high.

Rice Production Systems

Rice production systems vary by types of rice and region. Four types of *Oryza sativa* widely used in Thailand are:⁶⁰⁸

- **Wetland rice** (*Oryza sativa* var. *dura*) is often referred to as paddy, being produced in controlled flooded fields during the entire growing period and hence is restricted to the delta and valleys with developed irrigation systems. It supplies most Thailand's export rice, although statistical aggregation with glutinous rice usually requires socio-cultural assumptions to estimate its total production.
- **Glutinous rice** (*Oryza sativa* var. *glutinosa*), also known as sticky rice, varies in grain colour and cooking characteristics from paddy. Its translucent colour in the uncooked state and sticky characteristics upon cooking make readily distinguish it among informed consumers. Some ten percent of production is exported to neighbouring Tai-related groups, particularly in Lao-PDR, from the Northeast and North production areas. Production systems for glutinous rice are essentially similar to those for paddy.⁶⁰⁹
- **Upland rice** (*Oryza sativa* var. *montana*) is grown under shifting and permanent cultivation in the mountainous North and poorer upland regions of the Northeast. Entirely dependent on rainfall, it is a subsistence crop which is not considered of statistical importance in official surveys, which might explain false contentions that upland rice is unknown in Thailand.⁶¹⁰
- **Floating rice** (*Oryza sativa* var. *fluitans*) has been long grown in the region, being used earlier than the Mon-Khmer period. It is a type of wetland rice which can rapidly accelerate internodal growth in response to rising floodwaters up to two metres in depth by nutrient-uptake from water more than soil based roots. Low grain and very high stem yields, and modern water control works, have reduce its area to less than half the estimated five million rai (800,000 hectare) of the 1960s, now being used only in flood-prone areas of the Northeast.

Regional variations define much of Thai agriculture and rice. The Central Plain, the country's rice bowl, represents some 45 percent of the area under rice and more than half of total production which is primarily export oriented, producing less than four percent of glutinous rice. The Northeast, with about 43 percent of total acreage, produces less than 30 percent of all rice from its poorer overall water and soil regimes, and a dietary preference for the lower yielding glutinous varieties. The South, with about seven percent of the rice area, produces some nine percent of production, mainly paddy, from small river valleys and coastal plains. The three main river inter-mountain valleys of the North, Chiang Mai-Lampang, Chiang Rai-Lampang, and Phrae-Nan, with silty loam soils

⁶⁰⁸ Donner, W. (1978)

⁶⁰⁹ Judd, L. (1964)

⁶¹⁰ De Datta, S.K. (1975)

contribute more than ten percent of production from six percent of the national rice area, increasing with a shift away from glutinous varieties.⁶¹¹

Glutinous Rice

The long cultural and regional association with wet rice⁶¹² includes effects from trading, migration, and market demand. Technologies and varieties of the North or Northeast reflect the southern China migration route of the Tai, while the Central Plain reflects Indian influence through the Mon- Khmer and other cultures of the Mekong delta region in its Bengal rice cultivation approaches, in common with the South.⁶¹³ Glutinous rice history provides interesting insights to Thai culture.

Glutinous rice is a peculiarly Tai phenomenon. Today it is synonymous with subsistence production with some cross-Tai group trading, and possibly, an embryonic boutique market. Its different cooking, eating, and taste qualities separate sticky rice eaters from others in terms of kitchen, meal, and snacking behaviour. Cohering at temperatures as low as 72°C which produce no change in non-glutinous varieties,⁶¹⁴ sticky rices⁶¹⁵ exhibit different amylose:amylopectin ratios, and contain four to five percent of dextrose in their endosperm compared to very low levels in non-glutinous varieties.

Glutinous rice growing is today a cultural preference, not an indication of environmental variation. It covers an estimated one-half million square km⁶¹⁶ across several ethnic groups, the majority of which are of Tai origin and all of which have some Tai association (Figure 8.1). Originating as a short growing season variety suited to low rainfall regimes and light soils with minimal water control and being a recessive mutant which can only be differentiated at harvest, suggests that glutinous varieties were selected from non-glutinous varieties.

Figure 8.1 The Glutinous Rice Zone of South East Asia⁶¹⁷

Large scale adoption of non-glutinous varieties in response to market demand during the Ayutthaya and, in particular the Bangkok, period was consolidated through controlling of water environments to favour the, originally, longer growing season non-glutinous varieties.⁶¹⁸ The recent nature of the change to non-glutinous varieties with incidental changes in diets, is indicated from the, now export oriented Chiang Mai valley, which in 1974 grew glutinous varieties on more than 80 percent of the rice area.⁶¹⁹ Genetic modification of non-glutinous varieties led to their yield capacities exceeding those of glutinous varieties, thereby ensuring their commercial dominance.

⁶¹¹ Chomcalow, N. (1993)

⁶¹² Kato, K. (1998)

⁶¹³ Watabe, T. (1978)

⁶¹⁴ Chandraratna, M.F. (1964)

⁶¹⁵ Chang T.T. and Bardenas, E. (1965)

⁶¹⁶ Watabe, T. (1967)

⁶¹⁷ Watabe, T. (1967)

⁶¹⁸ Golomb, L. (1972)

⁶¹⁹ Tanabe, S. (1994)

Variations in photoperiodicity,⁶²⁰ photosynthetic and temperature responses, water regime requirements, grain production characteristics, suitability for harvest, and a range of other factors were considered in breeding new non-glutinous varieties. These produced the high-yielding varieties of the green revolution emanating from programs of the International Rice Research Institute.⁶²¹ Their development caused the apparent cyclical movement between broadcasting and transplanting techniques in Thailand's delta region. With the advent of rice mono-culture in the delta, the preferred transplanting of rice seedlings shifted to broadcasting, to cover the larger areas available.⁶²² Progressive intensification of rice production with the advent of high yielding varieties favoured re-introduction of seedling transplantation to allow double cropping and efficient water management. The less labour intensive broadcast sowing required growing periods of up to nine months.⁶²³ By the 1970s, 80 percent of the rice area was transplanted.⁶²⁴

Rice Breeding

Thousands of rice varieties chosen over millennia were once cultivated from India across southern China and through Southeast Asia when communities remained relatively separated. With migration, knowledge of varietal suitabilities to sites led to sharing of genetic material such that as recently as the eighteenth century some 300 varieties were in use in the Red River delta region of Vietnam.⁶²⁵ By 1991, such traditional varieties represent only about two percent of the planted area in Thailand⁶²⁶ and projected reductions in subsistence farmer numbers would exacerbate the trend of genetic uniformity.⁶²⁷ Modern recent rice breeding in Thailand began around 1907 at the Thanyaburi research station; production of longer grains to suit the domestic market led to some notoriety at the 1933 World Grain Exhibition Conference in Canada. However, until the 1950s, rice yields remained low averaging 250 kilogram per rai (1.6 ton per hectare). Foreign and Thai breeders of the 1950s used pure line breeding until hybridisation was introduced from India, although this work was soon overshadowed by the IR8 variety developed through the International Rice Research Institute.

Discerning Thai palates deemed IR8 as poor, causing its slow acceptance until it was crossed with a native variety, *Luang Thong*, to produce two palatable photoperiod-insensitive varieties. Further, glutinous and non-glutinous varieties were developed through the Thai Rice Research Institute for major rice production environments and dry season cropping. By the 1990s, 27 lowland rice varieties were being recommended, nine of which had been produced through hybridisation, three through mutation breeding and 15 through pure line selection, with 19 being non-glutinous varieties and 21 being photoperiod insensitive. Five floating rice and three upland rice varieties were also

⁶²⁰ Tanaka, A. et al (1966)

⁶²¹ IRRI, (1995)

⁶²² Tanabe, S. (1978)

⁶²³ Kulthong Kham, S. et al (1964)

⁶²⁴ Donner, W. (1978)

⁶²⁵ Steinberg, T. J. (1987)

⁶²⁶ Choice, W. (1995)

⁶²⁷ Choice, W. (1995)

produced, of which four were pure line selections for floating rice, three were non-glutinous varieties, and all were photoperiod insensitive, as was the single hybridisation produced variety of floating rice. Upland rice selections were based on pure lines, two of which were non-glutinous and all photoperiod insensitive. High demand rices such as Basmati were also imported from India and Pakistan.⁶²⁸

Rice Husbandry

During the 1960s, the relative labour inputs (Table 8.4) for three Thai rice cultivation systems indicated that the high labour inputs of transplanting produced lower outputs than broadcasting, thereby confirming that transplanting was used for other reasons other than saving of labour. Broadcasting dominated from years 1890 to 1935 when transplanting assuming importance. Shifting cultivation remained important throughout in some areas, although in major rice production areas was only of significance to the mid-nineteenth century.⁶²⁹

Table 8.4 Labour: Harvest Output Comparisons for Rice Production Systems⁶³⁰

System	Labour Days per Crop Season	Output (ton)	Output:Input
Shifting	245	2.5	9
Broadcast	301	6.2	20
Transplanting	430	5.4	12

The intensive work schedule for wet rice production follows the phases of:⁶³¹

- pre-crop preparation of nursery beds, watering facilities, ploughing and harrowing equipment, cleaning of paddies, repair of bungs and purchase of inputs
- nursery tending under semi-flooded conditions with supplemental watering, weeding and culling⁶³²
- ploughing and harrowing of paddy fields with traditional animal-powered wooden ploughs or two- or four-wheeled tractors, puddling of the paddy in cases where buffalo are used for draught, harrowing with wooden or modern implements followed by levelling with a simple grader
- cleaning of the paddy field in situations where ploughing and harrowing has been shallow or hurried and remaining weeds necessitate hand weeding
- preparing seedlings for transplanting by hand pulling from the nursery, shaking off excess mud, and trimming shoots from their 60 - 70 centimetre to about 40 centimetre to facilitate transplanting, minimise evapotranspiration, and to inhibit excessive tillage and vegetative production

⁶²⁸ Setboonsarng, Suthad et al (1988)

⁶²⁹ Hanks, L.M. (1972)

⁶³⁰ Hanks, L.M. (1972)

⁶³¹ Calavan, M.M. (1977)

⁶³² Watabe, T. (1967)

- transplanting as a communal activity performed by hand planting rows while walking back to the next planting position to achieve average spacing of about 15 - 30 centimetre with up to six plants per site
- weeding by hand or through herbicide spray once or twice within the first month, although in some cases not at all, to control aquatic species of *Cyperacia* and *Graminae*
- irrigation is largely determined by the projected release of dam waters which has formed the basis for scheduling other activities; with the arrival of water sufficient to flood the paddy, management of the regime is largely limited to maintenance of the flooded regime through pumping in marginal areas and weeding, and upon maturity, draining the paddy and allowing rice to dry
- harvesting of mature plants by grasping the tops of several together, cutting the stalks about 25 - 30 centimetre above ground level with a short, curved sickle and laying cut stalks to dry in the sun for two to three days, except in the South where a small curved knife is used to harvest only the head of the rice plant
- threshing of bundles of rice stalks which have been dried either by hand using a bamboo or wooden and rope tool to hold bundles which are beaten against the inside of the *khu* harvest basket, or by utilisation of small motorised threshing machines
- storing of threshed rice in farm storage bins possibly after further drying, or bagging for sale to rice mills.

The relationship between rice production and area has been reasonably stable notwithstanding an increase in double cropping with the development of irrigation facilities in the past three to four decades.⁶³³ The expansion of planted area over the period 1988 - 1997 (Table 8.5) by some 10 percent was associated with a production increase of approximately 22 percent as a result of a yield increase of 20 percent which, with an increase in farm price of 44 percent led to an increase in farm value of 70 percent, reflecting some redress of low returns in rural areas during the previous decade.

Table 8.5 Total (First and Second Crop) Rice Area, Production, Yield, Farm price and Value, 1988 - 1997⁶³⁴

Crop Year	Planted area '000 rai	Production '000 ton	Yield kg/rai	Farm Price baht/ton	Farm Value million baht
1988	58,888	18,428	322	3,946	70,874
1989	64,677	21,263	343	3,980	84,626
1990	64,439	20,601	334	3,629	74,761
1991	61,910	17,193	313	3,608	62,032
1992	59,671	20,400	361	3,808	77,683
1993	60,453	19,917	348	3,286	65,447
1994	59,251	18,447	348	3,727	68,752
1995	60,677	21,111	376	3,857	81,425
1996	63,353	22,016	387	4,764	104,884
1997	63,728	22,332	386	5,522	123,317

⁶³³ Office of Agricultural Economics (1998)

⁶³⁴ Office of Agricultural Economics (1998)

Variations in rice yields with rainfall and temperature have been made manageable with irrigation in many areas, although irrigation water availability, competitive water regimes for other crops, and drought in rainfed and partially irrigated rice areas continue to affect production. A critical period remains that of the early wet season when rice is planted before monsoon rains replace intermittent thunderstorms.⁶³⁵ Reliable access to water will determine the future of Thai rice and allow application of known technologies which can increase yields by two to four times current levels. This may well occur regardless of government intent as tradition continues to give way to commerce. Commercial production has already impacted on the disadvantaged Northeast where it was not predicted, as indicated by a relationship between rice plantings and price,⁶³⁶ which would not be expected if the traditional glutinous varieties were the majority crop.

Notwithstanding the substitution of other crops for rice whether as a result of farmer initiatives, government diversification policies, declines in domestic rice consumption, or depressed global prices, rice will remain critical to Thai agriculture. Large infrastructural investments, including irrigation systems, are more suited to rice than other crops and have decades of service left at marginal cost. Global demand for cereals remains high. The Thai environment and culture continue to favour rice production above other crops, and current production systems allow scope for large yield increases and possibly sustainable innovations as a benefit of relatively low current yields. Unrealised potential to patent research outcomes in rice production and high value processing could consolidate Thailand's historical leadership in international rice production, although ownership of such genetic material may have already left Thailand.⁶³⁷

Maize

Introduced more than four hundred years ago by Portuguese traders, the suitability of maize to the Thai agricultural environment led to widespread planting as a minor domestic industry. Introduction in the 1920s of flint and dent varieties suitable for poultry feeding by Prince Sitiporn Krisdakorn⁶³⁸ provided a fillip until, after World War II, maize rapidly became an export crop;⁶³⁹ domestically consumed maize was thenceforth treated as a miscellaneous vegetable despite rising use as a livestock feed.⁶⁴⁰ Now Thailand's third largest export income earning crop after rice and rubber, maize has shared green revolution advances including Thai-based breeding successes. Thailand ranks as about the sixteenth largest producer of maize in world terms (Table 8.6).⁶⁴¹

Table 8.6 Selected Maize Areas, Production and Yields, 1991 - 1995⁶⁴²

⁶³⁵ Tartasathy, N. (1971)

⁶³⁶ Rogers, K.D. and Itharattana, Prasit (1982)

⁶³⁷ Rerkasem, Benjawan. (1999)

⁶³⁸ Ampol, Poapongsakorn, Nipon (1995)

⁶³⁹ SEARCA (1975)

⁶⁴⁰ Ministry of Agriculture (1950)

⁶⁴¹ FAO (1995)

⁶⁴² Office of Agricultural Economics (1998)

Country	Production '000 rai					Area '000 rai	Yield kg/rai
	1991	1992	1993	1994	1995	1995	1995
World Total	478,414	520,968	465,585	566,698	508,100	835,572	608
Asia	131,187	131,346	136,628	134,249	148,982	254,940	584
China	99,094	95,722	103,050	99,622	112,331	142,819	787
India	7,983	10,202	9,480	9,490	9,800	37,500	261
Indonesia	6,256	7,995	6,460	6,869	8,223	22,794	361
Philippines	4,655	4,559	4,798	4,519	4,161	16,888	246
<i>Thailand</i>	<i>3,793</i>	<i>3,672</i>	<i>3,328</i>	<i>3,965</i>	<i>4,154</i>	<i>7,896</i>	<i>526</i>

Maize production expanded at an average of 22 percent per annum from the 1950s to the early 1970s⁶⁴³ as part of a rise from pre-World War II annual production of 5,000 ton to more than one million ton by 1965. Together with USA assistance, government programs in the Northeast built on the apparent suitability of its relatively drier climate for maize production.⁶⁴⁴ Successful expansion occurred in the Northeast in conjunction with a second promoted crop, kenaf,⁶⁴⁵ although subsequently maize expanded rapidly beyond the Northeast while kenaf did not. Statistical shifts in maize production from the Northeast to the Central region are confounded by some southern Northeast provinces where maize is grown being re-categorised as Central, with the result that only one Northeast province was shown as a major maize producer in 1971; hence maize production is considered highest in the Central region.⁶⁴⁶ These northern Central provinces are more accessible to the Bangkok port, and were some of the last frontier areas which once separated the Northeast plateau from the Central Plain. Their high fertility and reasonably reliable rainfall also met criteria for larger farm sizes.

Domestic consumption of maize as seed and livestock feed increased annually by 14 percent through the late 1960s as livestock feedmills and agribusiness expansion began, continuing through the 1970s. Some 2.3 million ton was exported in 1974 in a stable price environment as Japan, in particular, enhanced its own lifestyle through feedlot and other animal product consumption.⁶⁴⁷ As a newly expanded crop, maize escaped the historic premiums, price policies, and monopolistic trading of rice, and was consequently served by Chinese-Thai middlemen provision of credit, technical advice, collection, and marketing. Middlemen developed storage, shelling, drying, cleaning, and fumigation facilities to consolidate maize for transport to ports.⁶⁴⁸ Japan remained a most important market until the early 1970s with Japan, Taiwan, Hong Kong, Singapore, and Malaysia taking 90 percent of Thailand's exports; Taiwan became the principal market in 1974 accounting for 20 percent of the exports.

Despite statistical inaccuracies,⁶⁴⁹ maize production for export overshadowed increases in production of sweet corn for domestic consumption. Sweet corn varieties, particularly

⁶⁴³ Onchan, Tongroj (1975)

⁶⁴⁴ Brown, L.R. (1963)

⁶⁴⁵ World Bank (1959)

⁶⁴⁶ Gajewski, P. (1965)

⁶⁴⁷ Silcock, T.H. (1970)

⁶⁴⁸ Onchan, Tongroj (1975)

⁶⁴⁹ Silcock, T.H. (1970)

baby sweet corn, increased through the 1980s for the export oriented canning industry. The areas, production, yields, farm price and value for maize over the decade 1987 to 1997 are presented in Table 8.7. Through this period, the area planted has varied between years showing an overall decline, while yield and price have tended upwards, with the consequence that farm value has risen by an average of almost 12 percent per annum. In regional terms, the North followed by the Northeast, represent the current major areas of planting with production being greatest from the North and the Central Plain, thereby reflecting the lower average yields of the Northeast; for example, in 1996 - 1997, the Northeast averaged 482 kg per rai compared to 608 kg per rai for the Central Plains and a national average of 552 kg per rai.⁶⁵⁰

Table 8.7 Maize: Area, Production, Yield and Farm Price and Value, 1997 - 1996⁶⁵¹

Crop Year	Area '000 rai	Production '000 ton	Yield kg/rai	Farm Price Baht/kg	Farm Value million Baht
1987/88	10,941	2,781	328	2.52	7,008
1988/89	11,471	4,675	419	2.62	12,248
1989/90	11,166	4,393	411	2.92	12,827
1990/91	10,910	3,722	385	2.44	9,081
1991/92	9,219	3,793	434	2.75	10,430
1992/93	9,446	3,672	475	2.72	9,987
1993/94	8,370	3,328	437	2.81	9,351
1994/95	8,829	3,965	470	2.92	11,577
1995/96	8,346	4,155	526	4.05	16,827
1996/97	8,665	4,533	552	3.93	17,814

Rapid expansion of the maize industry was due to: malaria control: transportation improvements; Japanese market expansion; externalities of the rice export tax; low population to land ratios; Guatemala varieties and associated breeding; local adaptive research, and trade policy and agreements.⁶⁵²

The malaria control program of the 1950s allowed penetration of hitherto uninhabitable upland areas for logging and agricultural expansion.⁶⁵³ At the same time, assistance from the USA to build highways through the Northeast to Bangkok facilitated movement of agricultural inputs and product.⁶⁵⁴ Farmers responded by planting maize rather than rice as a cash crop in rainfed areas, as they avoided the substantial government tax on rice.

Pre-green revolution maize varieties suited Thailand. Subsequent green revolution research introduced the Guatemala variety⁶⁵⁵ which local adaptive research improved.⁶⁵⁶ Otherwise known as cultivar C-110 Tiquisati Yellow Flint, the Guatemala variety was

⁶⁵⁰ Office of Agricultural Economics (1998)

⁶⁵¹ Office of Agricultural Economics (1998)

⁶⁵² Onchan, Tongroj (1975)

⁶⁵³ Behrman, J.R. (1968)

⁶⁵⁴ Chaiyong, Chuchart et al (1962)

⁶⁵⁵ Silcock, T.H. (1970)

⁶⁵⁶ Wagner, M.M. (1969)

subject to broadly based mass selection for quantity and quality in a national Thai breeding program, and with subsequent refining, emerged in 1969 as a Thai variety known as Praputthabat Number 5. Useful until infestations by downy mildew (*Sclerospora sergie*) demonstrated the superiority of another cultivar being developed at the same time, Praputthabat, on which more than 95 percent of exported corn had relied in the early 1960s,⁶⁵⁷ gave way to Suwan 1.⁶⁵⁸ The Rockefeller Foundation-assisted research also demonstrated the benefits of ongoing agricultural research in a manner uncommon in Thai agricultural support services. It was extended beyond breeding to agronomic practices, in particular time and method of planting, seed bed preparation, and weed control practice. Consolidation of the research program led to The National Corn and Sorghum Research and Training Program being initiated in 1965 as a joint activity of Kasetsart University, the Ministry of Agriculture, the United States Overseas Mission, and the Rockefeller Foundation⁶⁵⁹.

Export agreements for maize aimed to secure markets and prices from 1959, although inability to deliver contracted production in short-fall years and opportunistic seeking of higher priced markets in surplus years, voided contracts. Government re-licensing of exporters led to annual government to government agreements with Japan from 1966⁶⁶⁰ with similar agreements being made subsequently with Taiwan.⁶⁶¹ Government issuance of several licences with small export quotas led to high costs per exported ton,⁶⁶² which entrepreneurial pooling of export licenses by Chinese-Thai traders overcame. By the mid-1970s, optimistic assumptions by planners of continued maize expansion would have required increased research allocations and an unprecedented level of cross-departmental coordination. In the event, yield targets were not met; an unsurprising outcome to scientists observing the declining fertility of the newly cleared soils under the high nutrient demands of maize.⁶⁶³ Hence, maize area has contracted from more than 11 million rai to something around 8 million rai in the most recent ten years.⁶⁶⁴

Environmental concerns from the 1970s noted the changing ecology of upland areas, biodiversity loss with widespread clearing, rapid soil fertility decline, and rapid depletion of soil organic matter, and linked these to declining yields which led to an unintended outcome of further clearing of virgin forest. Rotational planting of a legume crop to contribute some nitrogen for a subsequent maize crop⁶⁶⁵ has been adopted in some areas, although the higher environmental cost approach of high nitrogen fertilisers inputs has become the norm.

Mung Bean

⁶⁵⁷ Breitenback, C.A. (1964)

⁶⁵⁸ Poapongsakorn, Nipon (1995)

⁶⁵⁹ SEARCA (1975)

⁶⁶⁰ Houck, J. (1972)

⁶⁶¹ Tongpan, Sopein (1971)

⁶⁶² Fedderson, P. (1972)

⁶⁶³ Sato, T. (1966)

⁶⁶⁴ Office of Agricultural Economics (1998)

⁶⁶⁵ Donner, W. (1978)

Mung bean area expanded rapidly through the late 1950s to the 1970s finding ready market outlets as bean sprouts, gelatin, and vermicelli. By the 1970s, around 70 percent of the four upper Central provinces were planted with mung bean while in the Northeast, its early introduction was soon supplanted by the more suitable kenaf.⁶⁶⁶ Approximately two-thirds of the expansion of the crop occurred in Nakhon Sawan Province in association with transport improvements and immigration.⁶⁶⁷ The rapid adoption of the crop indicates the advantage of mung bean in two ways; it received no specific government promotion, and there was no recorded decrease in yield with expansion into new areas.

Early figures concerning mung bean production in Thailand are confused by their categorisation as peas. It would appear that in 1950 there was approximately 256,000 rai (41,000 hectare) producing some 32,000 ton, which by 1960 had risen to 325,000 rai (52,000 hectare) and 60,000 ton, and by 1970 to 1.5 million rai (240,000 hectare) and nearly 150,000 ton. Yields have been generally highest in the North and lowest in the South.⁶⁶⁸

Table 8.8 Dry Bean Areas, Production and Yield in 1995⁶⁶⁹

Country	Area '000 rai					Production '000 ton	Yield kg/rai
	1991	1992	1993	1994	1997	1995	1995
World Total	165,130	153,657	156,248	169,219	169,736	17,851	105
Asia	84,012	81,312	87,503	88,406	90,305	8,377	93
India	60,269	57,825	61,500	61,500	61,500	4,140	57
China	8,800	7,544	8,788	8,788	8,788	1,811	206
Myanmar	3,313	4,656	6,281	7,600	9,013	966	107
Indonesia	2,250	2,500	2,438	1,825	2,144	308	144
<i>Thailand</i>	<i>2,610</i>	<i>2,189</i>	<i>1,966</i>	<i>2,094</i>	<i>2,080</i>	<i>234</i>	<i>113</i>
Turkey	1,113	1,044	1,013	1,019	1,094	225	206
Iran	969	988	706	681	688	150	218

Thailand produces less than two percent of the world's dry bean product and nearly three percent of that produced in Asia, which represents nearly 50 percent of world production (Table 8.8). Areas of production indicate a marginal rise followed by a general decline over the period 1987 - 1996 which is reflected in production levels as yields have remained relatively static. The North represents some 78 percent of the planted area in recent years, some 80 percent of production with an average yield of the prior four years of 118 kg per rai compared to 113 kg for the Central plain, 104 kg for the Northeast, and 97 kg for the South.⁶⁷⁰ Areas, yields, and values for mung bean from 1988 to 1997 are presented in Table 8.9.

⁶⁶⁶ Donner, W. (1978)

⁶⁶⁷ Silcock, T.H. (1970)

⁶⁶⁸ Donner, W. (1978)

⁶⁶⁹ FAO (1995)

⁶⁷⁰ Office of Agricultural Economics (1998)

Table 8.9 Mung Bean Area, Yield, Farm Price and Value, 1988 - 1997⁶⁷¹

Crop Year	Planted Area '000 rai	Production '000 ton	Yield kg/rai	Farm Prices baht/kg	Farm Value million baht
1988	2,900	267	98	8.41	2,245.5
1989	2,964	333	115	8.67	2,887.1
1990	3,205	356	115	6.24	2,221.4
1991	2,808	303	113	6.70	2,030.1
1992	2,754	304	117	10.90	3,313.6
1993	2,404	261	119	9.23	2,409.0
1994	2,147	231	118	9.44	2,180.6
1995	2,267	256	122	9.72	2,488.3
1996	2,197	234	113	11.88	2,780.0
1997	1,978	218	115	11.62	2,533.2

Cassava

Thailand's uniquely low human consumption sets it apart from other major cassava producers; even in otherwise similar Indonesia it forms a component of upland diets.⁶⁷² Thailand's cassava is mainly destined for animal feeds, starch, and other food components. Ranking first among Asian countries and around equal third largest producer with Zaire, behind Brazil and Nigeria (Table 8.10), Thailand's benefits from this crop are linked to; the past three decades' export orientation policies, upland crop expansion, environmental degradation, and rural poverty.

Table 8.10 Cassava Areas, Production and Yields⁶⁷³

Country	1995		
	Area '000 rai	Production '000 ton	Yield kg/rai
World Total	101,183	161,830	1,599
Asia	22,389	46,411	2,073
<i>Thailand</i>	<i>7,782</i>	<i>16,217</i>	<i>2,084</i>
Indonesia	7,913	15,438	1,951
India	1,594	6,000	3,764
China	1,438	3,501	2,435
Vietnam	1,756	2,497	1,422
Philippines	1,344	1,870	1,391
Malaysia	263	440	1,673
Africa	61,750	82,776	1,341

First introduced to Asia by the Portuguese, cassava was adopted in Indonesia prior to its introduction through Singapore to Thailand around 1845.⁶⁷⁴ Initially used as a dessert,

⁶⁷¹ Office of Agricultural Economics (1998)

⁶⁷² Falcon, W.P., Jones, W.O., and Pearson, S.R. (1984)

⁶⁷³ FAO (1995)

the 1955 introduction of a starchy variety from Malaysia by Chinese expanded production marginally through intercropping with rubber.⁶⁷⁵ Its first expansion appears to have been in Chonburi Province which has the only recorded planting in the immediate post-World War II years, possibly as a outcome of wartime industrialisation. Introduction of a different variety to the Pimai District of Nakorn Rachasima Province in 1961 led to rapidly adoption in all provinces of the Northeast.⁶⁷⁶ Areas of planting in 1956 were recorded as 245,000 rai and in 1965 as 637,000 rai.⁶⁷⁷

The introduction of the *Manihot esculenta* bitter variety, transformed upland Thailand. Initially the industry was based on the export of dried cassava chips until the late 1960s when pelletising was introduced.⁶⁷⁸ The EEC proved a reliable market where domestic corn was maintained at a price 40 percent higher than that of the imported cassava,⁶⁷⁹ so Thai production areas reflected negotiated EEC import quotas. The ability of cassava to continue to produce a harvestable yield under conditions of low soil fertility and variable rainfall was complemented by its ease of planting into new areas, flexibility in harvest time, ready marketability, low requirements for management, and associated credit and advance purchase schemes through local middlemen. Never officially promoted by government,⁶⁸⁰ it has times been the subject of attempts at reducing planted areas to minimise environmental degradation.

The efficient nutrient extracting capabilities of cassava allow its use on areas depleted by other crops, with the result that cassava is sometimes mistakenly assumed to have caused the major degradation. On most upland soils of the Northeast, three consecutive crops of cassava are said to preclude any other crop being grown without fertiliser and organic matter inputs. Thailand's comparative advantage in transportation to ports and the EEC to gain a three-fold price advantage over other cassava producing countries⁶⁸¹ highlights a need for balanced agricultural development, such as applying windfall profits from this market to development of sustainable farming systems in poverty areas⁶⁸² where cassava is the main crop.

Cassava areas, production, yield and farm price and value over the past decade are presented in Table 8.11. A general decline in area planted and production is evident while yields have remained relatively constant and farm prices and value have varied according to export market contracts. The major region of planting has remained the Northeast with some 4.7 million rai in 1997 representing 60 percent of the total area, with some 25 percent in the Central Plains and 15 percent in the North; production follows similar proportions of 58, 19, and 12 respectively.

⁶⁷⁴ Poapongsakorn, Nipon (1995)

⁶⁷⁵ McFadyean, A. (1944)

⁶⁷⁶ Poapongsakorn, Nipon (1995)

⁶⁷⁷ Ministry of Agriculture (1958) and (1965)

⁶⁷⁸ Donner, W. (1978)

⁶⁷⁹ Ajanant, Juanjai (1987)

⁶⁸⁰ Silcock, T.H. (1970)

⁶⁸¹ Siamwalla, Ammar (1991)

⁶⁸² Kaosaard, Mingsarn and Rerkasam, Benjawan (1999)

Table 8.11 Cassava Area, Production, Yield, Farm Price and Value 1998 - 1997⁶⁸³

Year	Area '000 rai	Production '000 ton	Yield kg/rai	Farm Price baht/kg	Farm Value million baht
1988	9,668	22,307	2,307	0.60	13,384
1989	9,957	24,264	2,437	0.54	13,102
1990	9,297	20,701	2,227	0.64	13,248
1991	8,960	19,705	2,199	0.83	16,355
1992	9,066	20,356	2,245	0.77	15,674
1993	8,998	20,203	2,248	0.66	13,334
1994	8,642	19,091	2,209	0.58	11,072
1995	7,782	16,217	2,084	1.15	18,649
1996	7,676	17,388	2,265	0.98	17,040
1997	7,690	18,084	2,352	0.71	12,389

Sugar

A traditional crop of Thailand, sugar cane production and sugar manufacture have enjoyed periods of great confidence, foreign investment, government protection, and oligopoly. Notwithstanding such influence, the industry remains one which has failed to fulfil its potential. Against the very large world producers of Brazil and India which can produce more than 300,000 and 250,000 ton per year respectively, Thailand ranks as a medium level producer of something more than 50,000 ton per year at the present time, behind China⁶⁸⁴. Table 8.12 presents 1995 world areas, production, and yield for sugar.

Table 8.12 Sugar Cane Areas, Production and Yields for 1995

Country	Area 000 rai	Production '000 ton	Yield kg/rai
World Total	114,869	1,155,370	10,058
Asia	51,725	518,082	10,016
India	23,438	259,490	11,071
China	7,425	70,924	9,552
<i>Thailand</i>	<i>6,156</i>	<i>57,974</i>	<i>9,417</i>
Pakistan	6,306	47,168	7,480
Indonesia	2,531	30,272	11,960
Philippines	2,406	25,700	10,682
Vietnam	1,031	8,200	7,953

Sugar cane production expanded rapidly during the eighteenth century, particularly after Bowring predicted that it would become the major export of the country, stimulating successive investments which failed to yield to expectations. The 1867 formation of the

⁶⁸³ Office of Agricultural Economics (1998)

⁶⁸⁴ FAO (1995)

Indo-Siam Sugar Company with a 625,000 rai (10,000 hectare) concession never met expected yields of cane or crystalline sugar.⁶⁸⁵ Some thirty other registered factories of that time, each employing between 200 and 300 persons,⁶⁸⁶ as well as larger ventures, suffered when floods ruined new sugar cane areas rendering growers unable to repay advances. The introduction of steam ploughs to open up new lands more cost effectively than manual labour experienced a similar fate⁶⁸⁷. Statistics from this period until the immediate post-World War II period are unreliable.⁶⁸⁸

By 1950, the industry had evolved into one with fifteen private and two government sugar factories which was to rise to a total of 48 by 1960, falling subsequently to 31 by 1970. Expansion and contraction associated with speculation and poor policies marked the industry, as indicated in cane areas of some 337,500 rai (54,000 hectare) in 1950, one million rai (160,000 hectare) in 1960 and some 1.3 million rai (205,000 hectare) by 1970. From 1950 to 1970 production rose from 839,000 ton to 6.6 million ton and export increased from 3,750 ton to 168,000 ton. The combination of protection, periodic inefficiencies in management, and reliance on outdated grower-factory relationships has enabled the industry to make Thailand self-sufficient in sugar, a modest achievement.

Sugar was an import to Thailand until the 1960s when exports began with government aid and expansion to an industry four times larger than it might otherwise have been⁶⁸⁹. A ban on imports and imposition of a levy on internationally traded sugar fostered exports⁶⁹⁰ and produced a short-lived boom until international sugar prices fell.⁶⁹¹ Unregulated monopolistic behaviour allowed periodic exploitation of cane growers. From the mid-1960s, a geographical rationalisation of the industry occurred with the use of introduced cane varieties, some from Taiwan, increased efficiency of sugar extraction through improved delivery and receiving processes, and improved production through agronomic practices such as ratoon management and fertiliser application.⁶⁹² A shift away from the traditional centre of Chonburi is attributed to the greater productivity possible from the central plain provinces of Ratchaburi, Kanchanaburi, and Prachuap Khiri Kan.⁶⁹³ It may also have been associated with land control and lobby.

Areas, production, yield, and farm price and value for sugar cane over the recent decade are presented in Table 8.13. A 72 percent increase in planted area has produced a 107 percent increase in cane from a 21 percent increase in yield which, with a 25 percent increase in the price paid per ton, has increased the farm value of sugar cane by some 159 percent over the period 1988 - 1997. The main production areas have been the Central

⁶⁸⁵ Thompson, V. (1967)

⁶⁸⁶ Ingram, J.C. (1971)

⁶⁸⁷ Donner, W. (1978)

⁶⁸⁸ Gajewski, P. (1965)

⁶⁸⁹ Siamwalla, Ammar and Setboonsarng, Suthad (1989)

⁶⁹⁰ Corden, W.M. (1967)

⁶⁹¹ Silcock, T.H. (1970)

⁶⁹² Ministry of Agriculture (1961)

⁶⁹³ Wu, H.S. (1967)

Plain with 44 percent of the area and 45 percent of production, and the Northeast with 32 percent of the area and 30 percent of production.⁶⁹⁴

Table 8.13 Sugar cane: Area, Production, Yield, Farm Price and Value, 1988 - 1997⁶⁹⁵

Crop Year	Planted Area '000 rai	Production '000 ton	Yield kg/rai	Farm Price baht/ton	Farm Value million baht
1988	3,664	27,191	7,624	328	8,918
1989	4133	36,668	8,896	331	12,137
1990	4,298	33,561	7,823	402	13,491
1991	4,929	40,661	8,314	460	18,704
1992	5,791	47,480	8,288	336	15,953
1993	6,267	39,827	6,426	359	14,297
1994	5,355	37,823	7,569	468	17,701
1995	5,887	50,597	8,774	435	22,009
1996	6,279	57,974	9,417	386	22,378
1997	6,314	56,394	9,205	410	23,121

The extraction of sugar from the palmyra and coconut palm trees continued throughout the rises and falls of the commercial cane sugar industry, supplying local consumption in specialist and village markets.⁶⁹⁶

Coconut

Distinct from sugar cane, maize, and cassava, coconut is a traditional part of the Thai diet. Tending of coconut palms, albeit a minor management task, was part of the agricultural occupation of Thai farmers across the whole country until the nineteenth century attack of the black beetle (*Oryctes rhinoceros*) and red weevil (*Thynochophora*) which effectively eliminated intensive coconut production from the Northeast and Central Plains. The preeminence of southern Thailand has continued even with the introduction of new varieties and technologies to all regions of Thailand. In 1963, 44 percent of the some 34 million coconut trees were said to be in the South, a figure which fell to 41 percent in 1967 when the South produced 51 percent of the country's production.⁶⁹⁷ For the period 1950 - 1970, the area planted to coconuts quadrupled, the number of trees increased by 3.5 times with the consequence that statistics for the bearing trees and production per bearing tree fell, reflecting the higher proportion of young stands.

Coconut production in Thailand failed to develop as a major export industry during the colonial period while its neighbours benefited from these markets. Thai production through the 1960s was estimated to be similar to that of Malaysia which exported seven times as much copra; from such observations came the conclusion that the Thai diet contains a higher proportion of coconut than similarly populated peer producers, thereby

⁶⁹⁴ Office of Agricultural Economics (1980)

⁶⁹⁵ Office of Agricultural Economics (1998)

⁶⁹⁶ Donner, W. (1978)

⁶⁹⁷ Donner, W. (1978)

precluding large scale export of some coconut products.⁶⁹⁸ Until recent decades, about half of the fat component of the Thai diet may have derived from coconuts, representing an annual consumption of around 18 coconuts per person.⁶⁹⁹ Sweet juice continues to be extracted from the unopened coconut flower into a bamboo tube to produce fresh coconut sugar and illicit toddy.

Products of the coconut palm include: oil from the endocarp traditionally used for cooking and lighting and, in recent decades, for soap making, margarine and lubricants; the husk or pericarp which, after soaking in water for 15 to 20 days, can be made into mats, brushes, matting, mattresses, and coarse ropes; and commercial copra which is the coconut oil derived from large kernels. Thai copra of the 1960s yielded around 66 percent oil. In Thailand, coir mattress fibre and rope were produced by two factories with a capacity of around 3,000 ton per year during the 1960s.⁷⁰⁰ Indicative export figures for 1955 reveal export incomes of some 28,000, 541,000, and 8,800,000 baht for nuts, copra, and copra cakes respectively.⁷⁰¹

With the introduction of early maturing small and dwarf varieties, lower harvesting labour requirements and higher production paved the way to a commercial industry for copra production supported by research into the control of insect pests. The utility of coconut palms in stabilising and reclaiming low lying areas, even adjacent to the sea, has allowed a, sometimes temporary, increase in planting. The areas, production, yield, and farm prices and value for coconuts for the years 1987 - 1996 are presented in Table 8.14.

Table 8.14 Coconut Areas, Production, Yields, Farm Price and Value, 1987 - 1996⁷⁰²

Year	Planted Area '000 rai	Production '000 ton	Yield kg/rai	Farm Price baht/ton	Farm Value million baht
1987	2,545	1,311	632	2,072	2,715
1988	2,490	1,378	654	2,736	3,769
1989	2,481	1,437	656	1,816	2,608
1990	2,455	1,426	659	1,968	2,807
1991	2,432	1,379	655	2,600	3,584
1992	2,427	1,411	671	2,704	3,815
1993	2,384	1,435	678	2,704	3,880
1994	2,362	1,413	678	2,208	3,119
1995	2,351	1,419	680	3,312	4,699

Rubber

Thailand is the world's largest producer and exporter of natural rubber (Table 8.15). Unlike rice, it is an industrial crop and has developed from private initiatives in the first

⁶⁹⁸ Anonymous (1971)

⁶⁹⁹ Donner, W. (1978)

⁷⁰⁰ Donner, W. (1978)

⁷⁰¹ Ministry of Agriculture (1961)

⁷⁰² Office of Agricultural Economics (1998)

instance followed by coordinated government responses and skilful international negotiation involving both government and the private sector.

Table 8.15 Major Rubber Producing and Exporting Countries⁷⁰³

	Production (Mt)	Exports (Mt)
World	6,696,771	n.a.
China	451,970	321
India	542,000	1,673
Indonesia	1,586,744	21,352
Malaysia	971,100	119,600
Philippines	197,160	n.a.
Sri Lanka	105,783	107
<i>Thailand</i>	<i>2,168,720</i>	<i>231,035</i>
Vietnam	186,500	n.a.

Rubber is said to have first been introduced to the southern province of Trang in 1901 by the Chinese-Thai nobleman Kaw Sin Bee na Ranong⁷⁰⁴ and developed into an industry around 1918.⁷⁰⁵ This probably reflects Chinese planters from Malaya producing rubber in Thailand to circumvent the Stevenson restriction scheme, and as part of a general Chinese expansion out of Malaya. Under the protection of the King Chulalongkorn,⁷⁰⁶ Chinese-Thai entrepreneurs created an industry in provinces contiguous with Malaysia and populated by Malay speaking persons, possibly reflecting familiarity in working with these communities. From the 1930s, the majority of growers were Malay speakers and traders were Chinese speakers with local control over the industry which was interpreted periodically as illegal land tenure and corrupt exemption from export payments. These entrepreneurial Chinese agriculturists were well established by the 1950s when they were deemed squatters and forcibly ejected.⁷⁰⁷

In the early days, less famous than its colonially dominated neighbours, Thailand received a lower price as a result of poorer cultivation and management techniques. Although a member of the Second International Rubber Regulation Scheme, Thai production statistics are unreliable as a result of illegal plantings and lack of will to abide by the agreement. Cross-border smuggling allowed rubber traders to maximise prices and Thailand found itself the beneficiary of tolerant producer partners who valued survival of the agreement above rejection of one, albeit expanding, producer. By 1935, Thailand had achieved permission to export more than 30,000 ton, four times its 1934 allowance.⁷⁰⁸

⁷⁰³ FAO (1999)

⁷⁰⁴ Ungphakorn, Puey and Yossundara, Suparb (1955)

⁷⁰⁵ Thompson, V. (1967)

⁷⁰⁶ Skinner, G.W. (1951)

⁷⁰⁷ Silcock, T.H. (1970)

⁷⁰⁸ McFadyen, A. (1944)

Over the period from 1910 to 1940, exports increased from some 13 ton to more than 44,000 ton. Prices varied widely with the over-supply which the international agreements sought to regulate. Planting associated with perceived high prices led to over-production approximately 12 years after such periods, which in the case of Thailand, tended to be followed by agreements to increase export quotas.

Before World War II, rubber planting in Thailand was less efficient than that in Malaya and Indonesia which used European methods based on imported labour.⁷⁰⁹ World War I created demand which restrictions on export from British colonies amplified as an opportunity for large expansion of the Thai rubber industry. Through this time, Thailand's, simple production methods, surpassed the opportunistic bush planting of rubber trees of Indonesia and expansion, in conjunction with tin mining also through the Chinese-Thai community, financed the development of some important Thai banks.⁷¹⁰ Further expansions in rubber planting during World War II and the Korean War produced surplus output about seven years later.⁷¹¹

The external environment then shifted with competition from synthetic rubbers⁷¹² which necessitated a more intensive form of rubber production based on high yielding varieties, practical and effective use of bud-grafting, and improved agronomic management. Replanting schemes had been successfully devised and implemented in Malaysia,⁷¹³ although these were not adopted in Thailand until the late 1950s. The total area replanted to improve varieties over the period 1961 to 1965 was 166,000 rai of which some 51,000 was associated with cyclone relief for damaged plantations. Difficulties of accelerating replanting by government directive were the common ones of small-holder independence, risk-averse decision making, and rising distrust of government schemes. In any case the scheme eventually gained momentum and Thailand introduced its own research capacity which followed the tentative path of development of the industry itself before becoming a consistent contributor to expansion of the Thai rubber industry.

By 1960, the Thai rubber industry was characterised as being significantly different from other major producers with some 80 percent of planted acreage managed through small holdings of less than 50 rai and estates exceeding 250 rai representing less than 10 percent and foreign ownership being virtually zero.⁷¹⁴ Thailand's improvement of the rubber industry relied heavily on obtaining bud wood and kernel seeds from Malaysia and the copying of techniques adopted or devised in Malaysia. Improvement of sheet smoking factories, development of small-holder-cooperative size hand-operated machinery, creation of a latex assessment laboratory, as well as the beginning of training for Thai rubber experts flowed from international assistance to the rubber industry from the 1950s.⁷¹⁵ By the late 1950s, the Ministry of Agriculture⁷¹⁶ had noted that rubber was

⁷⁰⁹ Rowe, J.W.F. (1936)

⁷¹⁰ Silcock, T.H. (1970)

⁷¹¹ Silcock, T.H. (1970)

⁷¹² McHale, T.R. (1961)

⁷¹³ Fisk, E.K. (1967)

⁷¹⁴ Ministry of Agriculture (1961)

⁷¹⁵ FAO (1954)

⁷¹⁶ Ministry of Agriculture (1961)

assuming great importance to the Thai economy and contained the potential for great improvement in efficiency, production output, and price; it therefore appealed to the international community for continued foreign assistance through expertise and training.

By 1972, Thailand was the third largest rubber producer in the world behind Malaysia and Indonesia, contributing some 11 percent of world and 12 percent of Asian raw rubber production.⁷¹⁷ The production area had grown over the preceding decade by some 150 percent to more than 5.6 million rai (900,000 hectare).⁷¹⁸ Yields calculated for the period were less than 250 kilogram per hectare across multi-age stands; thus it was expected that yields would rise by the early 1970s to more than 275 kilogram per hectare, by 1975 to 325 kilogram per hectare, by 1980 to 400 kilogram per hectare, and by 1985 to 540 kilogram per hectare.⁷¹⁹ In fact, by 1987 the average national yield was 126 kilogram per rai (790 kilogram per hectare), a figure which rose to 223 kilogram per rai (1,400 kilogram per hectare) by 1996. The planted and tappable areas, production, yield, and farm price and value for rubber across the decade 1987 - 1996 are presented in Table 8.15. This indicates a continuing rise in planted area of about six percent over the decade and a rise in the tappable area of some 12 percent giving a rise in production of some 100 percent which, associated with a general rising farm price through the decade, led to an increase in farm value of 200 percent.

Table 8.15 Rubber: Area, Production, Yield, Farm Price and Value, 1987 - 1996⁷²⁰

Year	Planted '000 rai	Tappable '000 rai	Production '000 ton	Yield kg/rai	Farm Price baht/kg	Farm Value million baht
1987	10,800	8,449	1,061	126	18.30	19,416
1988	10,849	8,468	1,151	136	21.78	25,068
1989	10,899	8,541	1,310	153	17.66	23,134
1990	10,961	8,719	1,418	163	17.18	24,361
1991	11,022	8,824	1,500	170	16.26	24,390
1992	11,124	8,872	1,712	193	16.80	28,761
1993	11,213	9,067	1,811	200	16.00	28,976
1994	11,308	9,213	1,988	216	22.64	45,008
1995	11,376	9,348	2,061	221	31.13	64,158
1996	11,444	9,495	2,121	223	27.53	58,391

Thailand's departure from the two decade old International Natural Rubber Organisation in 1999, which caused its closure, indicates the critical position occupied by Thailand in world rubber production. From an unwelcome entrant to a colonial plantation dominated industry, Thailand developed a small-holder based industry which has received higher than predicated returns through skilful international negotiation. Forming a cartel with

⁷¹⁷ FAO (1972)

⁷¹⁸ Donner, W. (1978)

⁷¹⁹ Reed, M.E. et al (1971)

⁷²⁰ Office of Agricultural Economics (1998)

Malaysia, Thailand now seeks to raise rubber prices from their 30 year low to the benefit of producer small-holders, a difficult task in the face of global oversupply.⁷²¹

Fibre, Extraction and Other Crops

Fibre crops including kenaf, jute, ramie, cotton, kapok and silk, have been, or are, of importance to Thailand. Crops of importance for oil or other product extraction include sesame, oil palm, castor bean, and opium, while other crops of importance include pepper, tobacco, and coffee.

Fibre Crops

Kenaf (*Hibiscus pungenis*) is the most important fibre crop in Thailand while remnant industries of jute, kapok, cotton, and to an extent ramie continue. Thailand ranks fourth behind India, Bangladesh, and China in jute and related products and yet is not a large producer. Global production figures for jute and jute-like fibres are presented in Table 8.16. Several other kinds of fibre yielding plants are also of continuing importance at householder level in rural villages.⁷²² While kenaf is inferior to jute for rope and sack production, the plant's suitability to the drier conditions of the Northeast has allowed the huge Thai rice export market to create a demand for kenaf gunny sacks in an example of building on Thailand's leadership in rice exports. The industry was associated with the upland cropping boom, a government desire for creating an agro-industrial industry for the Northeast, and the opportunity to utilise a new product after a failure of the Bangladesh jute crop.⁷²³ The successful development of the kenaf industry with strategic protection associated with another huge industry was an opportunity not open to other fibres such as cotton and silk.

Table 8.16 World Jute and Jute-like Fibre in 1995: Area, Production and Yield⁷²⁴

Country	Harvested Area '000 rai	Production '000 ton	Yield kg/rai
World Total	11,252	2,863	254
Africa	131	16	122
NC & South America	195	34	342
Asia	10,926	2,813	257
India	5,569	1,527	274
Bangladesh	2,938	770	262
China	1,375	270	196
<i>Thailand</i>	<i>438</i>	<i>105</i>	<i>240</i>

Initially mixed with jute to produce gunny sacks through the late 1940s and 1950s, kenaf became an export commodity itself by 1957 when 10,000 tons was exported. Expansion of planted area continued through the 1950s and 1960s to some 2.4 million rai with

⁷²¹ FEE (1999)

⁷²² Ministry of Agriculture (1961)

⁷²³ Silcock, T.H. (1970)

⁷²⁴ FAO (1995)

adoption through farmer word of mouth rather than government extension.⁷²⁵ Export of jute rose from some 15 percent of production in 1950 to some 68 percent of production by 1970.

Produced with no or minimal fertiliser inputs, kenaf has joined cassava as a crop associated with environmental decline. In common with cassava, kenaf does not cause decline, but rather cultivation methods and poverty of producers creates a need to continue to produce meagre crops in order to survive in a cash economy. Kenaf is also polluting in its farm-level processing which relies on retting in ponds and natural water reservoirs for ten to twelve days to separate clean fibre for drying. The fouled black-coloured residual water is a conspicuous if localised form of agro-industrial pollution which is highlighted by the relative scarcity of dry-season water in kenaf production areas.⁷²⁶ Research has eventually determined methods to utilise kenaf in paper manufacture and stimulated private investment, and government incentives, for a paper mill in the kenaf growing Northeast.

Over the decade 1988 - 1997, kenaf production showed a rapid decline (Table 8.17) associated with difficulties of production and the introduction of alternative crops. Against a 56 percent reduction in area, production has fallen only 37 percent because average yields have increased by some 39 percent. The majority (94 percent) of kenaf is produced in the Northeast with the balance produced in the Central region; Central yields of around 336 kg per rai in 1997 exceeded yields in the Northeast by 42 percent.

Table 8.17 Kenaf: Area, Production, Yield, Farm Price and Value, 1988 - 1997⁷²⁷

Crop Year	Planted Area '000 rai	Production '000 ton	Yield kg/rai	Farm Price baht/kg	Farm Value million baht
1988	1,005	158	173	4.49	709.4
1989	810	157	199	4.63	726.9
1990	793	149	200	6.69	996.8
1991	799	157	207	4.39	689.2
1992	622	127	216	6.96	883.9
1993	598	126	220	6.12	771.1
1994	576	127	237	4.85	616.0
1995	511	116	247	5.66	656.6
1996	452	105	239	9.69	1,017.5
1997	437	99	240	7.88	780.1

Ramie (*Boehmerie nivea*) has been grown for centuries for its durable fish net fibres. Requiring well-drained soil, the agronomy of the crop has been determined through local knowledge as has its use of leaves, which contain around 25 percent protein, for poultry and other livestock feed and as a green manure.⁷²⁸ A labour intensive crop, with limited international demand, ramie production has continued to decline since the 1960s.

⁷²⁵ Chaoyong, Chuchart (1961)

⁷²⁶ Platenius, H. (1963)

⁷²⁷ Office of Agricultural Economics (1998)

⁷²⁸ Ministry of Agriculture (1961)

Kapok (*Bombax pentandra*), a ubiquitous sight in rural Thailand, continues to be used for its short unspinnable fibre and edible seed oil. Suitable for stuffing upholstery and bedding, the domestic association of the crop precluded it from statistical reporting until 1957 when production was of the order of 90,000 ton of fibre. Export in the 1960s reached 20,000 ton per year with the majority being sourced from the Northeast.⁷²⁹ Production since 1988 has risen slightly from increased planting to produce a rising farm value for the crop. Table 8.18 presents summary information for production and prices for kapok from 1998 - 1997.

Table 8.18 Kapok: Area, Production, Yield and Farm Value, 1988 - 1997⁷³⁰

Crop Year	Planted Area '000 rai	Production '000 ton	Yield kg/rai	Farm Price baht/kg	Farm Value million baht
1988	291	40	183	6.31	252.6
1992	317	37	171	9.18	340.5
1997	339	46	188	8.00	371.2

Cotton (*Gossypium aboreum*) has been a traditional domestic crop, and its weaving a traditional village industry, which declined substantially with imported cotton cloth from India beginning in the Ayutthaya period. By the 1920s, the industry was a mere remnant of its original extent.⁷³¹ After World War II, national attempts to develop a cotton industry ultimately failed through poor management of genetic material, diseases, and insect attack. The production area for cotton in the period 1915 to 1919 has been estimated at around 30,000 rai which had declined to some 20,000 rai by the period 1930 - 1934.⁷³²

In 1938, a cotton variety introduced from Cambodia was found to be less hardy, although desirable in other ways, than the native short-staple Thai cotton, and field experiments were conducted at Sukhothai to adapt a line for Thailand.⁷³³ Planted areas rose from some 231,000 rai (37,000 hectare) in 1950 to a peak in 1968 of more than 813,000 rai (130,000 hectare) in response to government restriction of imports,⁷³⁴ although this had declined to around 194,000 rai (31,000 hectare) by 1970.⁷³⁵ Cotton Bollworm and the American Army worm (*Heliothis armigera*) and the inability to quarantine production areas produced the decline; nevertheless, cotton has been considered an economic crop since 1961 as a result of its high demand within the country and the somewhat anomalous existence of a major cheap-labour based manufacturing industry for export.⁷³⁶

⁷²⁹ Donner, W. (1978)

⁷³⁰ Office of Agricultural Economics (1998)

⁷³¹ Credner, W. (1967)

⁷³² Silcock, T.H. (1970)

⁷³³ Ministry of Agriculture (1961)

⁷³⁴ Poapongsakorn, Nipon et al (1995)

⁷³⁵ Donner, W. (1978)

⁷³⁶ Evenson, J. P. (no date)

Technical research conducted through the 1980s⁷³⁷ confirmed earlier enthusiasm,⁷³⁸ and identified constraints related to shortage of seed material, inconsistency of fibre quality, and high costs of production.⁷³⁹ However, low returns relegated the crop to poor soils and suggest that it may remain an orphan crop with possible village level significance for the immediate future. The main production areas for cotton continue to be in the North (53 percent) and Central (32 percent) with no production in the South⁷⁴⁰. Production over the past decade indicates a tendency of decline in area and production and a general increase in yields (Table 8.19). Thailand is a extremely small world producer of cotton.

Table 8.19 Cotton: Area, Production, Yield and Farm Price and Value, 1988 - 1997⁷⁴¹

Crop Year	Planted Area' 000 rai	Production '000 ton	Yield kg/rai	Farm Price baht/kg	Farm Value million baht
1988	412	74	187	12.53	927
1989	442	106	240	10.73	1,137
1990	399	86	218	14.25	1,225
1991	461	97	218	14.04	1,361
1992	621	129	210	10.96	1,413
1993	483	99	222	10.48	1,037
1994	328	67	216	12.15	814
1995	355	78	226	15.90	1,240
1996	363	81	235	15.05	1,219
1997	337	75	234	12.51	938

Sericulture, a romantic and centuries-old industry associated with village handicrafts and palaces, has been the subject of attempts at expansion from a 1902 Department⁷⁴² of Sericulture under Professor Toyama and eight other Japanese experts,⁷⁴³ through to recent foreign aid initiatives. Small silk worms, small individual cocoon output, and traditional practices complement current practices employed in Thai village systems. Production facilities include reeling and threading to make natural silk cloth woven as an under-house village product which, in association with tourism and fashion industries, has developed into an export industry.⁷⁴⁴ In 1997, parts of the silk industry produced total values of some 500 million baht from woven fabrics of silk and related products.⁷⁴⁵

Oil and Extraction Crops

Sesame has been grown at least since last century; the area in the period 1915 - 1919 was estimated to be 7,000 rai. This rose to more than 10,000 rai between 1925 - 1929, falling

⁷³⁷ Evenson, J.P. (1987)

⁷³⁸ Ratanakomut, Konthip (1987)

⁷³⁹ Bromsupha, Suttipun (1987)

⁷⁴⁰ Office of Agricultural Economics (1998)

⁷⁴¹ Office of Agricultural Economics (1998)

⁷⁴² Brown, I. (1980)

⁷⁴³ Thompson, V. (1967)

⁷⁴⁴ Ministry of Agriculture (1961)

⁷⁴⁵ Office of Agricultural Economics (1988)

back to 7,000 rai in the period 1935 - 1939.⁷⁴⁶ With the expansion of cropping areas, introduction of multiple cropping particularly in the North, and the development of oil extraction processing facilities, sesame expanded to become a significant export; some 332 ton of sesame seed oil valued at around 20 million baht was exported in 1997.⁷⁴⁷ Areas, production, and prices have risen over the past decade producing a rise in farm value of more than 130 percent (Table 8.20).

Table 8.20 Sesame seed: Area, Production, Yield and Farm Value 1988 - 1997⁷⁴⁸

Crop Year	Planted Area '000 rai	Production '000 ton	Yield Kg/rai	Farm Price Baht/kg	Farm Value million baht
1988	283	27	96	9.26	252
1989	314	27	87	10.48	286
1980	331	28	83	14.95	410
1991	365	29	80	13.37	390
1992	385	32	83	11.08	354
1993	371	32	85	8.43	265
1994	377	33	87	8.95	293
1995	371	32	86	9.77	310
1996	381	34	88	18.00	603
1997	386	34	89	17.12	587

Producing some 2.3 million ton of palm oil in 1995,⁷⁴⁹ Thailand ranks as the distant fourth highest producer behind Malaysia (60 million ton), Indonesia (27 million ton), Nigeria (10 million ton) and Brazil (4.6 million ton).⁷⁵⁰ Grown only in the South, some 90 percent of production is consumed domestically as vegetable and palm oil. Each processing facility requires a production area of around 40,000 rai for efficient operation, which under extensive modern management conditions may be represented by as few as 10 farm managers. The suitability of plantation management for the crop is demonstrated in the continuation and enhancement of past colonial-style systems in Malaysia, the leading producer. Potential to increase both palm oil production and oil palm plantings has stimulated government assistance to expand the industry. The principal provinces of production are Krabi, Surat Thani, Chumphon and Satun. With a total planted area exceeding one million rai, yields have increased in each producing province with the highest yields being obtained in the provinces of Krabi (2,674 kilogram per rai), Surat Thani, Ranong, Trang and Satun.⁷⁵¹

Castor bean plantings for castor oil have declined markedly from more than 260,000 rai to less than 70,000 rai over the period 1988 to 1997. With a decline in yields over the same time frame, the farm value of the crop has declined from 153 million baht in 1988 to 39 million baht in 1997.⁷⁵²

⁷⁴⁶ Silcock, T.H. (1970)

⁷⁴⁷ Office of Agricultural Economics (1998)

⁷⁴⁸ Office of Agricultural Economics (1998)

⁷⁴⁹ Office of Agricultural Economics (1998)

⁷⁵⁰ FAO (1995)

⁷⁵¹ Office of Agricultural Economics (1998)

⁷⁵² Office of Agricultural Economics (1998)

Opium, an extraction crop long important to Thailand, has not been fully accounted in national statistics. From Rama III's attempts to suppress trading, his successor sold the opium monopoly to Chinese traders for revenues to the three ministries of Finance, Interior and Foreign Affairs. King Chulalongkorn established a State monopoly in 1908 and price rises through the 1920s increased government revenues by 250 percent peaking in 1917 at 25 percent of government income. Restricted Indian supplies in the 1930s stimulated illegal trading in Thailand with government seizure of illegal opium prompting a suggestion that the Ministry of Finance purchase additional opium from Kengtung for trading. Rejecting this idea, the government introduced official opium poppy cultivation in Chiang Mai and Chiang Rai provinces and cancelled import licenses; by 1939 government opium receipts exceeded one million pounds,⁷⁵³ while influential individuals' receipts were substantial and rising. World War II disruption in other opium producing areas widened opportunities for military leaders and other groups assisted by USA interests surrounding Vietnam. Declared illegal in 1957, entrenched opium interests belied government intent.⁷⁵⁴ Foreign supported opium replacement projects of the 1970s and 1980s⁷⁵⁵ showed technical crop and livestock alternatives which were finally made viable with road access and government service delivery, to produce the 1990s outcome of Thailand being a negligible producer of opium.

Other Crops

Pepper (*Piper nigrum* *linm.*), tobacco, coffee, and sorghum are of some importance in Thailand. Pepper expanded around the turn of the century in response to international trade. Planted areas averaged some 45,000 rai in 1912⁷⁵⁶ declining by 1935 - 1939 to some 5,500 rai.⁷⁵⁷ A mainly domestic crop, pepper was probably introduced from India some 2,000 years ago, and was an element of trade between Indonesia, China, and Europe from the twelfth century with Thailand contributing to that trade by the sixteenth century. Subsequent rapid decline in areas reflects global over-supply, and some diseases and pests uncontrollable until recent times. Continuing as a backyard species with a few vines per household,⁷⁵⁸ production is concentrated in the high rainfall southeastern provinces of Chantaburi and Trad. Semi-intensive production involves application of manure, chemical fertilisers, and mulched and burnt pepper leaves on average planted areas of six rai with approximately 340 posts per rai, which produce fruit from year three to at least year fifteen. Late 1980s increases in global demand led to a trebling of planted Thai area from some 10,000 rai in 1986 to 32,000 rai in 1990 until rising labour costs and declining prices of the 1990s stimulated inter-planting with durian and other fruit trees and some abandonment of pepper plots. Current government programs aim to stimulate improved cultivation to increase production for domestic needs.⁷⁵⁹

⁷⁵³ Thompson, V. (1967)

⁷⁵⁴ Phongpaichit, Pasuk and Baker, C. (1997)

⁷⁵⁵ Falvey, L. (1979)

⁷⁵⁶ Ministry of Agriculture (1961)

⁷⁵⁷ Silcock, T.H. (1970)

⁷⁵⁸ Ministry of Agriculture (1961)

⁷⁵⁹ Poapongsakorn, Nipon et al (1995)

Producing some 86,000 tons of coffee beans in 1995, Thailand is a minor producer.⁷⁶⁰ The *Robusta* variety accounts for some 95 percent of the production area which is concentrated in the six southern provinces of Chumphon, producing more than 50 percent, Surat Thani, Ranong, Nakhon Si Thammarat, Krabi, and Phangnga.⁷⁶¹ Exporting 75 percent of production, Thailand makes up only about one percent of world-traded coffee. Increasingly interplanted with coconut, betel, mango, rambutan, durian, mangosteen, and other fruit trees at a density of some 120 coffee trees per rai, declining prices and rising harvesting costs have caused government to assist farmers to replace coffee with fruit trees and cattle pastures.⁷⁶² Coffee areas rose from 440,000 rai to 540,000 rai in 1991 subsequently declining to 440,000 rai, while yields showed a general increase from 138 kilogram per rai in 1988 to 198 kilograms per rai in 1997, leading to production peaking in 1995.⁷⁶³

Tobacco production has been relatively constant, until recent decades, covering some 60,000 rai in the period 1915 – 1919 and some 62,000 rai in 1935 - 1939. Production of Virginia tobacco from 1957 - 1965 ranged from 7,000 to 9,000 ton per year with local varieties bearing between 40,000 to 60,000 ton per year. Tobacco was purchased through a government monopoly and in more recent decades through a private and government oligopoly, although a significant proportion has always been traded privately, especially local varieties which were exempt from the monopoly.⁷⁶⁴ Tobacco areas increased through the 1970s in response to foreign involvement and new markets, and have subsequently decreased from 135,000 rai in 1988 to 59,000 rai in 1997, with total production declining from 193,000 ton to 134,000 ton while yields rose from around 1,400 kilogram per rai to around 2,300 kilogram per rai.⁷⁶⁵

Sorghum, introduced as an alternative cereal crop to supply expanding livestock industries, relies on hybrid varieties supplied through multi-national agribusiness houses. About half of production occurs in the North followed by the Central region with some small production in the Northeast. Producing a globally insignificant 200,000 ton per year, Thailand claims potential for expansion. Areas planted over the decade 1988 to 1997 have declined marginally from around 1.2 million rai to 0.9 million rai, with production varying between 190,000 and 250,000 ton per year. Yields have shown a continuing increase from 192 to 268 kilogram per rai leading to a farm value rise from 424 million baht to 619 million baht.⁷⁶⁶

Fruits and Vegetables

Originating in association with household gardens, fruit crops have developed into a major Thai industry. Technologies introduced with Chinese immigrants, evident in the mounding of soil around trees, suggest that larger scale orcharding is less than a century

⁷⁶⁰ FAO (1995)

⁷⁶¹ Office of Agricultural Economics (1992)

⁷⁶² Poapongsakorn, Nipon et al (1995)

⁷⁶³ Office of Agricultural Economics (1998)

⁷⁶⁴ Silcock, T.H. (1970)

⁷⁶⁵ Office of Agricultural Economics (1998)

⁷⁶⁶ Office of Agricultural Economics (1998)

old. Various propagation methods have evolved, been adapted, and in some cases, invented to suit the production of superior fruit lines with a strong selection emphasis on taste and form. Commercial importance has risen with market road improvement.⁷⁶⁷ Production in the period 1958⁷⁶⁸ - 1965⁷⁶⁹ indicates a rise for pineapples from some 90,000 to 300,000 ton, for water melons from 20,000 to nearly 200,000 ton and bananas from 325,000 to 1.2 million ton. Canning factories developed through the 1960s based particularly on pineapple and large plantations have diversified into longan, asparagus, baby corn, mushrooms and bamboo shoots.

The most common fruit tree crop of Thailand has traditionally been the mango. In the 1960s, the estimated total of some 33 million fruit trees was broken down into mango (34 percent), orange (27 percent), jackfruit (13 percent), lime (eight percent), durian (seven percent), rambutan (seven percent), and longan (four percent)⁷⁷⁰. Thailand has developed into the world's major pineapple producer with a peak production of 2.5 million ton in 1993 falling to 2.1 million ton in 1995 representing more than 20 percent of the world's crop and more than twice that of the second highest producer, the Philippines in 1993.⁷⁷¹ The fall of recent years results from a reduction from the peak area of 624,000 rai in 1993 to a 1996 area of 521,000 rai, and from a peak yield in 1993 of 4,150 kilogram per rai compared to a decadal average of 3,917 kilogram per rai. A general trend of rising prices has assisted a continuing rise in overall receipts such that the 1996 farm value of 5.6 billion baht is the highest for the period 1987 to 1996. In 1997, Thailand exported some 280,000 ton of processed pineapple valued at 5.9 billion baht.⁷⁷²

Vegetable growing was expanded and initially dominated by Chinese immigrant farmers who caused a diversification of both Thai agriculture and the Thai diet. Thai transliteration of Chinese names for vegetables confirm their origins. Statistics have only been gathered since 1960⁷⁷³ when some 24 types of vegetable are listed for the estimated 1.9 million rai (300,000 hectare) planted to vegetables producing some 1.2 million ton per year.⁷⁷⁴ Until the 1970s, two major vegetable groups, cabbage and cucumber, accounted for more than 30 percent of the area and more than 40 percent of production. Other major vegetable crops of that period included; onion, eggplant, chilli, long bean, pumpkin, Chinese mustard, and Chinese radish produced predominantly (54 percent) in the Central Plain with the balance spread relatively evenly across the other three regions.⁷⁷⁵

Some major vegetable crops of the 1990s include shallot, garlic, onion, chilli, ground nuts and soy bean. In terms of shallot, the major producing provinces are Sisaket, Chiang Mai, Lamphun, Uttaradit, Sukhothai, and Petchabun. Planted area has risen over the

⁷⁶⁷ Silcock, T.H. (1967)

⁷⁶⁸ Ministry of Agriculture (1958)

⁷⁶⁹ Ministry of Agriculture (1965)

⁷⁷⁰ National Statistic Office (1963)

⁷⁷¹ FAO (1995)

⁷⁷² Office of Agricultural Economics (1998)

⁷⁷³ Ministry of Agriculture (1961)

⁷⁷⁴ Donner, W. (1978)

⁷⁷⁵ Donner, W. (1978)

period 1992 to 1997 by some 20 percent to nearly 100,000 rai producing more than 200,000 ton and providing a farm value of some 1.5 billion baht.⁷⁷⁶ While Thailand produces less than two percent of the world's garlic, this figure is better understood by removing the overwhelming (64 percent of global production) production of China which raises Thailand's figure to five percent of world production.⁷⁷⁷ Major garlic producing provinces in Thailand are Chiang Mai, Lamphun and Mae Hong Son. Planted area has tended to reduce over the decade to 1997, while production has increased as a result of rising yield. In 1997, 171,000 rai produced 147,000 ton of garlic with a farm value of 2.4 billion baht.⁷⁷⁸ Onion production in Thailand is a solely domestic crop with a production of 88,000 ton in 1995 against the total world production of more than 30 million ton.⁷⁷⁹ The major onion producing province is Chiang Mai with 90 percent of the 99,000 tons produced in 1997. Over the past decade planted areas have risen by some 66 percent to more than 25,000 rai contributing to a production increase of 125 percent which, in association with a rise in yield to 3,941 kilogram per rai of 34 percent, produced a farm value of some 412 million baht in 1997 compared to 157 million baht in 1988.

Soybean, probably introduced by Chinese immigrants more than 200 years ago,⁷⁸⁰ and grown predominantly in upland areas until the 1930s, has been adapted to suit paddy fields following rice.⁷⁸¹ Soybean production does not meet domestic demand and represents only 0.03 percent of global production.⁷⁸² More than 70 percent of production is in the North, where planted area appears vary with price; in 1997, some 1.7 million rai produced some 359,000 ton with a farm value of 3.1 billion baht.⁷⁸³ Groundnut expanded through the 1950s and by 1959 some 606,000 rai (97,000 hectare) produced some 122,000 ton mainly from intercropping with corn, cotton, and castor during the monsoon season.⁷⁸⁴ In world terms, Thailand's production of some 150,000 ton represents less than 0.5 percent of production.⁷⁸⁵ More than half of the crop is produced in the North and, overall, production area has declined along with production over the decade to 1997. In 1997, 619,000 rai produced some 147,000 ton of groundnuts with a farm value of 1.6 billion baht.⁷⁸⁶

Potatoes, not traditionally consumed, have been rapidly subsumed into the Thai diet while meeting new market demand from the hotel and restaurant trade.⁷⁸⁷ Chilli is an important domestic crop introduced via the South by the Portuguese in the fifteenth

⁷⁷⁶ Office of Agricultural Economics (1998)

⁷⁷⁷ FAO (1995)

⁷⁷⁸ Office of Agricultural Economics (1998)

⁷⁷⁹ FAO (1995)

⁷⁸⁰ Pookpakdi, A. (1990)

⁷⁸¹ Poapongsakorn, Nipon et al (1995)

⁷⁸² FAO 91995)

⁷⁸³ Office of Agricultural Economics (1998)

⁷⁸⁴ Ministry of Agriculture (1961)

⁷⁸⁵ FAO (1995)

⁷⁸⁶ Office of Agricultural Economics (1998)

⁷⁸⁷ Scott, T.J. (1987)

century; it was planted on some 140,000 rai which produced 33,000 ton of farm value of 1.2 billion baht in 1997.⁷⁸⁸

Crop Seeds

Breeding and testing of new varieties has supported agricultural expansion. While most seed is farmer-retained, a seed production industry has also developed as part of agricultural modernisation.⁷⁸⁹ The Seed Division of the Department of Agricultural Extension produced 0.4 percent of vegetable seed, three percent of rice seed, 26 percent of ground nut seed and 33 percent of soya beans seed.⁷⁹⁰ Of seed imported to Thailand, corn and sorghum comprise around 40 percent of which hybrid sorghum seed was the majority (1,500 ton) in 1985 followed by Chinese kale (139 ton), morning glory (116 ton), radish (60 ton), green mustard (59 ton), Chinese mustard and Cantonese mustard (each 40 ton) and watermelon (18 ton). Exports of seed from Thailand included morning glory (97 ton), Chinese kale (70 ton), and pumpkin (53 ton) among others. Recent Thai interest in intellectual property rights are likely to assist clarification of the role government in regulatory and legislative areas, including the ensuring of clean, disease free, and viable seed through all sources.⁷⁹¹

Summary

Key points pertinent to Thai agriculture from the perspective of crops are:

- Rice remains the most important crop in terms of; Thailand's dominance of the world market, rice production by most small-holders, the fixed design of most irrigation systems, predicted increases in global cereal demand, alternative food product potential, and its historical integration with Thai culture.
- Upland crops have widened Thai perspectives of agriculture, small-holder adaptability, private sector roles, and export and processing potential, leading to Thailand becoming a significant exporter and/or producer of cassava, maize, sugar, oil palm, and beans, and the world leader in pineapple and rubber production and export, with unrealised potential in other crops, in indicated by the establishment of the kenaf industry.
- Socio-cultural links to agriculture, and rice in particular, continue to weaken from such influences as urbanisation, destruction of Tai social organisation surrounding *muang fai* irrigation systems, and substitution of glutinous rice with the Central and South globalisation beginning centuries ago, and accelerated by application of green revolution technologies.

⁷⁸⁸ Office of Agricultural Economics (1998)

⁷⁸⁹ Setboonsarng, Suthad (1990)

⁷⁹⁰ Seed Division (1986)

⁷⁹¹ Setboonsarng, Suthad (1990)

Chapter 9

Livestock and Fisheries

Early Chinese references, archaeologists, and anthropologists place the Tai in valleys with wet rice cultivation. Livestock, particularly bovines are thought to have been significant for rituals, wealth, and status more than draught power.⁷⁹² Fish were a naturally available protein source. Technological developments, including improved plough designs and materials from Vietnam, later increased reliance on draught bovines, particularly buffalo (*Bubulis bubilis*). Modern agricultural intensification, which has incidentally displaced the buffalo, has created an advanced livestock subsector of Thai agriculture and agribusiness.⁷⁹³ Meanwhile, small-holder livestock has become a subsidiary industry in the case of bovines, a subsistence industry for poultry and even pigs raised under low margin conditions, or a labour-based industry for contract broiler and pig production. Coastal and freshwater Thai fishers sustainably harvested food resources for centuries, until new harvesting technologies allowed over-exploitation in recent decades, leading to an aquaculture industry which now serves export and domestic markets.

Animal Production Systems

Livestock induced environmental change is recent. From a situation of minimising clearing of *Dipterocarp* forest for both land care and shade for cattle and buffalo,⁷⁹⁴ the Northeast was changed into a largely treeless plateau. Once an essential component of life and family supported by laws to restrict their slaughter,⁷⁹⁵ partly in adherence to Buddhist preclusions of killing sentient beings,⁷⁹⁶ cattle are now raised to supply a growing middle-class market for beef. Past animal husbandry techniques criticised for their lack of consistency with modern disease control, including for chickens and pigs,⁷⁹⁷ may now be seen as a moral conflict which inhibited the development of meat industries prior to the 1950s.⁷⁹⁸ Fish, the preferred source of animal protein, did not require a deliberate act of killing, and was long a Tai food prior to adoption of Buddhism.

Thai livestock production systems⁷⁹⁹ extend from semi-domesticated poultry and pigs which essentially fend for themselves around villages in swidden and shifting agricultural systems, through the most wide-spread livestock production system in Asia, rainfed agriculture, with livestock supplying manure, stubble removal, puddling, land preparation, and capital accumulation services, and pigs, poultry, and small ruminants consuming agricultural waste. Irrigated agriculture provides higher levels of by-products

⁷⁹² Wyatt, D.K. (1988)

⁷⁹³ Kaosaard, Mingsarn and Rerkasem, Benjawan (1999)

⁷⁹⁴ Pendleton, R.L. (1943)

⁷⁹⁵ Nakajud, A. (1962)

⁷⁹⁶ Buranamas, B. (1963)

⁷⁹⁷ Ingersoll, J. (1966)

⁷⁹⁸ Pfanner, D.E. and Ingersoll, J (1962)

⁷⁹⁹ Asian Development Bank (1991)

for livestock feed, and in recent decades has shown the most rapid development of livestock industries. Plantation agriculture includes poultry, pigs, goats, and sheep utilising plantation by-products such as coconut cake, palm kernel cake and molasses. Contract farming in the vertically integrated poultry and pig industries also applies marginally to beef and dairy. Fish are raised in conjunction with rainfed, irrigated, contract, and commercial systems, as is an unsustainable form of shifting aquaculture, and fish capture. Non-traditional livestock includes deer, crocodiles, snakes, rabbits, quails, pheasants, and other game animals for meat, as well as elephants, monkeys, and horses for work and entertainment purposes.

Over the past three decades, animal agriculture in Thailand has changed as dramatically as that of crops. While intensification is evident in both sectors, and in particular in the production of poultry meat, the major change has been a cultural shift in the role of agricultural animals, from integrated components of farms and families to one of discreet production units. In common with cropping, Thai animal production may now be divided between two agriculture systems, industrial animal production and subsistence.

Traditional non-fish livestock production continues to be practiced in neighbouring Lao-PDR, providing a model for aspects of self-sufficient agriculture⁸⁰⁰ in integrated agricultural and natural systems.⁸⁰¹ Large livestock are raised under free range with variable levels of care,⁸⁰² while small livestock including pigs, poultry, and goats are raised under scavenging systems with some penning. While Lao-PDR systems reflect market⁸⁰³ opportunities afforded by neighbouring countries, they continue to accommodate the narrow capital base of Lao-PDR and traditional values of Tai people.

Production Levels

Thailand ranked sixth in terms of cattle numbers, third for buffalo, fifth for pigs, sixth for sheep, tenth for goats, fourth for chickens, and fourth for ducks out of twelve Asian countries (Table 9.1) in 1993.⁸⁰⁴ Thailand's advantage lies in its feed production base for chickens, pigs, and to a smaller extent, bovines.

Table 9.1 Livestock Numbers by Type for Selected Asian Countries in 1993⁸⁰⁵

	Cattle '000	Buffalo '000	Pigs '000	Sheep '000	Goats '000	Chickens Million	Ducks '000
Bangladesh	239,323	866		989	25,967	109	14,441
Cambodia	2,468	804	2,043			10	3,800
China	82,641	22,217	393,965	109,720	97,812	2,688	429,719
India	192,700	78,555	10,547	44,608	117,547	435	
Indonesia	11,000	3,452	8,200	6,300	11,800	620	30,000

⁸⁰⁰ Bangkok Post (1999)

⁸⁰¹ Simaraks, Suchint (1998)

⁸⁰² Pravongviengkham, Parisak (1998)

⁸⁰³ Ponvisay, Singkham (1998)

⁸⁰⁴ FAO (1995)

⁸⁰⁵ FAO (1995)

Laos	1,010	1,167	1,559		144	9	327
Malaysia	735	186	2,983	308	352	95	12,500
Pakistan	17,779	18,740		27,668	40,225	92	3,195
Philippines	1,781	2,561	7,954	30	2,562	65	8,394
Sri Lanka	1,600	870	90	19	500	9	40
<i>Thailand</i>	<i>7,190</i>	<i>4,747</i>	<i>4,800</i>	<i>136</i>	<i>151</i>	<i>134</i>	<i>16,000</i>
Vietnam	3,320	2,956	14,861		300	83	29,800

The contribution of livestock to GDP for the years 1971 to 1993 (Table 9.2) indicate declines in the proportions originating from hens, ducks, and eggs while all other categories increased.⁸⁰⁶ Such statistics suit the intensive vertically integrated production systems of pigs and poultry but may not capture contributions such as draught power in subsistence agricultural systems.⁸⁰⁷ Such uncalculated economic benefits from livestock include; wool, hair, hides, pelts, edible fat, horns, hooves, bones, tankage, endocrine extracts, draught power, traction, herding, irrigation, pumping, threshing, transportation, fertiliser, fuel, gas production, plaster, feed stuffs, capital, grains, grassland conservation, seed distribution, clearing aquatic plants, weeding, snail control, social benefits, sporting, fighting, hunting, pets, racing, riding, religious purposes, bride price, and social status.⁸⁰⁸

Table 9.2 Livestock Contributions to GDP (**Billion Baht, 1988 Prices**)⁸⁰⁹

Year	Bovines	Swine	Poultry	Eggs	Dairy Products	Other Livestock	Total
1971	1.4	0.8	1.4	0.7	0.009	0.1	4.3
1981	6.4	6.3	2.5	2.8	0.08	0.3	18.3
1991	11.3	6.5	6.1	4.0	0.5	1.1	29.4
1993	11.6	7.4	6.7	4.5	0.5	1.3	32.1

The estimated farm value of livestock products in 1996 was; buffalo 2.6 billion baht, cattle 8.6, pigs 40.5, poultry 41.5 (1995), eggs 21, fresh milk 3.2, freshwater fish 9.7 (1994), and marine fish 77.3 (1994).⁸¹⁰

Buffalo and Cattle

Related to the cattle of neighbouring countries⁸¹¹ rather than representing a specific breed,⁸¹² Thai cattle vary across the country as a result of exotic crosses with European and, to a lesser extent, Indian and Chinese lines from trading ships from the eighteenth century, and the importation⁸¹³ of a range of breeds from the 1950s. Buffalo lines are less controversial as the species attracted less attention from western educated authors of the

⁸⁰⁶ NESDB (1994)

⁸⁰⁷ Falvey, L. (1988)

⁸⁰⁸ McDowell, R.E. (1977)

⁸⁰⁹ NESDB (1994)

⁸¹⁰ Office of Agricultural Economics (1998)

⁸¹¹ Epstein, H. (1969)

⁸¹² Rife, D.C. (1960)

⁸¹³ Chantalakhana, Charan (1993)

1950s and 1960s.⁸¹⁴ Early reports note the separate roles of cattle and buffalo according to wetness of working conditions and heat stress.⁸¹⁵ Crossbreeding of the Thai swamp buffalo with the river species, Murrah, to produce more milk for human consumption⁸¹⁶ reflects foreign animal production influence.⁸¹⁷ By the late 1960s, cattle and buffalo trading became evident⁸¹⁸ in response to the meat demands of the USA military presence. Nevertheless, bovines continued to be managed simply in comparison with the intensive systems introduced to the poultry and pig industries in the 1980s. Such low management requirements of native cattle⁸¹⁹ favoured their long retention in remote areas.

Exports of bovines from Thailand is recorded from the nineteenth century, increasing through the early part of the twentieth century. Cattle originating in central and eastern Thailand were assembled and traded by Indians who enjoyed some special privileges as British subjects, including immunity from legal penalties associated with receiving stolen cattle and failure to pay tax.⁸²⁰ In 1897, government legislation targeted three identified concerns in the trade of bovines, namely, treatment of animals, cattle theft, and the spread of infectious disease, to little effect as cattle trading re-routed around the official Bangkok port.

A boom in demand for export cattle in the 1920s led to a three-fold increase in cattle prices paid to traders who appear to have colluded to minimise any increase in prices paid to farmers.⁸²¹ Trade in cattle was restricted by government from 1935 when annual exports of live animals and hides were estimated to be some seven million and one million baht. By the 1960s, cattle export was estimated to be less than 7,000 head per year⁸²² when the economy began to expand thus soon creating large-scale illicit bovine trading.⁸²³

Changes also related to technology, such as the need for buffalo to draw larger and stronger implements for cultivation of the larger plots of high clay soils as the Central Plain was settled.⁸²⁴ Paired bovine ploughing in the South reflects Indian influence, or even European, where multiple animals were necessary to pull the deep mould board ploughs of the European agricultural revolution. Likewise, the use of cattle rather than buffalo to plough paddy fields in the North may reflect associations with Indian cattle traders.⁸²⁵ Thai buffalo, once claimed as the world's largest,⁸²⁶ declined in stature as larger-framed young bulls were castrated in case they later proved intransigent.⁸²⁷

⁸¹⁴ Rufener, W.H. (1971)

⁸¹⁵ Buranamas, P. (1963)

⁸¹⁶ Boonlong, Siribongse (1963)

⁸¹⁷ Bhannasiri, Tim (1970)

⁸¹⁸ Rufener, W.H. (1971)

⁸¹⁹ Falvey, L. et al (1979)

⁸²⁰ Credner, W. (1935)

⁸²¹ Tompson, V. (1967)

⁸²² Donner, W. (1978)

⁸²³ Falvey, L. (1981)

⁸²⁴ Montrakun, Sarot et al (1971)

⁸²⁵ Falvey, L. (1985)

⁸²⁶ Donner, W. (1978)

⁸²⁷ Chantalakhana, Charan (1979)

Nevertheless, the Thai buffalo and the Thai agricultural system have evolved to mutual benefit. Buffalo heat fatigue is managed through work breaks which seem to suit both farmer and animal who develop a bond as they grow old together.⁸²⁸

Early development assistance⁸²⁹ supported disease control, pasture improvement, and animal breeding. However, governmental allocations to the Department of Livestock Development⁸³⁰ appeared to benefit agribusiness houses while small farmers relied on livestock for subsistence, a small cash income, and saving. Livestock industries grew with post-World War II demand although control of meat sales by Bangkok-based trading groups,⁸³¹ compounded with inappropriate government regulations, confused price signals received by small-holders. A famous area of corruption,⁸³² the buffalo and cattle industries consistently failed to fulfil their potential as other livestock industries modernised.

Subsequent development of the large ruminant industries of Thailand followed the patterns of countries receiving aid in Africa, Latin America, and elsewhere in Asia. The centrality of livestock in integrated social and agricultural systems was poorly understood.⁸³³ An exceptional input in this non-irrigated sector by the World Bank⁸³⁴ enhanced livestock production through improved forage, genetic upgrading, and disease control throughout the Northeast. Extensive development of legume-based pastures, crossbreeding with larger framed Brahman and Holstein-Friesian breeds, and strengthened veterinary services was supported by the development of a cadre of practical departmental livestock specialists. The project demonstrated early benefits, and its influence continues to be evident as poor Northeast farmers produce dairy cross-bred calves for the Central Plain dairy industry while maintaining the national bovine breeding base as other regions reduced breeding cow numbers.

Modernisation of livestock industries paralleled similar trends in cropping which in themselves also impacted on livestock. At the cost of reduced animal numbers,⁸³⁵ mechanisation of wet rice production introduced such benefits as; increased labour output and income, timely operation by tractor ploughing of hard dry soils, expanded land areas accessible to agriculture, reduced land required for livestock feed and forage, and meeting peak labour requirements of transplanting and harvest.⁸³⁶ In this transition from animal to mechanised power in rice agriculture, differences were seen as; higher capital investment requirements for machines, higher operating costs for animals, limitations in machine adaptability to varied environments, a depreciating asset replacing a self-reproducing and profit making asset, the pre-empting of any alternative mixed

⁸²⁸ Cockrill, W.R. (1974)

⁸²⁹ World Bank (1959)

⁸³⁰ Silcock, T.H. (1970)

⁸³¹ Muscat, R.J.(1996)

⁸³² Silcock, T.H. (1970)

⁸³³ Orskov, E.R. (1993)

⁸³⁴ World Bank (1983)

⁸³⁵ Falvey, L. (1985)

⁸³⁶ Stout, B.A (1966)

livestock and machine systems, and less tangible losses of contact with another sentient being, traditions, and other social assets.

However, double cropping required faster work than animal power produced, and provided such financial advantages that rapid replacement with ‘iron buffalo’ tractors was inevitable. Once adopted in an area, past influence of the working animal component of integrated small-holder farming became clear from increases in plot and farm size and cropping intensity. Two-wheeled tractors were initially employed in double-cropped rice production, although they soon were purchased for convenience and status reasons as well, leading to the disappearance of bovines from many Thai landscapes.

Bovine disappearance in Thailand was associated not only with substitution by tractors, but by; disease-related closure of live cattle exports to Singapore and Hong Kong, rising preferences for western styles of meat presentation, market corruption causing low farmer receipts from bovine sales, inadequate integration of small-holders with the wider meat industry, modernisation of savings mechanisms and religious rituals, and inefficient government support services. The successful Northeast pilot project, which adapted management and breeding technologies to small-holders, demonstrated means of slowing the rate of disappearance.⁸³⁷

Traditional Thai diets contained little red meat as fish was the preferred animal protein. Red meat was consumed primarily as small pieces cooked in mixtures of vegetables or curries. Tastes in recent decades have made beef a product in its own right, accelerating the demise of the buffalo which modern palates deem inferior, except for a lingering preference in the North. Models of bovine disappearance⁸³⁸ in the 1980s indicated severe shortages of mature male cattle in the South and likely shortages of buffalo in the Northeast and Central Plain. Potential shortages of draught animals was an unexpected outcome of mechanisation which was assumed to directly substitute for those tasks necessary for crop production at higher levels of efficiency (Table 9.3).⁸³⁹

Table 9.3 Hours per Rai for Paddy Ploughing by Tractors and Buffalo⁸⁴⁰

Rice Type	Large Tractor	Medium Tractor	Small Tractor	Buffalo
Transplanted Paddy	0.9 - 1.0	2.5 - 2.6	2.7 - 3.3	15.6 - 20.5
Broadcasted Paddy	0.5 - 0.6	2.1 - 2.2	2.3 - 3.1	11.3 - 17.9
Upland Dry Rice	1.3 - 1.6	2.4	3.4 - 3.6	12.6 - 17.6

Numbers and production of buffalo and cattle (Table 9.4) indicate the effect of mechanisation on buffalo, and the alternative use of cattle for meat. The majority (78 percent) of buffalo are in the Northeast, which also supports 39 percent of the cattle with 25 percent and 22 percent in the North and Central Plain respectively.⁸⁴¹

⁸³⁷ World Bank (1985)

⁸³⁸ Manowalailao, Koset and Juntaravong, Boonmee (1982)

⁸³⁹ Moerman, M. and Miller, P.L. (1989)

⁸⁴⁰ Manowalailao, Koset and Juntaravong, Boonmee (1982)

⁸⁴¹ Office of Agricultural Economics (1998)

Table 9.4 Numbers and Production of Buffalo and Cattle, 1993 - 1998 ('000 head)⁸⁴²

Year	Buffalo		Cattle	
	Population	Production	Population	Production
1993	-	0.53	-	1.02
1994	4.66	0.44	6.80	1.18
1995	4.18	0.41	6.82	1.16
1996	3.73	0.36	6.88	1.19
1997	-	0.31	-	1.13
1998	-	0.28	-	1.06

Vaccinations administered by the Department of Livestock Development have declined from nearly eight million to some five million for buffalo over the period 1987 - 1996 while increasing coverage as the buffalo population declined. Meanwhile, cattle vaccination levels rose from some eight million to 11.5 million reflecting a greater degree of epidemic disease control.⁸⁴³ Control of Foot and Mouth Disease, long recognised as a priority for Thai livestock development, improved from 1958 when identification of the specific causal FMD type allowed production of a cattle, and later a buffalo, vaccine.

Breeding management was addressed through government artificial insemination programs which introduced Brown Swiss, Red Sindi, Brahman, and other breeds during the 1950s to complement earlier introductions of small numbers of Zebu and Jersey cattle prior to World War II. Red Danish cattle and Murrah buffalo were also introduced as part of these general cross-breeding programs which aimed to increase production following conventional western quantitative genetics in support of quantifiable economic benefits. Improved nutrition was based on imported technologies for adaptation to the Thai environment and led to a strong reliance on grass rather than legume species, and a focus on mineral deficiencies rather than protein or non-protein nitrogen. Some studies indicated economic benefits from appropriate nutritional management without sophisticated cross-breeding programs,⁸⁴⁴ and concerns were raised about bovine losses from the wet rice farming system.⁸⁴⁵

Government cattle development projects have been frequently quoted for institutionalised corruption and inadequate technical advice. Promotion of small-holder purchase of imported cattle using credit resulted in widespread indebtedness following the allocation of imported animals to small farmers with inadequate management resources. In many cases, unadapted animals were known to be unlikely to be productive in that environment. In another case, the low educational levels of small-holders made them easy dupes for speculative manipulation of prices for cattle which provided no production benefit, such that upon the inevitable peak of the fashion, losses accumulated to them;

⁸⁴² Office of Agricultural Economics (1998)

⁸⁴³ Department of Livestock Development (1997)

⁸⁴⁴ Falvey, L. (1982)

⁸⁴⁵ Patanapongsa, Narinchai et al (1983)

prices fell significantly, such as 50,000 to 20,000 baht for Droughtmaster, 70,000 to 20,000 baht for American Brahman, and 500,000 to 20,000 baht for Indu Brazil.⁸⁴⁶

Cattle production is mainly associated with non-irrigated agriculture including the poverty areas of highland northern Thailand⁸⁴⁷ where rectification of primary mineral nutritional deficiencies can increase production more than 30 percent with additional reproductive increases of more than 30 percent.⁸⁴⁸ Similarly the widespread poverty of the Northeast, where most bovines are produced,⁸⁴⁹ has led to considerable research on cattle nutrition, breeding, and management. Potential for continued increases in the efficiency of livestock production in marginal areas exists; available labour and crop by-products can be better used, and beef production could be linked to the developing dairy industry by providing males for quality meat while females provide milk production and bulk meat.⁸⁵⁰ In the South, the fighting bull sport has assisted retention of a local breed type.⁸⁵¹

Indigenous cattle have been falsely assumed to be unresponsive to improved nutrition, health and management, and therefore inferior to exotics. Naive comparisons of live-weight gain rates under favourable conditions have been biased by differing breed mature live-weights, unobserved differences in the efficiency of conversion of rough feed, and in terms of rural social requirements. The high rates of gain per unit live weight and early maturity at smaller sizes of indigenous cattle offer several advantages to small-holders, including:

- productivity - live-weight gains which, when calculated on an area basis or relative to live weight, exceed those of introduced breeds⁸⁵²
- adaptability - suited to local regimes in terms of dietary tolerance and compatibility with farmers
- divisibility - allowing the raising of urgent cash by sale of one animal without disrupting a small breeding unit
- heat tolerance - in addition to the physiological adaptations of *Bos indicus*, small size provides a higher skin area to body volume ration which facilitates cooling
- fecundity - the ability to produce a calf each year, to nurture these small calves well, and to remain unperturbed by human involvement⁸⁵³
- disease resistance - herd ability to survive epidemics
- independence - ability to forage for basic nutritional requirements without the need of supplements to induce oestrous cycling or to withstand epidemics.

Notwithstanding these advantages, widespread crossbreeding has produced a national herd which includes introduced *Bos indicus* and some *Bos taurus* genetic material from a range of beef, milk, and dual purpose breeds. Farmers operating in a semi-subsistence

⁸⁴⁶ Poapongsakorn, Nipon et al (1995)

⁸⁴⁷ Falvey, L. (1986)

⁸⁴⁸ Falvey, L. (1985)

⁸⁴⁹ Rufener, N.H. (1971)

⁸⁵⁰ Na Phuket, Suntraporn. (1999)

⁸⁵¹ Chantalakhana, Charan. et al (2000)

⁸⁵² Falvey, L. (1982)

⁸⁵³ Falvey, L. (1981)

environment would have done better from selection within indigenous types than they have from exotic introductions of government and speculators. However, potential to link small-holders to supply intensive dairy and beef production systems suggests inevitable modification the sector, which will necessitate improved small-holder management skills, improved natural resource management, supplementary feeds, and other inputs.

Development strategies for beef cattle and buffalo are currently based on a strategy which provides: special attention to bovines in border regions through fattening, quarantine and forage development; a review of outdated legislation concerning draught and traction animals, breed improvement, slaughtering and marketing facilities, animal and carcass movements; markets and marketing in terms of cleanliness, consumer education, producer cooperatives and export of live animals and meat; and slaughterhouse improvement in standards, quality, and sanitation. Promotion of improved production through credit, extension and an enhanced role for the private sector, creation of a bovine fund for research, development and farmer credit, conservation of buffalo and indigenous cattle, and research and development, support the strategy.⁸⁵⁴ With improved cognition of global trends, improved departmental efficiency, and strategic policy application, Thailand is well placed to be a major beneficiary⁸⁵⁵ of the large forecasted increase in demand for livestock and livestock products in Asia.⁸⁵⁶

Dairy

The Thai dairy industry has developed from milk being a product for children and the infirm,⁸⁵⁷ through a period when Thai adults were said to be lactose intolerant, to today's expanding small-holder industry⁸⁵⁸. Sustained by Thai Indians with a tradition of milking cattle and goats, the industry was neglected by government until Danish and German foreign aid with Thai scientists introduced appropriate technologies in the Central and the North regions respectively⁸⁵⁹. Decades of local adaptation produced technologies suited to small scale dairying, including collection and processing cooperatives. The absence of vested interests and unbiased screening of credit applicants through BAAC ensured that early entrants to dairying had potential to benefit from their investments, thereby providing confidence to other prospective entrants.

The industry is now underpinned by a concerned research sector,⁸⁶⁰ and is seen as in other similar countries, as possessing a viable future⁸⁶¹ hitherto unrecognised by most development agencies.⁸⁶² Expansion through 1993 - 1997 included rises in; cooperative members from 15,300 to 23,500, numbers of farms from 9,800 to 17,500, numbers of

⁸⁵⁴ Ministry of Agriculture and Cooperatives (1999)

⁸⁵⁵ Falvey, L. (1999)

⁸⁵⁶ Delgado, C. (1999)

⁸⁵⁷ Donner, W. (1978)

⁸⁵⁸ Falvey, L. and Chantalakajna, Charan (1999)

⁸⁵⁹ Smith, H.D. (1963)

⁸⁶⁰ Chantalakajna, Charan (1999)

⁸⁶¹ Skunmun, Pakapan., Boonsom, J., Keawsuwan S. and Chantalakhana, C. (1999)

⁸⁶² Falvey, L. (1999)

dairy cows from 126,000 to 307,000, and numbers of cows milked from 56,000 to 130,000. Over that period, the production rise from 157,000 tons to 194,000 tons and price rise from eight baht to 9.3 baht per litre, produced an increase in farm value received from 1.2 billion baht to 1.8 billion baht.⁸⁶³ Cooperatives, other than those of the semi-government Dairy Farming Promotion Organisation of Thailand, produced some 56 percent of milk in 1997; the value and quantity of fresh milk and numbers of cows and cooperative members and farms for 1997 are presented in Table 9.5.

Table 9.5 Producer Members, Farms, Cows, Milk Production and Value in 1997⁸⁶⁴

Collection Point	Number of Members	Number of Milk Farms	Number of Dairy Cows	Tons of Fresh Milk	Value million baht
DFPO:					
Muaklek	1,993	1,776	34,296	22,296	219.7
Prachuap	1,062	855	13,416	9,297	93.1
Chiang Mai	120	114	1,187	988	9.1
Khon Kaen	669	588	6,823	4,339	40.6
Sukhothai	176	154	1,664	429	4.0
Total DFPO	4,020	3,487	57,386	37,382	366.5
Other Coops	15,315	10,092	170,664	110,834	1,021.3
Education Inst'ns	88	88	2,418	1,195	11.1
Others	4,159	3,820	76,362	45,003	416.6
Total	23,528	17,487	306,830	194,416	1,815.5

Small-holder dairying differs from other industries as the daily output is 90 percent water, perishable, and is highly priced in industrial, food, and health markets. As small-scale producers are vulnerable to market changes, cooperative processing appears critical to success. Its sustainability poses complex political, socio-economic, educational, and technical questions,⁸⁶⁵ yet the benefits that have accrued are highly congruent with other espoused plan objectives, such as:

- year round engagement of rural and peri-urban labour
- utilisation of agricultural and other by-products
- integration with cropping systems management
- conversion of by-products to organic manure for application to crops
- provision of nutritious and hygienic food for children
- production of meat from male calves and older cows
- reduction of meat costs as draught power declines as the primary bovine product
- providing rural and peri-urban industrial development through milk factories
- developing of new products for niche exports
- reducing rural to urban population drift
- providing draught and traction as a dairy industry by-product or adjunct
- allowing landless persons to make a reasonable local living from dairying⁸⁶⁶

⁸⁶³ DFPO (1998)

⁸⁶⁴ DFPO (1998)

⁸⁶⁵ Egan, A.R. (1999)

⁸⁶⁶ Falvey, L. (1999)

The future of the Thai dairy industry in the 1990s depends on improvements in survival rates, reproductive rates, feed quality, and genetics,⁸⁶⁷ and wider use of agricultural by-products of the sugar,⁸⁶⁸ oil palm, and rubber⁸⁶⁹ industries. More full-time dairy farmers will be required in the view of some analysts⁸⁷⁰ and these are likely to be farmers who manage risk through family-wide systems through a range of agricultural enterprises.

Pig

Prior to the introduction of European breeds, the Chinese Black Pig (*Suc indicus*)⁸⁷¹ was spread widely throughout Thailand. Today commonly viewed as inferior, poorly bred, and of limited productive use, the breed has been maligned in comparisons with European pork producing breeds, and is now largely restricted to poorer hilltribe villages. Nevertheless, this so called native pig combined the essential elements of disease and parasite resistance, fecundity, scavenging capability, compatibility with village life, ability to grow quickly when nutrition was favourable, and early maturity with associated capacity for high levels of fat deposition.⁸⁷² As fat was a major dietary component derived from these animals, the pig was well suited to the Chinese, and to a lesser extent, the Thai, diet.

Studies with residual indigenous pigs kept in highland villages of the North indicated a continuing preference for fat production as recently as the 1980s⁸⁷³ which carcass studies confirmed.⁸⁷⁴ Raising indigenous pigs on a locally produced pigeon pea with intestinal parasite control⁸⁷⁵ indicated potential for improved production which was confirmed^{876,877,878} and recommended⁸⁷⁹ for development options. However, the residual pool of these animals continued to shrink, such that it is now the subject of genetic resource studies. Scope for crosses with later maturing animals remains for pigs produced in self sufficient or near subsistence family units.

Lowland rural Thai households each maintained an average of 1.4 pigs in 1960 under conditions of poor disease and nutritional management. In 1970, the under-estimated 3.7 million pigs were located in the Central Plain (59 percent) and the Northeast (41 percent). A prior dominance of the Northeast⁸⁸⁰ had been usurped by the growing concentrations of pigs around Nakhon Patom, Sing Buri, and Saraburi, heralding future large-scale

⁸⁶⁷ Yamada, Y. (1988)

⁸⁶⁸ Kawashima, T. (1996)

⁸⁶⁹ Devendra, C. (1992)

⁸⁷⁰ Kumagai, H. and Ngapongsai, Wanwisa (1998)

⁸⁷¹ Davidson, H.R. (1966)

⁸⁷² Falvey, L. (1981)

⁸⁷³ Visitpanich, Theera. and Falvey, L. (1980)

⁸⁷⁴ Falvey, L. and Visitpanich, Theera (1980)

⁸⁷⁵ Posri, Sangwien., Falvey, L. and Hengmichai, Prakob. (1978)

⁸⁷⁶ Visitpanich, Theera and Falvey, L. (1979)

⁸⁷⁷ Falvey, L. and Visitpanich, Theera (1980b)

⁸⁷⁸ Falvey, L. and Visitpanich, Theera (1980c)

⁸⁷⁹ Falvey, L. (1988)

⁸⁸⁰ Credner, W. (1967)

intensive production. Pig production expanded with the development of rail and road transport serving a predominantly (98 percent) domestic market.⁸⁸¹

The efficiency of the low-input scavenging management system, with some supplements mainly to ensure pigs could be caught by owners, was poorly appreciated when the modern industry was created from the 1950s. Just as government programs focused on beef and dairy cattle upgrading to European breeds without an understanding of the advantages of domestic breeds, so the imported pig lines displaced the naturalised pig. USA, Germany, Denmark, Switzerland, and Australia were the source of genetic material of the Large White, Hampshire, and Duroc-Jersey breeds. A standard three-way cross system was introduced and gradually extended to farmers who, in so modernising, became committed to intensive pig raising, purchasing of feed stuffs and medicines, and production for regular sale.

A more than three-fold expansion⁸⁸² in the number of pigs officially slaughtered in Bangkok between 1947 and 1965 coincides with a rise in preference for imported breeds. Within less than thirty years, the 1965 production figure of 614,000 pigs per year rose some fourteen times to 8.7 million through the emergence of agribusiness and contract farming in association with feed millers, particularly the multi-national company Charoen Pokaphand. However, comparability of statistics is problematic. Even today, unofficial pig slaughter and roadside sale of meat is evident throughout the country, suggesting that statistics prior to 1965 which referred only to pigs officially slaughtered in Bangkok, reflect but a fraction of national production.

In 1978, 86 percent of pigs were raised in backyard enterprises with only four percent of producers maintaining more than 110 head. Medium to large scale producers were concentrated around Bangkok, the major market and were based on three-way cross lines where feed conversion efficiencies reached 3.0:1; backyard producers tolerated feed conversion ratios of up to 5:1. Slaughtering took place in modern abattoirs, municipal slaughterhouses, and simple local government slaughterhouses, although backyard slaughtering was the most popular. Processing into hams, bacon, roast pork, and sausages involved many small processors, dominated by the Belucky LP group which controlled about half of the market share.⁸⁸³ Export of live and frozen pigs and piglets was mainly undertaken by groups such as Charoen Pokaphand, which was not yet the dominant pig producer. Late 1970s' margins as a proportion of retail pork price were; 10 percent for pig growers, 2.1 percent for live pig wholesalers, 9.2 percent for carcass wholesalers, 13.9 percent for retailers. The risks of production and price were allocated to the grower who received the lowest margin, thus suggesting one attraction of the contract systems attached to feed mills.

The number of commercial pig farms in 1993 was recorded as 3,652 of which some 13 percent had more than 1,000 head, nine percent between 500 and 1,000 head, 21 percent

⁸⁸¹ Donner, W. (1978)

⁸⁸² Ministry of Agriculture (1965)

⁸⁸³ Valentine, Laurie and Davies Pty Ltd (1981)

between 200 and 500 head, 20 percent between 100 and 200 head, 27 percent between 50 and 100 head and 10 percent between 10 and 50 head.⁸⁸⁴

Since 1993, pig production has continued to rise by an average of four percent per year to a 1998 total of some 10.6 million head. The majority of pigs in 1996 were raised in the Central Plain (42 percent) with the North and Northeast having similar proportions (23 percent each). The most populous pig provinces in 1996 were Nakhon Ratchasima, Buriram, Ubon Ratchatani, and Sisaket, all in the Northeast.⁸⁸⁵ Vaccination of pigs over the period 1987 to 1996 has increased some three-and-one half times from 1.5 to 5.2 million head.⁸⁸⁶ The numbers and production of pigs from 1994 to 1996 is presented in Table 9.6.

Table 9.6 Production and Millions of Pigs for each Region, 1994 – 1996 (millions)⁸⁸⁷

Region	Number of Pigs			Pig Production		
	1994	1995	1996	1994	1995	1996
Northeast	1.3	1.3	1.4	2.1	2.1	2.1
North	1.3	1.2	1.4	1.8	1.8	1.9
Central	2.1	2.1	2.5	4.9	4.9	5.2
South	0.8	0.7	0.8	1.0	1.0	1.0
Whole Kingdom	5.4	5.4	6.1	9.9	9.8	10.2

The success of the intensive pig industry in Thailand has increased the risk of pig to human disease transfer to potentially higher levels than in many western pig producing countries. The apposite spreading of a virus from pigs to humans in Malaysia in 1999, assisted by rapid news coverage, led to slaughter and disposal of around one million pigs after the death of more than 100 persons. Thailand has irreversibly committed itself to modern intensive pig production in a manner similar to its industrial chicken industry, and is thereby reaping economic benefits while unwittingly introducing higher levels of moral hazard associated with human health and environmental risks.

The strength of developing the monogastric industries has been availability of high quality feeds from domestic agriculture and agribusiness. High levels of domestic demand for western-style pig meat and the rapid reduction in demand for pig fat have been met through the modern industry's expansion. The 1997 Asian economic crisis affected livestock feed-poor countries and thereby highlighted the comparative advantage of Thailand in this competitive and low margin industry. Intensive pig production based on imported feeds are easily rendered unviable by exchange rate fluctuations. In Thailand, responsibility in waste management and utilisation and treatment of waste water are now major management issues. With a farm value of 40 billion baht in 1996,

⁸⁸⁴ Department of Livestock Development (1994)

⁸⁸⁵ Office of Agricultural Economics (1998)

⁸⁸⁶ Department of Livestock Development (1997)

⁸⁸⁷ Ministry of Agriculture (1998)

second only to poultry in the land-based livestock sub-sector, pig production ranks fifth ahead of maize in terms of value received by Thai farmers.⁸⁸⁸

Poultry

Possibly the homeland of the ancestors of today's domestic chickens, Thailand has developed into one of the world's large poultry producers. First domesticated⁸⁸⁹ through providing feed to wild birds and progressively favouring those individuals with limited flight ability, chickens raised by ancestors of the Thai allowed the basis for successive technological developments in poultry raising. This led to chickens, ducks and, to a minor extent other poultry, being associated with the ecology of Tai and other villages. Poultry was raised as a source of protein to complement the predominantly fish and rice diet, and assumed importance in animistic rituals. Each household had poultry which survived predominantly on feed scavenged around the village and surrounding forest with occasional rewards of kitchen scraps, mainly as a means of maintaining some identity between birds and owner. More than a millennia ago, fighting cocks were apparently valued in the advanced and Indianised centre of Nakorn Si Thammarat, as indicated in a statue of that era; cockfighting had long been codified as a wordly art in India by this time.⁸⁹⁰

Until Chinese immigration, ducks had simply been mixed in with chickens, with the only separation being the preference of ducks for wetter regimes around a village. A separation between large ducks flocks raised by Chinese and a preference for chickens among village Thai favoured a duck industry over chicken industry due to Thai reluctance to kill chickens. As recently as the 1970s, chickens raised around Thai villages provided low levels of production from large numbers necessary to withstand epidemic diseases and attacks by predators in a system which many consider inefficient.

Low consumption of meat and eggs among Thai farmers is also indicated in the sales of chickens and eggs to Chinese and wealthier townspeople. A survey in the 1930s indicated that the average Thai family consumed less than three chickens and 24 eggs per year;⁸⁹¹ consumption may not have increased substantially, even by the 1970s.⁸⁹²

The rapid and successful development of a modern poultry industry in Thailand occurred through the combination of agribusiness development and favourable government policies. Policies allowed Chinese-Thai agribusiness houses to become established under protected conditions with guaranteed access to critical resources. The broiler industry exemplifies the success of Thai agribusiness through the development of Charoen Pokaphand as a feed milling company extending into the poultry industry through contract farming based on monopolistic supply of highly bred chickens from the USA.

⁸⁸⁸ Ministry of Agriculture (1998)

⁸⁸⁹ Andrews, J.M. (1935)

⁸⁹⁰ Burton, R. and Arbuthnot, F.F. (1963)

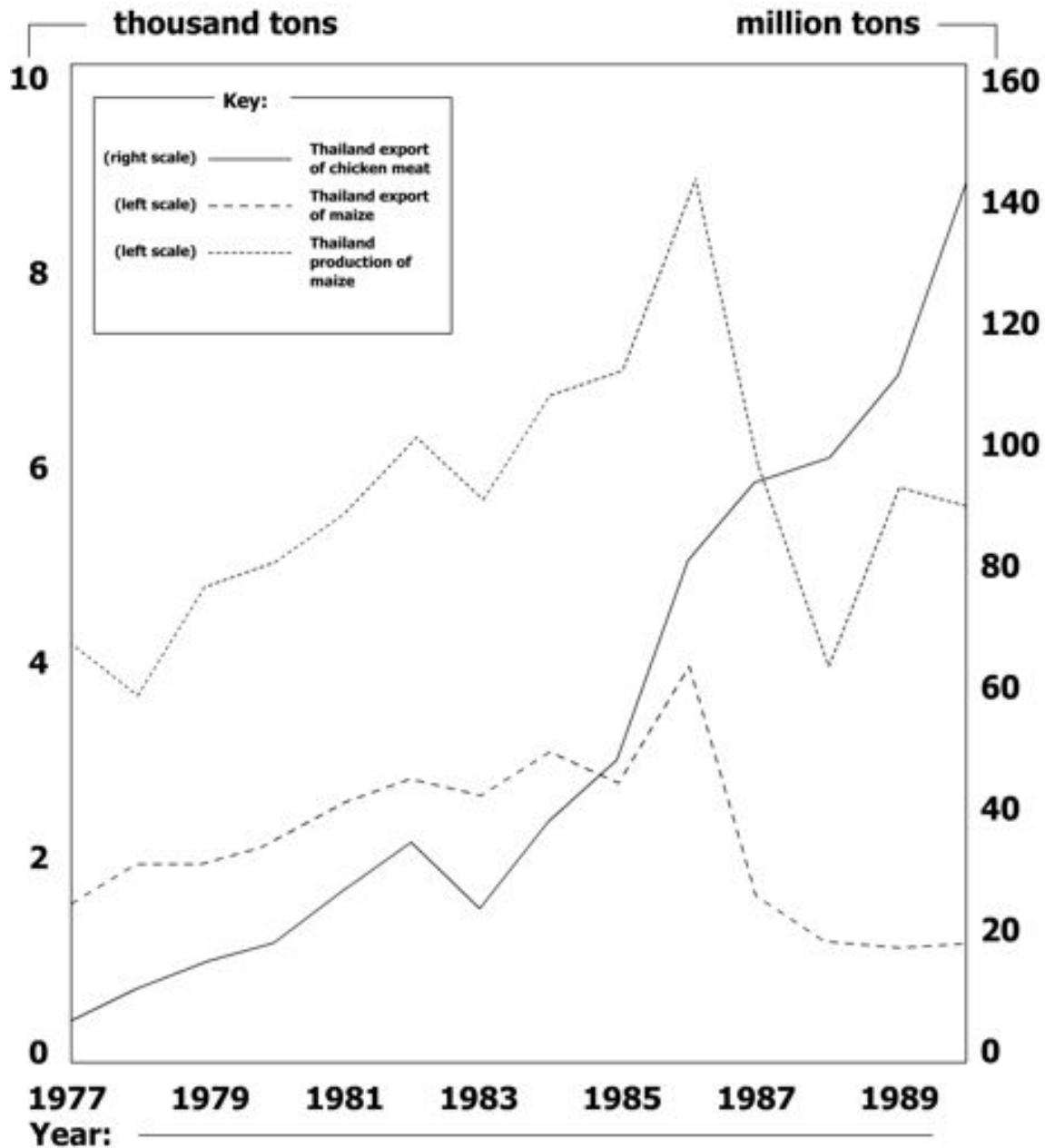
⁸⁹¹ Zimmerman, C. (1931)

⁸⁹² Donner, W. (1978)

The export of chicken meat from Thailand expanded rapidly (Figure 9.1) creating demand for maize such that maize exports declined from 2.2 million tons or 45 percent of total production in 1980, to 1.2 million tons or about 20 percent of production in 1989. Expansion in maize production through the 1960s and 1970s was hardly related to this later demand; by the time the chicken industry was a major force, areas suited to maize production had largely been exploited. No importation of maize occurred through this period due to high tariffs; with their reduction from six percent to 0.6 percent in 1992, some 250,000 ton was imported within one year. Nevertheless, Thailand has remained a net exporter of maize.⁸⁹³

⁸⁹³ Siamwalla, Ammar (1992)

Figure 9.1 Export of Chicken Meat Compared to Maize Production and Export⁸⁹⁴



Chicken farms include backyard, independent commercial, and contract farms. Backyard growers continue to each raise around ten native chickens for home consumption and occasional sale from eggs and birds, and also for cock fighting. Native breeds such as *Kai Ooh* and *Kai Tapao*⁸⁹⁵ roam the house-yard requiring low labour inputs. Independent commercial growers follow modern management techniques and, often from prior contract-growing experience control their own marketing, and in assuming greater risk,

⁸⁹⁴ Siamwalla, Ammar (1992)

⁸⁹⁵ Chantalakhana, Charan (1981)

attract higher potential rewards than contract farmers. Economies of scale appear to be reducing the proportion of independent growers. Contract farming includes price guarantees, flat price contracts, and open account contracts; growers generally receive inputs in exchange for a guaranteed price. Dating from the mid-1960s, contracts became popular only after the introduction of price guarantees in the mid-1970s; by the 1980s, more than 99 percent of intensive growers were contracted and were located close to Bangkok.

Purchasing, feed stuffs, medicines, and imported breed stock (Figure 9.2), the contract grower provides labour and skill to produce broilers on behalf of integrated feed mill, slaughterhouse, and processing firms.⁸⁹⁶ Contracts vary from open accounts for feed inputs and interest against chicken sales, to being essentially payment for wages to manage an enterprise.⁸⁹⁷ Sale price guarantees which shift the risk of growth rates, disease and input costs to the producer have been preferred by chicken processing firms, including Bangkok Livestock Trading Company (Charoen Pokaphand), Saha Farm, and Srithai Livestock Company. More recent piece-rate contracts with profit shares and incentive payments, in some cases including loans to build chicken houses, follow a USA system of Charoen Pokaphand's partner Arbor Acres.⁸⁹⁸ Contract farming has allowed Charoen Pokaphand to replace the USA as the leading supplier of broilers to Japan and to pioneer one approach to allow small-holders to remain on their land.⁸⁹⁹

Figure 9.2 Inputs and Outputs in the Commercial Thai Chicken Industry⁹⁰⁰

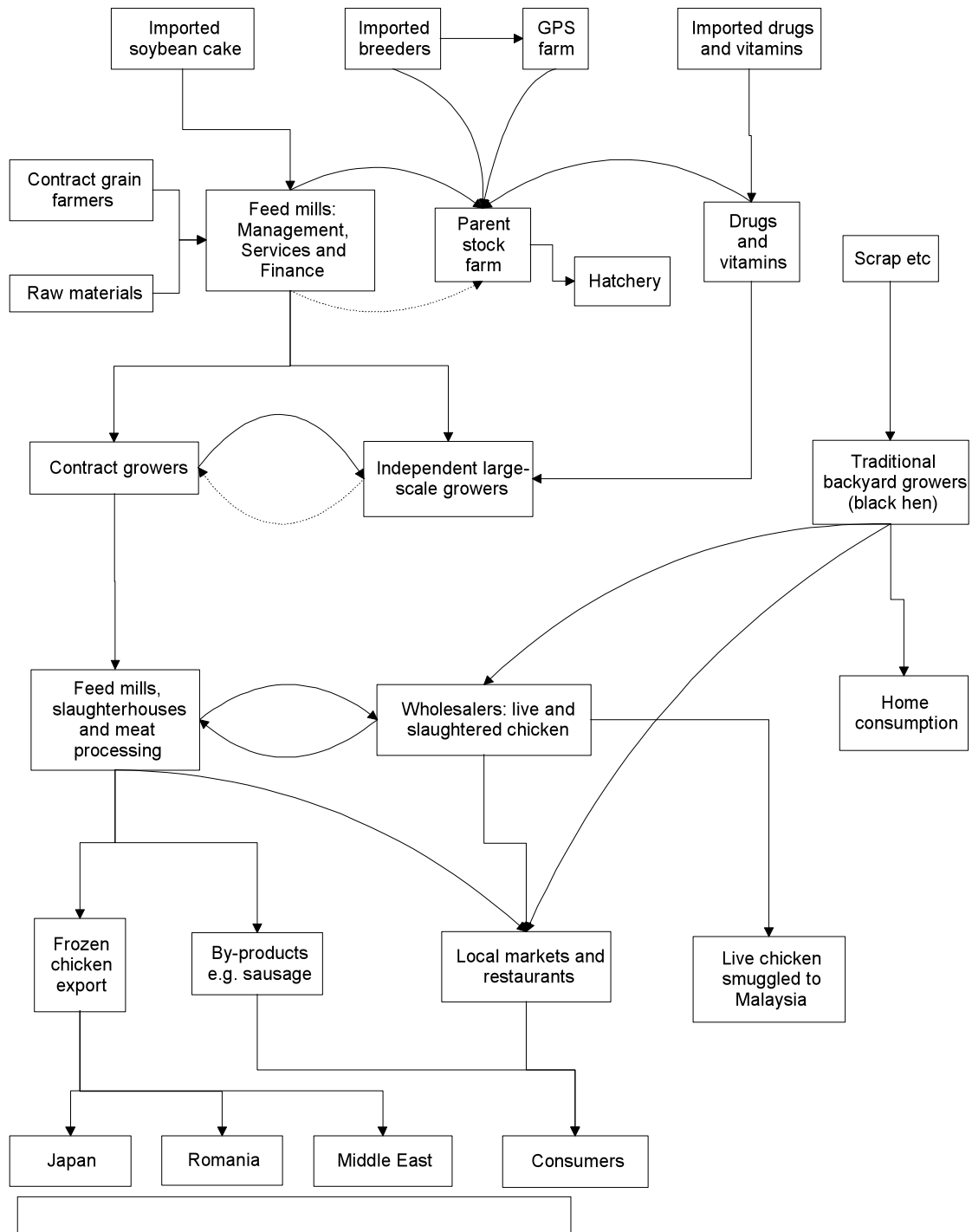
⁸⁹⁶ Poapongsakorn, Nipon (1985)

⁸⁹⁷ Manarangsarn, Sompop (1992)

⁸⁹⁸ Pipatkusolsook, Preecha (1982)

⁸⁹⁹ Bello, W., Cunningham, S. and Kheng Poh, L. (1998)

⁹⁰⁰ Poapongsakorn, Nipon (1985)



From hand processing of unevicerated carcasses with heads and feet attached, integration of major groups involved in the six major stages of chicken production and marketing (Table 9.10) has produced, for example, the second largest company within the CP Group, the Bangkok Livestock Trading Company, which processes more than 100,000 chickens per day.

Table 9.10 Vertical Integration in the Thai Chicken Industry⁹⁰¹

Activities	Firms	Share (%)	Year
Day-old chicks hatchery	<ul style="list-style-type: none"> • CP and its members • Seven firms: CP, Laemthong, Centago, Thai Feed Mill Industry Sri Thai and P. Charoenphan 	40-50	1981
Animal Feeds	<ul style="list-style-type: none"> • CP and its subsidiaries • Eight firms: CP, Laemthong, Centago, Betagro, Krung Thai, Sri Thai, Laemthong Kaset, Inter Industry Trade 	33-40 70-80	1980 1980
Drugs, vitamins, premix	<ul style="list-style-type: none"> • CP (Advanced Pharma), May & Baker, Diethelm, Wellknow, Pfizer, Thai Pharmi, etc 	n.a.	-
Broiler farm	<ul style="list-style-type: none"> • CP and its contractors • Nine farms: CP Betagro, Centago, Sri Thai, Laemthong, First Farm, P. Charoenphan, Krung Thai, Saha Farm 	26-30 65-70	1980-81 1980-81
Chicken trading (live and slaughtered) in Bangkok	<ul style="list-style-type: none"> • CP • Six firms: CP, Saha Farm, Centago, Betagro, Sri Thai 	40-50 80-90	1981 1981
Export	<ul style="list-style-type: none"> • Wholesalers at Klongton • CP (Bangkok Livestock Trading) • Saha Farm • Laemthong • Centago 	38.9 32.4 19.5 9.2	1980

Board of Investment promotion of chicken slaughterhouses has ensured capital intensive modern facilities suited to export production, particularly for Japan. Large growers, traders and processors are committed to technological and management advances, including in-house research, linkages to the Department of Livestock Development, and strategic joint venturing with foreign partners. Size enables weathering of low international prices or other crises, such as epidemics, which often force smaller scale producers out of the industry or into contract growing.

Chicken exports rose from a 1973 total of 142 ton at more than 60 percent per annum into the 1980s until Thailand supplied 26 percent of the Japanese market in the form of; boneless breasts, boneless leg fillets, skinless boneless breast, wing sticks, and bone-in leg products with assistance through strategic links to major Japanese trading firms including Marubeni and Itoman. Such success includes certain continuing risks, including:

- dependence on imported technology
- reliance on joint venture arrangements for technology, management, and markets
- uncertain sustainability of low returns to agricultural producers
- reliance on imported soya bean meal
- governmental taxes including inspection service costs
- processing plant supervision for night operations with high labour turnover
- transportation risks to slaughterhouses.⁹⁰²

⁹⁰¹ Paopongsakorn, Nipon (1980)

⁹⁰² Paopongsakorn, Nipon (1985)

By 1997, animal products, the majority of which were derived from chicken, represented the third largest agricultural export from Thailand.⁹⁰³ Within the 1997 the export value of animal products of 30.3 billion baht, poultry exports were:

Fresh Chilled Frozen Meat	11.0 billion baht
Duck Meat	0.3 billion baht
Other Fresh Chilled Frozen Poultry	0.08 billion baht
Eggs	0.1 billion baht
Swallow's Nests	0.04 billion baht

Poultry export as live animals contributed a further 70 million baht in 1997. The numbers of chickens and ducks has risen over the past decade in response to rises in the price per animal and egg prices. Over the period 1987 to 1986 (Table 9.11), chicken numbers rose from some 84 billion by nearly 100 percent, while duck numbers rose from 16 billion birds by around 40 percent. Numbers of geese appear to have remained relatively stable.

Table 9. 11 Poultry Numbers ('000) and Farm Prices (bt/kg; bt/1000) , 1987-1996⁹⁰⁴

Year	Number on Farms			Farm Price			
	Chicken	Duck	Geese	Live Chicken	Live Duck	Chicken Eggs	Duck Eggs
1987	84,495	15,620	433	19.15	19.82	1,050.00	1,180.00
1988	93,134	15,934	642	19.49	24.21	1,250.00	1,490.00
1989	102,343	16,683	427	20.66	35.16	1,280.00	1,550.00
1990	117,647	17,902	519	23.12	37.74	1,380.00	1,620.00
1991	126,609	19,124	536	22.44	32.04	1,370.00	1,630.00
1992	137,386	19,345	440	22.02	31.23	1,300.00	1,540.00
1993	139,085	21,778	548	22.85	32.54	1,400.00	1,620.00
1994	147,092	21,812	460	25.19	37.16	1,320.00	1,660.00
1995	148,784	18,897	413	27.96	33.92	1,470.00	1,710.00
1996	160,789	21,400	-	26.79	41.47	1,610.00	1,870.00

Production of broilers and hen eggs over the period 1992 to 1998 indicates rises of 10 percent and 14 percent respectively (Table 9.12).

Table 9.12 Millions of Broilers and Billions of Hen Eggs, 1992 - 1998

Year	Broilers	Hen Eggs
1992	723.3	8.1
1993	725.8	7.3
1994	679.8	8.0
1995	700.0	8.3
1996	718.8	8.6
1997	753.5	9.0

⁹⁰³ Office of Agricultural Economics (1998)

⁹⁰⁴ Office of Agricultural Economics (1998)

1998	798.3	9.2
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The majority of chickens (48 percent) and ducks (56 percent) are raised in the Central Plain; the next largest production area is the Northeast, associated with the higher human population, which supports 23 percent of chickens and 31 percent of ducks respectively. The intensive broiler industry is concentrated (75 percent) in the Central Plain as indicated in Table 9.13, notwithstanding a different distribution for overall poultry numbers. The difference is partly due to the raising of native chickens which, while developing some boutique high-priced outlets in Bangkok, remains primarily a locally traded and consumed product.

Table 9.13 Production of Broilers and Native Chickens by Region, 1994 - 1996⁹⁰⁵

Region	Number of Birds					
	Broiler			Native Chicken		
	1994	1995	1996	1994	1995	1996
Kingdom	679,798,094	699,875,927	718,836,830	73,978,956	82,154,416	89,878,324
Northeast	66,118,197	67,972,912	62,988,977	32,425,890	36,320,687	39,455,472
North	59,174,122	60,825,080	55,594,755	25,632,785	28,051,308	30,034,879
Central	494,240,858	509,597,766	540,673,299	9,432,350	10,571,566	12,046,582
South	60,264,917	61,480,169	9,579,799	6,487,931	7,210,855	8,341,391

Aquatic Animals

The traditional association of fish and rice in Thai culture is coincidentally evident in the importance of these commodities to modern-day Thailand. Today's fisheries production bears as little relationship to the fish in Sukhothai waters as does the high-input rice crop to the rices of the Sukhothai fields.⁹⁰⁶ Freshwater, marine, and brackish shrimp culture fisheries provides around 35 percent of animal protein in the Thai diet,⁹⁰⁷ a significant component of export income, and is an important part of the domestic economy. The Ramkhamhaeng Inscription also bespoke a balanced ecosystem where fish co-existed with rice in paddy fields, a situation less evident in modern Thailand. Over-fishing, changed environments, and higher human population density has now outstripped the ecosystem's ability to provide the low-cost subsistence animal protein which fuelled the building of a Thai civilisation.

Asia is the world's main producer of fish.⁹⁰⁸ Thailand is the fifth largest producer in Asia behind China, Japan, India, and Indonesia, and is eighth in the world, the USA, Peru, and Russian Federation also being larger producers. Sophisticated catching and farming techniques introduced in recent decades have been underpinned by continuing rises in fish prices, unlike other agricultural products.⁹⁰⁹

⁹⁰⁵ Office of Agricultural Economics (1998)

⁹⁰⁶ Wyatt, D.W. (1988)

⁹⁰⁷ Williams, M. (1999)

⁹⁰⁸ ICLARM (1999)

⁹⁰⁹ Williams, M. (1999)

The motorised fisheries boom of the 1960s based on demersal or seabed fishing replaced the traditional bamboo-stake system.⁹¹⁰ Unregulated use of such efficient capture techniques led to rapid exploitation of fisheries resources which spurred the Thai fishing fleet to expand its area of coverage, which was only curbed by the introduction of the 200 mile economic zone agreements of the 1970s. Similarly, inland fisheries faced exhaustion of naturally available resources which in turn spurred the development of aquaculture, initially developed around catfish and later, fresh water shrimps. Marine aquaculture of tiger prawns along coastal areas destroyed mangrove forests as it captured high priced foreign export markets.⁹¹¹

Freshwater

Tradition pervades fisheries as agriculture, albeit in the shadow of export fisheries industry techniques. Freshwater fishing continues to include village level crafts proudly executed during the agricultural off-season. Communal harvesting of freshwater fish, once socially efficient, has contributed to over-exploitation as the human population rose. Aiming to regenerate freshwater fish species from the 1970s, government stations produced some five million fry for annual distribution and release into public waterways. As native stocks failed to meet demand and tastes of immigrants, freshwater fish culture expanded from the opportunistic cultural systems of Khmer barai.

Fish culture technological has changes through the twentieth century from pond culture probably introduced around 1915 by Chinese immigrants to farm the Common Carp (*Cyprinus carpio*), and later other Chinese Carp. A small-scale activity around Bangkok, the technology evolved by the 1950s into small farmer constructed ponds which borrowed from Chinese-style ponds and traditional Thai trapping ponds. Ponds were constructed beside streams and canals to allow fish to migrate naturally during periods of flooding, and after being allowed to grow for three months or so, caught in simple nets across draining ponds.

The introduction of Tilapia (*Tilapia mossambica*) in 1951, with assistance from the United Nations' Food and Agriculture Organisation to construct some 15,000 ponds, led to a rapid shift to a new staple fish. Expansion of fish culture employed sociological understanding of traditional farming systems and thus belied the adage that traditional Thai agricultural industries are the most difficult to change. However, swamp-land conversion to ponds is now considered as one of agriculture's environmental imposts.

The high reproductive and growth levels of Tilapia, its suitability to both fresh and brackish waters, and its palatability as a table fish, led to widespread cultivation in Thailand, as in many countries. Within the 1950s, it was raised in all provinces of Thailand and was especially important away from the sea and major rivers; yields averaged nearly 3.2 ton per rai (20 ton per hectare). At this time of rapid expansion of the cultured fish industry of Thailand, it was estimated that the area suitable for fish

⁹¹⁰ Arbhabhirama, Anat et al (1987)

⁹¹¹ Siamwalla, Ammar (no date)

culture was in the order of 3.6 million rai (575,000 hectare) of which only some 10 percent had then been developed.⁹¹²

Official introductions of exotic fish species were apparently limited to the Tilapia, and Common and Chinese Carps, from Penang and Hong Kong respectively in 1948; ignoring earlier introductions and other species brought with immigrants. Government-owned fish ponds numbered 625 compared to 12,619 private ponds in 1967 with a combined surface area of seven square kilometre, mainly (44 percent) in the drier Northeast. Irrigation storages served as fish breeding units to further supplement freshwater fish supplies.⁹¹³

Ponds provided alternative, rather than complimentary, freshwater fish as native habitats declined and as introduced species dominated the newly created aquatic environments. Annual catches in the early 1950s of the order of 54,000 ton rose to 91,000 ton by the late 1960s, 60 percent of which was from the Central Plain and 33 percent from the Northeast.⁹¹⁴ However, fisheries statistics are unreliable due to the rapid and local consumption of fish and their association with traditional diets in rural areas.⁹¹⁵

Inland fishing along rivers, canals, swamps, and lakes, was traditionally based on bag nets, seines and gill nets, cast nets, dip nets, scoop nets, traps, baskets, lines, and spears. Natural narrow sections of watercourses, enhanced by creating small gateways, evolved into systems associated with drainage of specially created fish ponds. Production of traditional systems declined as agricultural intensification, including ponds, advanced; catches of small cyprinid fish, once numbered in the millions, today yield far less than those remembered by old folk. Before the 1950s, local markets were well supplied with fish through river transport associated with rice collection and distribution. The major freshwater fish, according to historic reports, appear to have been Serpent Heads, Climbing Perch, Feather Back, and Catfish.

Fish culture in Thailand recognises four reproductive variations:

- native fish which can reproduce under cultured conditions
- native fish unable to spawn in ponds, requiring fry and fingerlings collection from natural waters
- introduced fish able to reproduce under cultured conditions
- introduced species unable to reproduce in ponds requiring fry and fingerlings to be imported

These categories continue to dominate fish culture, although research outcomes have enabled local breeding of lines capable of spawning in cultured conditions, as well as enhanced exotic fish adaptation to local conditions while also improving growth rates.

Marine

⁹¹² Pongsuwana, Ubol (1955)

⁹¹³ Donner, W. (1978)

⁹¹⁴ Donner, W. (1978)

⁹¹⁵ Ministry of Agriculture (1961)

Marine fisheries has been practised along all parts of the long Thailand coast. Based on stake traps and sea vessels, over-exploitation of the fish resource was protected by technological limitations until recent decades. The stake trap used timber poles driven into the sea bottom to form circular enclosures with long wings of bamboo or wooden poles to intercept fish and direct them into the trap. Thousands of such traps once operated, in some cases appearing to cover the whole surface area of the extensive Songkhla Lakes, although these were initially aimed at shrimp capture. Utilised in water up to 20 metres in depth, traps require strong construction to withstand wave and current actions, and hence require significant investment. In recent years, financial returns from traps have been dependant on the availability of the Little Mackerel (*Rastrelliger*) which is consumed widely in Thailand. Nets constructed across river mouths, while used periodically, have been outlawed.

Thai fishing boats were motorised from the 1950s thereby allowing the use of other mechanical devices. Thus began an era of increased fish extraction which led to over-fishing of the Gulf of Thailand. From a slow beginning in collecting fisheries statistics in the 1950s from net sampling procedures, regulations to limit catches were promulgated which, appear to be taking effect in the 1990s.

Handling and processing of fish has similarly changed from traditional practices into a sophisticated industry. Fish which can be traded fresh, are packed in ice before boats dock and maintained in-ice through to final marketing to throughout the country. Processed fish are dried, salted, smoked, cooked for preservation, and made into paste, meal, liver oil, cakes, crackers, and fish sauces. Fermented fish, a traditional Tai product made from freshwater fish is still appreciated in the Northeast and North, and is seen a having further market potential. Canning of fish products for human and pet consumption attracted foreign investment through such companies as Safcol, and introduced new canning concepts to Thailand. Meal from waste fish similarly stimulated the agribusiness expansion into animal feeds.

Marine fishing value increased by more than 1,000 percent during the 1960s with the introduction of motorised vessels, modern catching equipment, and structural change in the industry as small simple fisherman withdrew. Taxing of catches proved difficult with such rapid changes, while government taxation on traditional marine fishing systems continued, raising an annual revenue of only some 9 million baht.⁹¹⁶ Marine fisheries production increased from the 1950s catches of 143,000 ton to 907,000 ton by the late 1960s.

Brackish Waters and Shrimp Culture

Culture of fish in brackish water required widespread destruction of mangrove areas to create a financially successful yet environmentally unsustainable black tiger prawn industry. Other brackish water fish cultivation is based on Sea Bass, Milk Fish, and Molluscs.⁹¹⁷ Sea Bass (*Lates calcarifer*), one of Thailand's best eating fish, was traditionally sourced from estuaries around the Gulf of Thailand. Under cultured conditions, young Sea Bass of less than 20 centimetres are collected for culturing in

⁹¹⁶ NSO (1967)

⁹¹⁷ Ministry of Agriculture (1961)

ponds or wooden enclosures, and fed small fish and shrimps until they attain market size. Prescriptive feeding and use of enclosed cages in natural brackish waters have advanced the industry in recent years. Milk Fish (*Chanos chanos*) production, based on fry and fingerling collection from tidal streams and backwaters on both sides of the Gulf, has borrowed technology from Indonesia and the Philippines. Mollusc culture was based on the Sea Mussel (*Mytilus smaragkinus*) in estuarine areas in muddy flats until oyster production assumed dominance in the 1970s.

A long-term supplement to the diets of coastal Thai people, shrimp cultivation began with extensive ponds tended on a seasonal basis, probably with minimal environmental impact.⁹¹⁸ Of the various shrimp species naturally found in Thai waters, Banana, School, and in particular Black Tiger shrimp, proved the most popular for culture as catches declined through the 1970s.⁹¹⁹

Thailand became the largest producer and exporter of Black Tiger shrimp (*Penaeus monodon*) from 1992, subsequently rising to produce almost twice that of the second highest producer, Indonesia. The coastal areas of Thailand suited development of artificial habitats for shrimp aquaculture⁹²⁰ and unregulated mangrove destruction allowed rapid industry development.⁹²¹ Shrimp capture which formed 90 percent of national production in 1975 declined to 25 percent within two decades, with the greatest expansion of aquaculture being in the eastern region, followed by the south, west, mid-gulf and inner-gulf regions.⁹²²

By 1995, almost the whole coastline suited to shrimp production had been developed for aquaculture.⁹²³ Research focused less on environmental concerns than production problems⁹²⁴ to justify the high capital and low land and labour intensities of the industry.⁹²⁵ Just as rice production has irreversibly changed the natural environment of Thailand and created a potentially socially and environmentally sustainable system suited to natural seasonal rhythms, one hopes that current prescriptive approach to shrimp culture⁹²⁶ evolves to more sustainable system.

Intensity of production increased through the 1980s, ostensibly to protect remaining mangrove areas, although the greater concentration of waste introduced a new environmental burden.⁹²⁷ At the same time, policies to facilitate foreign exchange earnings encouraged contract farming system akin to the poultry industry. From initial investment with World Bank and Asian Development Bank assistance,⁹²⁸ the industry

⁹¹⁸ Wilks, A. (1995)

⁹¹⁹ Gronski, R.T. (1997)

⁹²⁰ Csavas, I. (1994)

⁹²¹ Bailey, C. and Skladany, M. (1991)

⁹²² Department of Fisheries (1995)

⁹²³ Flaherty, M. and Karnjanakesorn, Choomjet (1995)

⁹²⁴ NACA (1995)

⁹²⁵ Pathranarakul, Pairote (1995)

⁹²⁶ Norgaard, R.B. (1994)

⁹²⁷ Panyotou, T. and Sussengkarn, Chalongphob (1992)

⁹²⁸ Skladany, M. and Harris, C. (1995)

rapidly became dominated by multinational and national private sector interests.⁹²⁹ The Fifth and Sixth Plans specifically promoted shrimp aquaculture; the first multinational company, Cargill, entered the Thai industry in the late 1980s. Small-holder shrimp growers were encouraged, through BAAC and private bank loans, to associate with agribusiness groups such as CP Feedmill and Aquastar,⁹³⁰ and continued World Bank support was justified as assisting small-holders to access new technologies, quality control, and marketing services.⁹³¹

Two agribusiness groups came to dominate shrimp aquaculture, Aquastar Limited and CP Aquaculture Business. Aquastar initially strived to integrate social, development, economic, and environmental principles, while CP used a vertical integrated approach similar to its poultry business. Beginning with a demonstration farm, Aquastar worked with individual land holders and provided extension services. Rapid expansion led to an agreement with Bechtel Engineering for large scale expansion of a standard pond design, with Aquastar providing larvae, feed, and marketing. BP Nutrition acquired Aquastar thereby linking it to wider international marketing resources which also introduced monitoring procedures aimed at increasing aquaculture water quality, with some environmental benefit.

CP Aquaculture business was the fastest growing division of the massive agribusiness conglomerate CP Group through the last decade, as it expanded shrimp aquaculture into China, Indonesia, India, Vietnam, Mexico, and Australia. Overtly oriented to vertical integration, and high efficiencies, CP expanded shrimp production rapidly from 1990 utilising products from its feed mills and marketing product through its continually expanding food market network. With land resources of between 2,000 and 5,000 coastal hectare, contract farming operations link with company operations in a manner which minimises overhead costs while reliably producing an export quality product. The CP Group also processes shrimp through four facilities in Thailand and two in Indonesia and, prior to the Asian economic crisis was engaged in negotiations for access to other Asian coastlines.⁹³²

Shrimp aquaculture technology, rapidly exceeded human management capabilities within the ecosystem. Prescriptive chemical treatment of ponds eliminated organisms which consumed residual feed and waste, thereby allowing accumulation until algal blooms utilising these nutrients, consumed available oxygen, thereby reducing water quality and weakening shrimp to virus attack. Tidal water exchange, once used in extensive ponds to manage water quality, is of limited long term utility in such an intensive system and ponds have been readily abandoned for new areas in a form of shifting aquacultivation.⁹³³

⁹²⁹ USDC (1992)

⁹³⁰ Gronski, R.T. (1997)

⁹³¹ Glover, D. J. and Kusterer, K.C. (1990)

⁹³² Gronski, R.T. (1997)

⁹³³ Weber, M.L. (1996)

Fish Production

In the 1960s, marine and freshwater fish were consumed fresh (70 percent), dried (10 percent), boiled, or smoked (four percent) with the balance processed into paste, fish sauce, meal, fertiliser or fermented.⁹³⁴ Calculation of the average production through the decade of the 1960s suggests that some 15,000 ton of fish and products were exported while some 9,000 ton valued at 50 million baht per annum were imported.⁹³⁵

By 1985 - 1994, catches and production of marine and freshwater fish (Table 9.14) had risen by 140 percent for freshwater production and more than 400 percent for marine capture. Major production in 1994 was of; Tilapia, Local Carp, Catfish, Snake-head, Sepat Siam, and Prawns (*Macrobracium*).⁹³⁶ For marine fish, major production was of; Jumbo Tiger Prawn, Anchovy, Sardines, Indo-Pacific Mackerel, Jelly Fish, Bonito, Thread-Fin Bream, Scad, Squid, miscellaneous Shrimp, Green Mussel, Trevally, and Indian Mackerel.⁹³⁷

Table 9.14 Quantity and Value of Marine and Freshwater Fish, 1985 - 1994⁹³⁸

Year	Freshwater Fisheries ('000 ton)		Marine Fisheries (million baht)	
	Quantity	Value	Quantity	Value
1985	167	4,134	2,058	15,650
1986	188	4,004	2,349	18,877
1987	177	4,558	2,602	23,083
1988	184	4,382	2,446	28,039
1989	201	4,441	2,539	31,428
1990	231	5,903	2,555	35,492
1991	259	6,260	2,709	46,765
1992	274	6,477	2,966	59,067
1993	337	8,579	3,048	69,827
1994	373	9,702	3,150	77,299

The decade 1986 - 1995 substantiated dominance of pond culture over paddy field fish, ditch, and cage culture. Areas for cultured fish (Table 9.15) rose by some 2.7 times for ponds; numbers of farms with ponds increased by more than three-fold, while paddy field culture increased marginally, a trend consistent with the number of culture units.⁹³⁹ The value of fish from pond culture in 1995 was 4.4 billion baht, from paddy culture was 0.9 billion baht, and from ditch and cage culture was 32 and 19 million baht respectively.⁹⁴⁰

⁹³⁴ Department of Fisheries (1969)

⁹³⁵ Donner, W. (1978)

⁹³⁶ Department of Fisheries (1996)

⁹³⁷ Department of Fisheries (1996)

⁹³⁸ Department of Fisheries (1996)

⁹³⁹ Department of Fisheries (1996)

⁹⁴⁰ Department of Fisheries (1996)

Table 9.15 Area (ha) of Freshwater Fisheries Cultural Systems, 1986 - 1995⁹⁴¹

Year	Pond Culture	Paddy Culture	Ditch Culture	Cage Culture
1986	90,691	149,011	1,443	24
1987	146,881	147,025	1,178	31
1988	143,460	141,492	1,556	36
1989	117,583	141,678	918	54
1990	115,371	140,657	1,168	74
1991	125,698	140,096	729	29
1992	158,468	148,589	1,054	24
1993	178,011	153,243	1,435	87
1994	191,934	169,358	3,711	10
1995	247,292	112,258	5,421	22

Inland fisheries stations produced fish fry and other aquatic animals to a total number of more than 350 billion units in 1994, dominated by Thai Silver Carp, Small Scale Mud Carp, Giant Fresh Water Prawn, Cinnib Caro, Nile Tilapia, and Rohu. Overall production of freshwater fisheries was highest for Local Carp (19,000 tons), Tilapia (15,000 tons) and Snake-head (11,000 tons), although in terms of value, Snake-head ranked ahead of Local Carp and Tilapia. Notwithstanding the sophistication of the modern fisheries industries, official fish catch and raising figures may be underestimated by up to 30 percent as a result of subsistence use.⁹⁴² The role of small-scale fishers and fish production in integrated farms is thus easily neglected in development planning.

Goats, Sheep and Elephants

Goats, and to a lesser extent sheep, form part of the undeveloped genetic resources of Thailand.⁹⁴³ Production in the North suggested the superiority of goats to sheep,⁹⁴⁴ although greater potential exist in the South where Muslim communities raise as many goats as large ruminants.⁹⁴⁵ Interpolations indicate that some 2,000 goats are imported from Burma each month,⁹⁴⁶ and that imported goat meat volume has been rising at about 12 percent per year.⁹⁴⁷ Census inaccuracies⁹⁴⁸ are indicated from this demand, and the biological capacity of around 38 percent increase per year from goats in the South, as well as unrecorded movement of goats and goat meat to Malaysia. Raised predominantly as a secondary activity to fishing, rice, oil palm, or fruit tree production, goats are mainly used for home consumption⁹⁴⁹ from meat breeds⁹⁵⁰. Dairy goats form less than one percent of the population. Productivity potential can be improved by judicious cross-

⁹⁴¹ Department of Fisheries (1996)

⁹⁴² Williams, M. (1999)

⁹⁴³ Falvey, L. (1977)

⁹⁴⁴ Falvey, L. (1977)

⁹⁴⁵ Saitanoo, Somkiat (1985)

⁹⁴⁶ Saitanoo, Somkiat., Cheva-Isarakul, B. and Bichaironarongsongkram, K. (1991)

⁹⁴⁷ FAO (1989)

⁹⁴⁸ Office of Agricultural Economics (1998)

⁹⁴⁹ Saitanoo, Somkiat., Norton, B.W., Pattie, W.A., and Milton, J.T.B. (1991)

⁹⁵⁰ Chantalakajna, Charan. (1985)

breeding, and improved health and nutrition, although the indigenous breed's suitability to village conditions favours its retention for most current purposes.

Deriving from Indian and Arabic sheep breeds which arrived in Thailand more than 5,000 years ago,⁹⁵¹ local types of Thai indigenous and Bangladesh-Burmese types⁹⁵² have been raised with limited success.⁹⁵³ Mature weights of around 24 kg and growth rates of less than 55 gram per day under field grazing produces low meat yields⁹⁵⁴ and coarse fibre, indicating unlikely prospects for development.

Thai working elephants⁹⁵⁵ form part of a wider tradition of the regional colonial period of timber extraction as the Indian and Burmese commands used by Thai mahouts reflect.⁹⁵⁶ A traditional regal and religious association with the elephant is also reflected in wider social empathy with individual elephants affected by over-stocking today. The Lampang Elephant Training School created by the Royal Forestry Department for a past era included medical care and welfare, functions now assumed by a non-government group. However, the size and digestive inefficiencies of large numbers of unemployed elephants suggest that unsustainable numbers exist. If forest areas are now less than 20 percent of those when elephant numbers were at their peak, and provided with special treatment for log extraction, then one might argue that today's stocking rate should be proportionally lower. Notwithstanding new roles in tourism, elephant welfare will include a realistic approach to the number of animals able to maintained in a comfortable state.

The Future for Livestock

Livestock including fish production, once an integrated component of subsistence agriculture, is now also a specialised industry supplying modern animal products. Livestock and livestock product consumption (Table 9.16) is conservatively expected to rise 300 percent within 25 years especially in less developed countries. This will cause further intensification in Thailand with its comparative advantage in feed production, and probably polarise livestock industries between subsistence and commercial.

Table 9.16 Tons of Meat Production Per Thousand Capita in Asia⁹⁵⁷

Country	Production	Production/Capita	Annual Growth Rate (%)		
	1995	1995	1966-75	1976-85	1986-95
China	47,752,610	39.1	3.81	7.48	8.40
Japan	3,200,840	25.6	7.29	4.47	-0.78
Rep. of Korea	1,416,683	31.5	5.71	10.82	6.56
Mongolia	214,427	87.1	4.16	-0.13	-0.53
Cambodia	153,508	15.3	1.68	5.17	5.60

⁹⁵¹ Devendra (1975)

⁹⁵² Hoare et al (1976)

⁹⁵³ Falvey, L. (1986)

⁹⁵⁴ Falvey, L. and Hengmichai, Prakob (1978)

⁹⁵⁵ Falvey, L. (1988)

⁹⁵⁶ Corvanich, A. (1976)

⁹⁵⁷ Kaosaard, Mingsarn and Rerkasem, Benjawan (1990)

Indonesia	1,936,497	9.8	3.35	6.36	6.58
Laos	49,141	10.1	-3.42	6.60	3.24
Malaysia	956,259	47.5	6.74	5.49	8.21
Myanmar	335,467	7.4	3.92	4.48	0.73
Philippines	1,622,850	23.9	2.68	1.55	8.35
Singapore	147,872	44.4	8.76	1.40	1.20
<i>Thailand</i>	<i>1,473,500</i>	<i>25.3</i>	<i>4.66</i>	<i>4.91</i>	<i>3.16</i>
Vietnam	1,385,620	18.8	-0.20	7.12	4.72
Afghanistan	230,520	11.7	2.86	0.68	0.57
Bangladesh	370,837	3.1	1.72	0.80	3.55
Bhutan	7,764	4.4	2.48	3.50	1.71
India	4,391,485	4.7	2.15	3.18	3.55
Maldives	850	3.3	2.50	2.83	1.25
Nepal	204,648	9.5	3.60	4.99	2.07
Pakistan	1,856,250	13.6	3.32	5.17	6.73
Sri Lanka	88,108	4.9	1.12	-0.49	4.64

Consideration of the environmental costs of intensive animal industries, effects small-holder use of by-products, and benefits such as work, savings, and social status, indicate a continuing role of subsistence livestock production. Linking this to a semi-commercial production system, such as for cattle and buffalo in the Northeast, may well allow some small-holders to gain financial benefits. However, subsistence production systems are by definition unable to supply the product demanded by cities and export markets. Thus intensive livestock industries which use by-products of other agro-industries such as fish meal from the fisheries industry, palm oil cake from the oil palm industry, and brewers' waste from the brewing industry, will probably lead growth in agriculture in the next two decades.⁹⁵⁸

Except for fish, meat production statistics for the region do not yet indicate Thailand's comparative advantage. With increased demand for livestock products and feed, the shifting of demand more to less developed countries, integration with global food markets, and continued substitution of livestock food products for cereals in the human diet, Thailand might be expected to show more intensive livestock production close to cities, rapid technological progress for intensive livestock production, and improved efficiencies in grazing and other ruminant management.⁹⁵⁹

This will raise ethical and environmental concerns such as animal welfare, air and water pollution, and genetic engineering in all countries which seek to export livestock products. Nutrient surpluses, from intensive animal wastes, of the order of 1,000 kg of nitrogen per hectare per year, the equivalent of seven percent of the inorganic nitrogen fertiliser produced in the world, can easily contaminate groundwater and wetland ecosystems. Loss of mangrove habitats, high coastal nutrient loads, green house gases, and health risks are already associated with intensification of livestock industries.⁹⁶⁰

⁹⁵⁸ Falvey, L. (1999)

⁹⁵⁹ Delgado, C., M. Rosegrant, H. Steinfeld, S. Ehui., C. Courbois (1999)

⁹⁶⁰ Chantalakhana, C., Korpraditsakul, R., Skunmun, P. and Poondusit, T. (1999)

Thailand has begun its land and water livestock revolution through the agribusiness activities of CP and others. Further increases in demand will favour expansion of intensive enterprises and offer some opportunities to poorer livestock producers. This will necessitate an improved regulatory environment to maintain export market access. Strong legislative and administrative integrity and an effective education and research sector across all aspects of environmental management for fish and land livestock will be essential.

Summary

Key points pertinent to Thai agriculture from the perspective of livestock and fisheries include:

- Livestock including fish have been integrated to Thai agriculture from its origins, as remains partly evident in subsistence production systems, although self-sufficient production is increasingly linked to the wider economy, thus requiring a means of ensuring that small-holders receive benefits concomitant with risks associated with supplying stock or product to the commercial sector.
- Buffalo numbers are expected to continue to decline, and cattle numbers to rise with meat and milk demand, while chicken, pig, prawn, and other aquaculture production increase in value, and fish catches decline, and goats possibly increase with Asian demand.
- As a leader in intensive chicken and black tiger prawn production as a result of a reliable feed base, multinational agribusiness firms, and government tolerance of environmental damage, Thailand has been a beneficiary of regional market expansion, and is expected to widen its lead while meeting changing international regulatory environments.

Chapter 10

Forestry

Until relatively recent times, Thailand was dominated by impenetrable forests accessible only through water courses in the Central Plain, rain forests in the South, dry *Dipterocarp* forests in the Northeast, and mixed forest including extensive areas of teak in the North. Beginning with teak, poorly regulated extraction signalled the beginning of the demise of the forests, a trend which was accelerated with the introduction of plantation crops in the South, expansion of upland cropping in the Northeast, water control in the Central Plain, and general rising population in the forested mountainous areas of the North. One indicator that most of this decline has occurred during the twentieth century is the remnant attraction of the world's largest living teak tree (*Tectona grandis*) in Uttaradit Province; discovered in 1927 with a height of 47 metres, its girth at waist height exceeds ten metres and its age is estimated to be about 1,500 years.

Having largely lost these forests, the story of Thai forestry will increasingly include references to agriculture, social concern including community forests, and well-managed plantations of a range of species suited to industrial needs. However, the few remaining pockets of original Thai forest are of critical environmental importance.

Frontier Forests

Forests traditionally represented the frontier; a barrier to most of the population, until population increase, new commercial opportunities, or the very value of products from the forest, ultimately led to the frontier being civilised. Notwithstanding reductions in forest area, remaining frontier forests are a critical global and national resource⁹⁶¹ being large enough to provide a breeding haven for some indigenous species.⁹⁶² However, once fragmented, small areas of natural forest cannot sustain their full natural biodiversity,⁹⁶³ and supplementation with plantations or man-made native refuge forests provide an incomplete replacement for old standing dead trees, for example, which once provided unique habitats for some species.⁹⁶⁴

Thailand has lost up to 95 percent of its original forest, and the remaining five percent is considered 100 percent threatened. This places Thailand with ten other countries which require immediate action to avoid losing remaining frontier forests.⁹⁶⁵ With relatively open economic policies for foreign exploitation in the past, and exploitation by its own citizens through the twentieth century, Thailand now differs from its neighbours. By contrast, Cambodia, Lao-PDR, and Myanmar, through periods of instability, have reaped the unexpected reward of maintaining much of their frontier forests intact. Today,

⁹⁶¹ Bryant, D. et al (1997)

⁹⁶² Schonewald-Cox, C. (1983)

⁹⁶³ Harris, L. (1984)

⁹⁶⁴ Norse, E. (1990)

⁹⁶⁵ Bryant, D. (1997)

satellite infra-red photographs indicate a sharp delineation of Thailand from these neighbouring countries on the basis of differing vegetative cover.

Overclearing natural forests impacts primarily on Thailand itself, while also combining with high levels of forest clearing across Asia to affect the regional and global environment. Forest resources and rates of change in selected Asian countries are presented in Table 10.1. These figures include plantation forestry, which is only significant in comparison to natural forest in China and India.⁹⁶⁶ Within its 51 million hectare total land area, Thailand has designated some 112 nationally protected areas covering some 6.7 million hectares or 13 percent of total area, three biosphere reserves, and one internationally protected area.⁹⁶⁷

Table 10.1 Asian Forests by Area and per Capita, and Annual Rates of Change⁹⁶⁸

Country	Land Forested (%)	Forest per Capita (ha)	Annual Change 1981 - 1990 (%)	Annual Change 1991 - 1995 (%)
China	14.30	0.1	-0.3	-0.1
Cambodia	55.7	1.0	-1.1	-1.5
Indonesia	60.6	0.6	-1.0	-0.9
Laos	55.9	2.5	-0.9	-1.1
Malaysia	47.1	0.8	-1.8	-2.3
Myanmar	-41.3	0.6	-1.2	-1.3
Philippines	22.7	0.1	-2.8	-3.2
<i>Thailand</i>	22.8	0.2	-2.8	-2.5
Vietnam	28.0	0.1	-1.2	-1.4
India	21.9	0.1	-0.5	0.0

With the two most populous countries showing a lower rate of forest destruction, and a long period of rapid forest destruction in Thailand, continuing forest loss at more than two percent per year indicate poor management of this natural resource.

The naturally forested areas of Thailand by province and region have been monitored by the Royal Forestry Department across several decades. Over the period 1961 - 1985, the proportion of native forest in the North has declined from 69 percent to 50 percent, in the East from 58 percent to 22 percent, in the Northeast from 43 percent to 14 percent, in the Central Plain from 53 to 26 percent, and in the South from 42 to 22 percent; over the whole country forested areas declined from 53 percent to 29 percent.⁹⁶⁹ However, official estimates are constrained by the need to demonstrate policy successes, and inherent data inconsistencies. Unofficial area estimates, vary markedly from official or targeted figures (Figure 10.1), and are also substantially less than those of United Nations figures.⁹⁷⁰ One of the confounding factors in past statistics has been the combination of forest and grazing land, which easily leads to optimistic estimates of the remaining forest cover.

⁹⁶⁶ Kaosaard, Mingsarn and Rearkasem, Benjawan (1999)

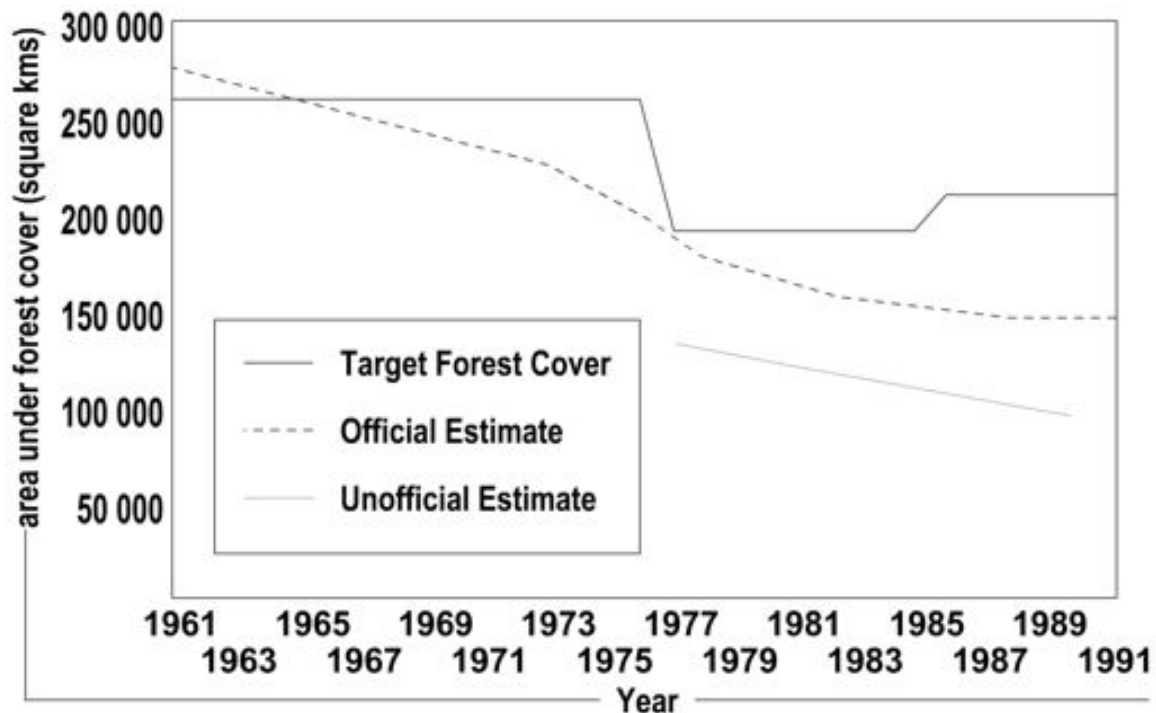
⁹⁶⁷ WRI (1997)

⁹⁶⁸ FAO (1997)

⁹⁶⁹ RFD (1985a)

⁹⁷⁰ FAO (1997)

Figure 10.1 Official, Targeted, and Unofficial Forest Estimates, 1961 - 1991⁹⁷¹



Forest Types

Thailand's forests include both evergreen and deciduous; evergreen is divided into four types. The first comprises; valuable *Dipterocarpus*. timber species, rattans (*Calamus caesius* and others), dammars used in varnish manufacture, gamboge from *Gardinia hamburyi* used as a yellow colouring agent, gutta-parcha from *Palaquium ovatum* used as a heat and electricity insulator, wood oil from various *Dipterocarpus* species used in local torches, for caulking boats and varnishing, and waterproofing basketware as well as for fuelling engines during times of oil shortages, cardamoms from various *Amomum* species used for medicine and flavouring food, jelutong from *Dyera costu-lata* used in chewing gum manufacture, incense wood from *Mansonia aqilaria species* for joss stick and perfume manufacture, bamboos for multiple purposes, chaulmoogra oil from the seeds of *Hydnocarpus kurzii* used in treatment of leprosy, *Corypha* species leaves used for religious texts and hat manufacture, and phungtalai fruits from the *Scaphium lychophorum* used in confectionaries.

The second type of evergreen forest, hill evergreen, occurs in limited areas above 1,000 metres and produces tan barks from *Quercus* species used in tanning and for mixing in beetle-nut chewing, and gum benjamin derived from *Styrax* species. Mangrove forests constitutes the third type which supplies fuel-wood, charcoal, dye and tan barks, the latter especially from *Ceriops roxpurghiana*. Conifer forests, the Fourth evergreen forest type,

⁹⁷¹ Sadoff, C.W. (1992)

occur at elevations of 700 to 1,000 metres or more and are dominated by *Pinus* species used for resin which can be distilled into turpentine and rosin for local industries.

Deciduous forests were once the most prevalent, covering 70 percent of the Kingdom. Mixed deciduous forests contained teak and other valuable species as well as providing fibres, traditional medicines, and food. Tannin, derived from *Terminalia*, *Anogeissus*, *Diospyros* and *Acacia* species are used in various industries as well as in local crafts and foods. Dyes from mixed *Dipterocarp* forests are derived from satin wood (*Caesalpinia sappan*) for red dye, *Cudrania javanensis* for yellow dye, and *Diospyros mollis* for dyeing of re-exported silk to China. Deciduous *Dipterocarp* forests have possibly been the most valuable to Thailand yet the least recognised. Railway sleepers and construction work extracted more than 800,000 cubic metres per year from such areas although forests are more known for their minor products which include dimmarz, wood oils, seeds of *Strychnos nux-momica* for local strychnine uses, oil from the seeds of *Parinari anamense* used for waterproofing umbrellas and laquerwork, and olio resin from *Melanorrhoea* species to provide the black varnish associated with Thai laquerware.⁹⁷² All types of forest provide timber useful for a range of purposes, with those timbers in particular demand for export markets being teak and some *Dipterocarpus* species.

Forest Destruction

Major causes of forest destruction in Thailand have included:⁹⁷³

- population increase
- expansion of low productivity agriculture
- legal and illegal logging, also involving agribusiness
- shifting cultivation in the highlands

The rise in population from less than 18 million in the early 1960s to more than 65 million today has reduced forests, even when agricultural activities are excluded. The pattern of forest destruction in heavily populated areas has long been observed in demand for fuel-wood and charcoal,⁹⁷⁴ and a correlation⁹⁷⁵ between population growth is evident with variations explained through changes in agricultural production systems and market prices.

Expansion of traditional agriculture has required greater areas of land than would otherwise have been required from more intensive techniques. Thailand continues to show yields well below its potential and regional averages, with higher ratios of land to population than its often less naturally fertile neighbours.⁹⁷⁶ New agricultural land created from forests in Thailand was associated with cash crops more than national food production, unlike its neighbours; although in the Northeast, much of the expansion in recent decades has also been associated with maintaining larger families than the national

⁹⁷² Ministry of Agriculture (1961)

⁹⁷³ Ramitanondh, Shaoardchai (1989)

⁹⁷⁴ Buri, Rachit (1989)

⁹⁷⁵ Sermsri, Santhat (1989)

⁹⁷⁶ Phantumvanit, Dhira (1989)

average. Between 1960 and 1975, the total cultivated land rose from 20 percent to 35 percent of the total land area while forest land declined from 59 percent to 41 percent, the balance including grazing and other lands.⁹⁷⁷ Such expansion met with little real government concern as farmers encroached on forests adjacent to farmlands, often already logged by influential groups, and converted these breached forests into cash cropping fields when prices were favourable, thus inadvertently attracting further migrant farmers to follow suit.⁹⁷⁸

Logging complemented agricultural expansion. Illegal logging left low value timber in accessible forest areas making such lands both easier to convert to cropping and less contentious for farmers to clear. Rising world timber prices encouraged illegal logging as the only means of maintaining an industry when prohibitions on logging were introduced. Powerful forces thus continually subverted the intent of the State, leading to profits accumulating in the hands of a few persons.⁹⁷⁹ Issues surrounding illegal logging include poverty, landlessness, and small farm size particularly in the Northeast, the transacting of land through illegal means including private appropriation of forest lands, the involvement of some officials in logging and land transactions, and poorly funded government programs.⁹⁸⁰

Forest destruction in the catchment areas of the North has been associated with the rising population of hill tribe groups,⁹⁸¹ now exceeding half a million. Estimates that more than 300,000 rai of prime watershed forest is lost each year to shifting cultivation were made at a time of peak population rise including immigration. Failure to acknowledge these persons as bona fide residents of Thailand, and official harassment associated with opium and other agricultural production, exacerbated a perception that these persons were responsible for massive forest destruction. In fact, the major forest destruction in Thailand has been associated with the expansion of rice in the Central Plain, upland crops in the Northeast, and plantation crops of rubber and oil palm in the South. Nevertheless, the potential danger of highland agriculture accelerating siltation of dams, serves to alarm the lowland majority. More equitable recent policies concerning hilltribe persons have facilitated social reforestation programs in the highlands.

However, logging more than shifting or other types of agriculture, has caused the disappearance of forests.

Logging

Logging first began on a large scale more than 200 years ago⁹⁸² when teak prized in China caused whole ships to be made from the timber for export. Involving Burmese, Ngeo, Chinese, and local merchants,⁹⁸³ the industry became attractive to colonial groups

⁹⁷⁷ Office of Agricultural Economics (1975)

⁹⁷⁸ Amyot, J. (1987)

⁹⁷⁹ Tingsapadh, Charit (1989)

⁹⁸⁰ Vichit-Vadakan, Juree (1989)

⁹⁸¹ TDRI (1986)

⁹⁸² Sukwong, Somsak (1989)

⁹⁸³ Bhumibhamon, Suree (1987)

who eventually negotiated means to harvest the teak forests of Thailand. From an historical perspective of assumed abundance of forest products, a new tradition of harvesting derived from forests being the property of feudal chiefs who allocated their exploitation to concessionaires.⁹⁸⁴ Legislation during the reign of King Chulalongkorn created the Royal Forest Department in 1896 with forests reverting to the King from 1899,⁹⁸⁵ although the initial Directors-General of the department being British foresters has caused some commentators to highlight potential conflicts of interest between commercial colonial objectives and long-term resource management.

Foreign expansion of teak extraction in the nineteenth century initially utilised Chinese merchants for saw-milling and teak export, shifting after 1880 to British financing of Burmese to obtain northern Thai forests concessions.⁹⁸⁶ Exports grew rapidly, notwithstanding the royal ownership of forests and creation of the department, until in 1909 many leases expired and more conservative terms were introduced. The peak official export volume of 122,000 cubic metres of the period 1905 - 1909 was thus never again officially reached, with the average exported volume over the period 1925 - 1940 being some 76,000 cubic metres,⁹⁸⁷ although teak consumption within Thailand continued to rise.

Initially, teak and other valuable species were logged from areas in the vicinity of rivers, with expansion upstream from major rivers which allowed logs to be floated to collection points. Already by the 1890s, one observer had noted that all forests in the western section served by streams had been exhausted.⁹⁸⁸ Extraction continued utilising elephants and flotation until recent decades. In the early part of the twentieth century, teak was even floated down the Mekong river from Thailand to Saigon.⁹⁸⁹ Logs took as little as a few weeks to reach their destination, or as much as twelve years from more remote areas with large distances of travel. Notwithstanding the rapid rate of efficient exploitation through the colonial-influence period, the highest rates of extraction of teak probably have occurred through the 1950s and 1960s when it is estimated that around 400,000 cubic metres was harvested in some years.⁹⁹⁰

By 1927, 32 forests were under concession, 17 to British, six to French, and one to a Danish company. Of the estimated 1.3 billion teak trees at that time, only 95,000 trees were in the eight concessioned forests run by Thai.⁹⁹¹ Deforestation may thus be considered to have begun with colonial expansion in the region, rather than as an economic objective of the Crown⁹⁹².

⁹⁸⁴ Chunkao, Kasem (1987)

⁹⁸⁵ Brockelman, W.Y. (1989)

⁹⁸⁶ Samapuddhi, Krit (1957)

⁹⁸⁷ Mahapol, S. (1954)

⁹⁸⁸ Warington Smyth, H. (1989)

⁹⁸⁹ Credner, W. (1966)

⁹⁹⁰ Donner, W. (1978)

⁹⁹¹ Soonthornsawat, Chamaichom (1977)

⁹⁹² Ramitanondh, Shalardchai (1989)

Informed concern about logging of teak, expressed from the 1950s,⁹⁹³ caused government to establish a company to assume foreign teak concessions.⁹⁹⁴ However, illegal cutting led to substantial additional losses from teak reserves to which some well-intentioned policies contributed, such as the allocation of a forest concession to Kasetsart University to provide an independent income in the mode of the USA land-grant colleges.⁹⁹⁵ Overharvesting of teak, and rising government attention, led to logging expertise shifting to other valuable timber species, thereby widening the environmental impact of forestry. Government revenues from the industry included export duties, business taxes, business profits, and royalties, each of which was probably consistently under-collected.⁹⁹⁶ Throughout this period, the primary agricultural activities of logging and rice monoculture provided the major export income of Thailand.⁹⁹⁷

The 1950's construction of large hydro-electric dams legitimised widespread tree felling in areas to be flooded, thereby providing a cover for illegally logged timber in the hands of influential military leaders. Counter-insurgency campaigns of the mid-1960s provided the means of continuing such logging, sometimes by linking army and private business interests which extended at one point to an unsuccessful attempt for army monopoly control over the whole timber trade of Thailand.⁹⁹⁸ With such forces of forest destruction, coupled with the expansion of population, annual rates of deforestation across Thailand rose to more than six percent during the late 1970s; although the average annual rate of deforestation from 1970 to 1990 appears to be of the order of 2.5 percent.⁹⁹⁹ Policies to curb such unsustainable action were mainly ineffectual.

Forest Policy

National forest policy has drawn from the policies of other countries and comprises statements of good intent which have seldom been able to be fully implemented due to an inadequate regulatory environment, and economic expansion associated directly, or peripherally, with agriculture. Forest policy, in the 1950s for example, included the unenforceable policies of:¹⁰⁰⁰

- preservation of native forest to provide the public with forest products in perpetuity
- protection of areas to minimise soil erosion and preserve watersheds
- production forests to be cut on a sustained-yield basis including national parks
- detailed surveying to ensure monitoring and policing capability
- sound supportive educational structures at tertiary and sub-tertiary level in forestry
- afforestation to provide future forest product needs
- research into improved economic efficiency in the use of forest products
- engagement of the wider populace in understanding the value of forests
- encouragement of private tree planting

⁹⁹³ Ungphakorn, Puey and Yossundara, Suparb (1955)

⁹⁹⁴ Ratanaprasidhi, Metah (1963)

⁹⁹⁵ Silcock, T.H. (1970)

⁹⁹⁶ Usher, D. (1967)

⁹⁹⁷ Poapongsakorn, Nipon (1995)

⁹⁹⁸ Phongpaichit, Pasuk and Baker, C. (1995)

⁹⁹⁹ Sadoff, C.W. (1992)

¹⁰⁰⁰ Ministry of Agriculture (1961)

Forest destruction by the 1980s was perceived as a failure to implement legislation and modern knowledge concerning sustainable forestry, rather than a failure of understanding the industry and its management.¹⁰⁰¹ Deforestation at a rate of three million rai per year for 30 years caused professional foresters to officially note an underlying change in assumed national values,¹⁰⁰² and incidentally their own impossible task of policing the forests. Rising political activity included local rallies against logging, particularly in the North. Revocation of a forest concession resulted from such civil concern in 1988, emboldening involvement in a campaign which successfully blocked a reforestation project of a politically-aligned family and converted the area to a community forest. A fatal mud slide in the South associated with logging, and rising civil pressure, caused government to revoke all logging concessions in 1989. Through this period, agribusiness separately lobbied government to have lands classified as degraded in order to then have land allocated to them for reforestation, usually with fast-growing introduced species such as *Eucalyptus*. That some of these lands had been communal grazing lands or otherwise providing herbs and forest products for local communities led to villager objections. The Royal Forest Department, the Army, and agribusiness combined to plan the removal of perhaps six million persons who, according to the reallocation of ownership, were now designated as squatters on what they considered their own agricultural land.¹⁰⁰³

Various government attempts to regulate logging have been subverted by inherent conflicts in the legislative and administrative arms of the government. As early as 1895 it appears that teak extraction rates were some three-and-one half times sustainable levels,¹⁰⁰⁴ heralding an approach to logging which was to continue to the 1990s, and only to decline in response to international environmental interests, and exploitation of all easily accessible timber. Government ownership of forests, and the limited native forest reserve, now provides an opportunity for forest reserves created in the 1930s to be managed appropriately. This has caused reassessment of simple use of standard GDP measures which overstate national income by failing to acknowledge depletion in resource stocks.

Since the 1970s, increased public awareness of the need for environmental conservation and management has brought a focus onto native forests causing government to enforce its own regulations.¹⁰⁰⁵ During the early 1980s, Thailand's rate of forest loss exceeded that of the Southeast Asian average by nearly two-and-one half times¹⁰⁰⁶ and nearly five times the average rate for all tropical areas.¹⁰⁰⁷ In this context, Thailand's world-leading 1989 prohibition on logging,¹⁰⁰⁸ rather than being a far-sighted environmental management policy, can be seen as a need for extreme action in response to excessive

¹⁰⁰¹ Ramitanondh, Shalardchai (1989)

¹⁰⁰² RFD (1993)

¹⁰⁰³ Phongpaichit, Pasuk and Baker, C. (1995)

¹⁰⁰⁴ Bhumibhamon, Suree (1986)

¹⁰⁰⁵ Sukwong, Somsak (1989)

¹⁰⁰⁶ ESCAP (1990)

¹⁰⁰⁷ WRI (1988)

¹⁰⁰⁸ Sadoff, C.W. (1992)

exploitation. Such exploitation built on a century-old tradition of the elite viewing forests as unlimited and available for exploitation, itself anomalous with respect to both Tai¹⁰⁰⁹ and Khmer¹⁰¹⁰ village traditions, which required maintenance of at least one forested area close to each village.

If the State is deemed to have been negligent in its forest management in the past, its future role may well be ensuring a balance between competing interests. Enhanced commercial forestry under the regulatory umbrella of government seems possible in a market place where the price of teak has risen some 150 percent in the past decade while *yang* rubber wood has risen some 600 percent.¹⁰¹¹ Thus Thailand's forestry has moved from the hunting and gathering era to that of the era of agriculture, a revolution spurred by the prohibition on logging.

Prohibition of Logging

The logging prohibition has been effective in reducing total forest clearing although it has been less successful in selective extraction of high value trees. The ban itself is in fact an amendment to three acts concerning forestry, wildlife conservation, and national parks and continues to allow for felling of trees in privately operated forestry plantations, harvesting of designated species and trees which have been damaged through age or natural disasters, and clearing for national infrastructure projects. The Bill's passage through parliament included it being characterised as a temporary measure. It has caused the losses of legitimate logging employment and rising log prices, which in turn has led to some increased illegal cutting in the short term.¹⁰¹²

Perhaps the worst of unintended effects has been the additional pressure put on the forests of neighbouring countries. In Myanmar, logging concessions have been granted in areas resisting Central government control; concessions have brought together Thai businessmen, the Myanmar and Thai Military, and government officials, in a complex and largely undeclared arrangement, which will supposedly result in greater Myanmar government control of logging and trade, and construction of roads to facilitate ethnic integration in Myanmar. With increased control over sensitive areas, the Burmese military has sought to reign in Thai concessionaires, for commercial rather than environmental reasons. However, the history of such arrangements suggests that logging in Myanmar may settle back to semi-official and illegal activities soon.

Land importation of logs from Cambodia to Thailand no longer requires certification of origin, in common with those arriving by sea. Cambodian forests have reduced from 73 to 50 percent of the land area over the last twenty years, increasing siltation rates in the Mekong and Tonle Sap rivers, and possibly increasing the severity of monsoonal flooding. The government of Lao-PDR, treated in a similar manner as Cambodia by Thai timber traders, attempted to control domestic logging, although recent economic

¹⁰⁰⁹ Sheng-Ji, Pei (1985)

¹⁰¹⁰ Van Liere, W. J. (1989)

¹⁰¹¹ Tingsabadh, Charit (1989)

¹⁰¹² MIDAS (1991)

pressures, which have impacted on the tiny Lao-PDR economy to a greater extent than provincial Thailand, has heralded a need for rapid replenishment for foreign exchange through one of the few saleable assets of the country, timber.¹⁰¹³ The economic and political influence of Thailand, its skills base related to both illegal and legal logging, and a rising world price for timber, suggest that Thailand may now be exporting its destructive forestry management systems. An analysis of the Thai logging prohibition indicates its local economic benefit,¹⁰¹⁴ although exporting exploitive techniques across borders has obvious costs, and in the long term most will accrue to Thailand. Meanwhile, some acknowledgment of the requirements of social and conservation forestry has been introduced through development programs.

Conservation and Social Forestry

In addition to national parks and community involvement, conservation forestry trials indicate the viability of tourism, collection of forest products on a controlled basis, and even controlled cropping within highland watershed areas. Involvement of communities in forest management enhances management efficiencies through reduced regulatory and labour costs; experience suggests that this may be the only forest management technique which can work in areas of rising or high population. Effective involvement with community from the planning stage has been demonstrated to be successful for village wood lots, tree farms, and management of existing forests.¹⁰¹⁵

Community, or social, forestry is a complex concept worthy of expansion to avert further unintended consequences of open-exploitation of forests. Compulsory resettlement from areas where commercial plantations are to be established easily contravene moral, and possibly legal, rights of residency, and tend to be impractical as land available for resettlement is usually of marginal utility. They also undervalue socio-cultural ties and indigenous knowledge of native forests.¹⁰¹⁶

Forest losses have contributed greatly to Thailand's economic and agricultural development. However, though some costs of development are inevitable with rising population, it is clear that Thailand has exploited its natural forest resources to an extent far beyond that which was necessary or desirable. Effects on stream flows, increased risk of natural disasters from flash flooding and mud slides, and loss of less tangible assets such as bio-diversity, have socially impoverished Thailand. Protection of remaining forests, and enhancement through reforestation, are essential requirements for Thailand's agricultural development today.

The most obvious, and probably the most successful, aspect of forest protection in Thailand has been the creation of national parks. While encroachment, exploitation, and corruption have featured in most parks, their designation has resulted in an overall protection benefit, while at the same time raising public consciousness of the benefits of

¹⁰¹³ Sadoff, C.W. (1992)

¹⁰¹⁴ Sadoff, C.W. (1992)

¹⁰¹⁵ Tingsabadh, Charit (1989)

¹⁰¹⁶ Bello, W., Cunningham, S. and Kheng Poh, L. (1998)

environmental management linked to eco-tourism. The first national park was established in 1962 at Khao Yai, with a further three added over the subsequent decade. Over the period 1972 - 1979, a further twelve parks were created, and between 1979 - 1982 a further 29. By 1989, a total of 52 national parks covering 5.2 percent of the country's land area had been created. Wildlife sanctuaries and hunting areas were also established from the 1960s and by 1989, some 28 sanctuaries covering 4.2 percent of the total land area were under management.¹⁰¹⁷ With around 10 percent of the country designated as national parks and sanctuaries, these areas form a basis for future public education and management of natural resources.¹⁰¹⁸

Expanding the areas designated as national parks and sanctuaries has not led to a concomitant increase in government budgets to protect these areas. Increased eco-tourism traffic has led to a rise in maintenance costs by 30 percent during a period when cost recovery has fallen from 51 to 30 percent even though users appear willing to pay 150 percent more than current entry related charges.¹⁰¹⁹ In concluding that Khao Yai National Park is under-utilised, under-priced, and dependent on government subsidy, it has also been noted that encroachment and poaching is necessitated by the welfare loss of adjacent villagers, whose traditional resource has been reallocated to local resort owners, tour operators, and middle-class tourists.¹⁰²⁰

Protection of forests and reforestation relies on the support of rural dwellers. Past failures, for both commercial and social forestry developments, have been traced to an ignorance of the root causes of rural poverty, part of which is the absence or withdrawal of secure resource entitlements. Land ownership, infrastructure development, enhanced incomes preferably through agricultural productivity, enhanced farm investment through responsible credit, improved education, policy revision, policing of agribusiness activities, and reforestation of watersheds have been determined as means of reducing both reforestation failures and poverty.¹⁰²¹ One practical approach acknowledges the needs of rural dwellers for fuel-wood in the design of projects.

A UNDP/World Bank study¹⁰²² has identified the need for reforestation to offset lost forest cover, and to provide sustainable forest products and cash income for rural dwellers, through sustainable supplies of fuel-wood and charcoal from tree planting combined with the planting of fruit and other productive trees. Multi-purpose village and army or school wood lots, associated with legume-based grazing areas, are termed alternative agriculture by some, yet represent a simple acknowledgment of past socio-environmental management systems. Products of fuel-wood, charcoal, poles, pulp, plywood, and timber can contribute financial rates of return to planters of more than 20 percent. Associated with such farm forestry is rehabilitation of fringe forest areas, enhanced research and development, education and training, and monitoring of the

¹⁰¹⁷ Faculty of Forestry (1987)

¹⁰¹⁸ Sukwong, Somsak (1989)

¹⁰¹⁹ Dixon, J.A. and Sherman, P.B. (1990)

¹⁰²⁰ Kaosaard, Mingsarn et al (1995)

¹⁰²¹ Tongpan, Sopin et al (1990)

¹⁰²² UNDP/World Bank (1988)

investment. Such projects, which can represent applied outcomes from broad investigations of current problems and global solutions, provide an indication of likely future directions for forest protection and reforestation in Thailand.

Agriculture – Forestry Interactions

The rate of forest destruction has been related to agricultural prices¹⁰²³ even though arable land is at times left uncultivated under circumstances of:¹⁰²⁴

- low crop prices
- low soil quality
- agricultural population growth
- higher returns from the non-agricultural sector
- larger average farm holding

Rural residents rely on remaining forest resources for energy supplies. In the Northeast, for example, only 15 percent of rural households utilise commercial fuels such as kerosene, liquid petroleum gas, or electricity, and cooking for virtually the whole population relies on fuel-wood and charcoal, which constitutes about 98 percent of total household energy used¹⁰²⁵. Consumption levels of 207 kg of fuel-wood and 68 kg of charcoal per person per year equate to some 13 million cubic metres of timber which, from degraded forests and young trees, indicates the impossibility of re-establishing forests without first meeting the ongoing needs of poor rural dwellers. In the Northeast, the main causes of deforestation are poverty, population growth, and low cassava prices. Poverty is thus both a cause and a consequence of deforestation, as crop yields decline with soil exhaustion, and each new area of land opened is of lower agricultural value.¹⁰²⁶ Equitable involvement of small-holders in future forestry development will apply especially to private forestry investments.

Private Forestry

Notwithstanding eloquence in national economic and social development plans, the national forest policy has accepted the inevitability of forest degradation. For example, the 1985 policy acknowledges the continuing reduction of native forest as a matter of fact, thereby indicating powerlessness to implement policies which purport to protect natural forests. Acknowledgment of the need for private sector investment is balanced against perceived difficulties in attracting the necessary long term investment, which is associated with natural hazards such as fire, and price hazards associated with global markets and government policy.¹⁰²⁷ However, a shift in public attitudes between 1985 and 1989¹⁰²⁸ led to forest protection policies under headings of conservation, economic, and agricultural zones, with conservation areas representing 28 percent of the country. Conservation areas cannot be logged or farmed, and mining concessions cannot be

¹⁰²³ Cropper, M. (1997)

¹⁰²⁴ Panayotou, T. and Parasuk, Chartchai (1990)

¹⁰²⁵ UNDP/World Bank (1998)

¹⁰²⁶ Phantumvanit, Dhira and Panyotou, T. (1990)

¹⁰²⁷ Phantumvanit, Dhira et al (1989)

¹⁰²⁸ Phongpaichit, Pasuk and Baker, C. (1995)

renewed. However, conservation areas so declared exceeded forest conservation targets of the Seventh Plan by 25 percent, nearly doubled the targets of the Sixth Plan, and exceed the probable areas of remaining forest in the country. Such ambitious policies can only be realistic with successful development of the economic forest area which aims to cover 16 percent of the total land area,¹⁰²⁹ in concert with strong regulatory action.

With the Reforestation Act of 1992, plantations may grow exotic species, except in conservation areas. Agribusiness interests, initially dampened by the perceived risks of natural or anthropogenic fire,¹⁰³⁰ have extensive plantings of *Eucalyptus calmandulensis* and other fast growing species for paper pulp.¹⁰³¹ Controversies which focused on such species¹⁰³² often used it as a proxy for underlying resentment of the social inequity of reallocating lands, once accessible to agriculturists, to agribusiness firms for monocultural plantations. Cutting of virgin forests in order to create land for *Eucalyptus* plantations¹⁰³³ which require as little 20 persons per square kilometre as labour,¹⁰³⁴ increases the social inequity with respect to poor rural dwellers forced to assist their own demise. Nevertheless, the extent of the environmental and agricultural problem associated with forest degradation possibly required the involvement of agribusiness. Reforestation by government agencies and their concessionaires over the period 1961 - 1985 indicates variable success across some 3.4 million rai,¹⁰³⁵ an over-estimate as many reforested areas have been re-degraded.

Research and incentives from government have encouraged planting of trees with rotation lengths of less than seven years, including the species: *Eucalyptus calmandulensis*, *Leucaena leucocephala*, *Azadirachta indica*, *Casuarina equisetifolia*, *Rhizophora mucronata*, *Casuarina junghiana*, *Acacia auriculiformis*, *Acacia mangium*, *Melia azedarach*, *Pinus kesiya*, and bamboo.¹⁰³⁶ The potential for further forest plantation development in Thailand is indicated by:¹⁰³⁷

- the low base of plantation development, estimated at 529,000 hectares in 1990
 - the extensive use of plantations in regional countries, such as some 32 million hectares in China, 13 million hectares in India, and six million hectares in Indonesia.
- Thailand's development of plantations may be expected to link with other agricultural changes with an overlap between horticultural tree crops and timber trees in a manner exemplified by the rubber industry, and to thus support further growth in integrated forest industries.

Forest Production and Industries

The shift in exports of forest products has been, across the centuries:

¹⁰²⁹ Sadoff, C.W. (1992)

¹⁰³⁰ MIDAS (1991)

¹⁰³¹ Siamwalla, Ammar (1986)

¹⁰³² Sadoff, C.W. (1992)

¹⁰³³ Bello, W., Cunningham, S. and Kheng Poh, L. (1998)

¹⁰³⁴ Lohmann, L. (1991)

¹⁰³⁵ RFD (1985b)

¹⁰³⁶ Phantumvanit, Dhira et al (1989)

¹⁰³⁷ FAO (1997)

- Ayutthaya and before - forest products for medicine, food, household items, and domestic use of timber
- Beginning of the Ratanakosin period - exports of teak to China, as well as rising local use.
- Late nineteenth century - sales and concessions of teak and other timbers to colonial companies
- 1930s - nationalising concessions and exporting teak and other valuable timbers
- 1960s - declining availability of non log-based forest products including firewood, charcoal, barks, cardamom, dammar, gamboge, rattan, and lac
- 1980s - conversion of timber into value-added products such as furniture for domestic use, and in particular export
- 1990s - utilisation of fast growing timber species and previously rejected timber from plantations, such as rubber.

Yields of forest products in recent decades are difficult to reconcile from official statement. Plans and projections for, and assessments of, the state of Thai forests which are based on areas planted, degraded, or encroached do not provide specific enough information to understand the potential for future forest production. The density of forests is also critical in determining forest stock, as is forest type, climatic conditions, and the rates of extraction for each separate area.¹⁰³⁸ An estimate of the volume of Thailand's forests over the period 1970 - 1990 is presented in Figure 10.2, which includes estimates for each of the four major regions. The difficulty of presenting such information is indicated in attempts to estimate wood consumption, the measurement of which is based solely on legally harvested timber. Wood consuming industries have been sustained by illegal harvesting and wood imports; Thailand has been a net importer of logs and sawn wood since 1997.

Figure 10.2 Forest Volumes in Thailand, 1970 - 1990¹⁰³⁹

Imports of commodities related to forestry include paper, paper board, boxes, pulp, household utensils made of wood, ply-wood, and other veneer sheets. Through the 1980s, imports of these products represented a little over 40 percent of the total value of wood related commodities consumed in Thailand, the bulk of which related to paper, paper board, boxes, and pulp.¹⁰⁴⁰ These follow a long history of importing wood related products, which even in the 1950s, approached 200 million baht per year for products of newsprint, other papers, ply-wood, artificial timber and boards, and rattan.¹⁰⁴¹ A comparison of exported and imported wood products against the comparative advantages of production in Thailand reveals opportunities to increase production of; wood charcoal, parquet, hard board or particle board, wood pulp, wood chip, cement-based board, and fibre board.¹⁰⁴²

¹⁰³⁸ Sadoff, C.W. (1992)

¹⁰³⁹ Sadoff, C.W. (1992)

¹⁰⁴⁰ Department of Customs (1986)

¹⁰⁴¹ Ministry of Agriculture (1961)

¹⁰⁴² Phantumvanit, Dhira (1989)

Export of wood products has been largely unaffected by logging prohibitions. In particular, furniture export has continued a rising trend established in the late 1980s (Figure 10.3).

Figure 10.3 Exports of Wood and Wood Products, 1985 - 1990¹⁰⁴³

Income in the wood related industries has continued to grow relatively unaffected by the 1989 logging ban. Income growth derives primarily from value-adding; wood related industries exceeded forestry income in 1977, rising to about five times its value by 1990. The primary wood based industries are furniture, processed wood products, paper, and paper products. Incomes in the latter group are further insulated by their dependence on waste paper and non-wood pulp, such as kenaf, for fibre inputs.¹⁰⁴⁴ Government revenue derived from forestry products is attracted through royalties on teak, other woods, firewood, charcoal, and other forest products, through fees, fines, sale of forest products, and forest improvement fees. Over the period 1987 - 1996, total revenues have declined from 272 million baht to 104 million baht with the major declines occurring in revenues from teak and other woods (115 million baht in 1987 and only one million in 1996).¹⁰⁴⁵ This decline in government revenues is indicative of changes from traditional government revenue raising through concessions and licenses used since the Ayutthaya period, to a taxation system based on business profits, transactions, and incomes.

Pulp production in Thailand has risen from some 31,000 tons in 1974 to 117,000 tons in 1986.¹⁰⁴⁶ The first pulp mill, founded in 1945, utilised rice straw, although later more successful mills were based on the processing of imported pulp. The six pulp factories established through the 1970s suffered from world pulp and paper price rises, which led to increased interest in using non-wood raw materials, including bagasse, rice straw, grass weeds, and bamboo. However, bamboo resources were similarly declining in Thailand, bagasse had alternative uses, and rice straw declined in availability with the adoption of short-straw varieties and new agronomic techniques.¹⁰⁴⁷ The utilisation of kenaf as a component of pulp appears to be technically successful although the one major venture associated with its use has produced mixed results. Further aspects of forest business are discussed in the following chapter concerning agribusiness.

The production and value of teak, yang, and other timber cut under licence, and bamboo, yang oil, and gum damar over the period 1987 - 1996 (Table 10.2) indicates a 94 percent decline in total value from 6.7 billion baht to 0.4 billion baht. Over this period, the number of power operated saw mills has increased from 480 to 683 while the number of hand operated saw mills has declined marginally from 84 to 73. Major investment has been in the South, a reflection of the availability of timber from rubber plantations and the reliably higher rainfall suited to plantation forestry.¹⁰⁴⁸

¹⁰⁴³ Sadoff, C.W. (1992)

¹⁰⁴⁴ Sadoff, C.W. (1992)

¹⁰⁴⁵ Royal Forest Department (1997)

¹⁰⁴⁶ TPPIA (1987)

¹⁰⁴⁷ Phantumvanit, Dhira et al (1989)

¹⁰⁴⁸ Royal Forest Department (1997)

Forestry has become a social and environmental concern in Thailand, primarily as a result of having been viewed, and over-exploited as, an economic resource. Plantation forestry is therefore assuming importance as industries which rely on forest products, especially timber, create rising demand. Having moved from a stage akin to hunting and gathering, forestry is now both a sector of agricultural production and agribusiness, while retaining an additional component of conservation and management. The relationship of small-holders to forestry will continue to change as community wood lots and fast growing private plantations are adopted. Agribusiness, in concert with the State, may be expected to assume the risks and rewards of larger scale plantation forestry and processing over the next decade. The role of institutions in the agricultural sector has influenced policy effectiveness, and will continue to be a force as the role of government is clarified in moderating competing interests, while meeting long term objectives; institutions are discussed in the following chapter.

Summary

Key points pertinent to Thai agriculture from this discussion of forestry include:

- From a forested land until this century, Thailand's forests have been degraded to rank tenth in terms of risks to forest survival, as a result of illegal and legal logging providing high private and government returns, and openings for agricultural expansion, with concomitant losses of forest products which once met a range of industrial, health, and handicraft demands.
- Beginning with Chinese demand for teak, colonial interest and government revenue expanded logging of valuable timbers, until attempts to slow extraction caused illegal and quasi-legal logging associated with national security and dam construction, thereby voiding policy intent, which while acknowledging the inevitability of further destruction, included attempts to introduce environmentally considered law, and industrial plantation.
- Traditional associations with forests adjacent to villages with assumed continuous availability of fuel, medicines, game, and other supplies has changed, as access became limited by transfer of perceived ownership from communal to private hands through logging and forest product concessions to eventually produce a competitive situation for residual forests and products, which necessitates social and environmental planning before economic gains in any future State forest re-establishment.

Table 10.2 Production (m³) and Value ('000 baht) of Teak, Yang, and Other Timber Cut Under Licences, Bamboo, Yang Oil and Gum Damar^a, 1987 - 1996¹⁰⁴⁹

Year	Sawlogs						Others			
	Teak		Yang		Other		Bamboo		Yang Oil	
	Volume	Value	Volume	Value	Volume	Value	Production	Value	Production	Value
1987	38100	4191000	543185	1412281	1567751	4685966	40733	183669	660961	11897
1988	46934	563208	531703	1541939	1469455	4808366	60798	633086	533797	10142
1989	26234	341042	148082	444246	744689	2787645	54333	583102	413628	10341
1990	17641	232861	35343	109563	438661	1358730	48295	436388	292605	7315
1991	2836	38286	3664	12824	225005	726043	51827	427207	254566	7128
1992	1167	15988	3844	14223	114426	368645	56509	893134	43.560	1307
1993	6147	89131	2804	12618	55917	186743	37039	569817	56449	2258
1994	5781	86715	5103	22964	51443	181.837	14167	164324	14228	711
1995	2154	34464	3093	15465	29637	118548	6674	106670	2807	140
1996	10684	170944	2603	14317	30606	137727	7577	117961	2558	179

^a Gum damar production figures limited to 1989 and 1990 when they were 31,500m³ and 126,000 baht, and 6,000m³ and 24,000 baht respectively.

¹⁰⁴⁹ Royal Forest Department (1997)

Chapter 11

Some Agricultural Institutions

Modernisation of agriculture, regulation of natural resources management, and social equity policy and implementation rely of sound government institutions. Institutions of the Thai government are structured on historically derived criteria modified across transitional periods, such as the reign of King Chulalongkorn and the post-1932 revolutionary period. Embodying traditional elements which may be construed as conflicts-of-interest in Western terms, the system reflects patronage, influence, and a level of separation between government and the populace.¹⁰⁵⁰ Within an evolving role for government over the centuries and especially in recent decades, the ministries concerned with agriculture, and in particular those arms of government supporting agricultural growth through research, extension, education, cooperative action, credit and marketing, have changed, and require further change; these agencies are discussed in this chapter.

Government and Agriculture

The Ramkamhaeng inscription, eulogises abundance of fish and rice in the Sukhothai waters and fields, and continues ... *[the people] establish areca and beetle plantations all over ... many coconuts ... mangos ... tamarinds are planted in this city ... whoever plants, owns those plants ...*¹⁰⁵¹ The individual freedom implied has pervaded Thai self-image, and might even be interpreted as a freedom from the need for government involvement in ensuring agricultural welfare. From this perspective, Ayutthaya and Ratanakosin views of agriculture as a source of tax revenue may be linked to the slow creation of specifically government agricultural institutions.

Centralised government facilitated resistance to colonial impositions while extending the Central Plains Kingdom, producing national institutions rather than autonomous provincial departments. Tai and Mon-Kymer structures of *ban*, *muang*, and to an extent *nakorn*, evolved into today's some 76 provinces with populations ranging from a few hundred thousand to 3.5 million. Provincial administration through *ampur* or districts implements central policy; *tambon* or sub-district activities are conducted through some arms of government, such as agricultural extension. At the village or *muban* level, traditional governance systems are now part of the centralised system with village headmen being responsible for leadership and maintenance of records.¹⁰⁵²

Nevertheless, urban and rural knowledge bases have diverged as urban bureaucrats identify with Western procedures, and rural leaders with traditional ways. The failure of some government initiatives of recent decades illustrate gaps between urban and rural

¹⁰⁵⁰ Phongpaichit, Pasuk and Baker, C. (1995)

¹⁰⁵¹ Sukwong, Somsak (1989)

¹⁰⁵² Donner, W. (1978)

perspectives, and within institutional hybrids of tradition and components of diverse foreign systems.

Institutional Instruction

As learning from experience has been a hallmark of Thai culture, recent policy and institutional failures provide a means of assessing past and likely future developments. Thai agricultural policy has reflected the weaker lobby of agriculture compared to countries where the majority of produce is domestically consumed and hence producer and consumer are closely linked when shortages threaten. Self-sufficiency policies in China and India for example, have focussed government on agricultural research more than has been evident in Thailand. This has been compounded by a tendency to copy such policies, as indicated at times by emphasis on import substitution crops more than major export crops.¹⁰⁵³ Poorly informed planning has further biased policy outcomes, where intentions to assist farmers rather led to increased hardship.

Well-documented failures of the post-1950s' development period, include a revolutionary Land Reform Act in 1975 which perpetuated absentee landlordism¹⁰⁵⁴ and created private ownership for some forest reserves.¹⁰⁵⁵ Risks of forest incursion were borne by poor small-holders whose rights were then procured by privileged urbanites when land values increased.¹⁰⁵⁶ The failure of good government intent to improve land administration¹⁰⁵⁷ was matched by a need to ensure social and environmental equity in fisheries.¹⁰⁵⁸ The legal and resource underpinnings to the promise that ... *whoever plants, owns those plants* ... have lagged behind development.

Other unintended consequences of government programs have created farm level suspicion that government technology and information is unreliable or unrealistic. For example, the Four-Pronged Project of 1987 supported the private sector to coordinate small-holder cashew trees planting with credit from the Bank of Agriculture and Agricultural Cooperatives (BAAC). Government fervour to replace cassava with another crop and to assist the Northeast, overrode the lack of relevant research, with the resulting high insecticide costs and low yields causing farmer indebtedness. Contrasts had been drawn with successes in Taiwan where strong small-holder to government links exist,¹⁰⁵⁹ and differing education system coverages.

In the livestock sector, government introduced exotic cows to the Northeast without investigating feed or management requirements, with the result that low production and reproductive rates again left farmers in debt for an unproductive asset. Contract production of seed-corn for the hybrid corn industry was promoted to farmers without

¹⁰⁵³ Setboonsarang and Khaoborisuth (c. 1986)

¹⁰⁵⁴ Ramitanondh, Shalardchai (1989)

¹⁰⁵⁵ Siamwalla, Ammar (1986)

¹⁰⁵⁶ Ramitanondh, Shalardchai (1985)

¹⁰⁵⁷ Onchan, Tongroj (1990)

¹⁰⁵⁸ Arphaphirama, Anat et al (1987)

¹⁰⁵⁹ Dohs, L.S. (1988)

advice that yields would be lower than regular corn crops.¹⁰⁶⁰ Many such examples have been linked to unfair personal gain by individuals. The tradition of *kin muang*, originating as a means of supporting agents of the Crown by their retention of part of the revenue they collected, has been eloquently linked to the continuing receipt of gratuities by officials.¹⁰⁶¹ However, even where argued as culturally acceptable, such antecedents are now irrelevant as the source of funds is government, and the element of ensuring that overtaxing did not affect future productivity has long been lost.

Additional to such internal constraints, institutional assumptions that Thailand can follow rural development policies of other successful Asia economies ignore fundamental differences, not only in the composition of the economy, but in investment in education and research. The number of years of general education of the general populace in 1995 was 3.8 for Thailand compared to, for example, 8.8 for Korea; the number of scientists per thousand persons for Thailand was two compared to 41 in Korea and 110 in Japan; and the percentage of GNP allocated to all research, for Thailand was 0.2 percent compared to 1.4 in Korea and 2.8 in Japan.¹⁰⁶² Yet at the same time, it was claimed that Thailand had achieved industrialised status.

Following the outward form of a balanced economy, protests against forest policies led to the imposition of a prohibition on logging to domestic and international acclaim. However, powerful forces subverted the needed 80 percent enforcement level, and such issues as land tenancy, forest incursions, and the forest needs of small-holders, remained unresolved. Recent de-gazetting of degraded forest reserves, creation of new reserves, and understanding of policy needs, herald a possible new era in this case¹⁰⁶³

It would seem that having one of the most developed institutional and legal infrastructures for environmental management in the region¹⁰⁶⁴ does not guarantee its effective application. Inter-agency conflict, opaque government workings, and poor dialogue between the public, non-government organisations, and media, have constantly pre-empted realisation of potential. Attempts to coordinate, such as the establishment of the National Environment Board in 1991 to improve on the some 70 laws related to the environment, still rely on cooperation between ministries and increased delegation of responsibilities in a manner more suited to Western than current Thai culture.

Within this learning process for institutions, those related to agriculture have been tending toward areas which constitute a primary responsibility of government, including:

- research for public good aspects of commercial agriculture, as well as problem solving approaches to poverty affected rural dwellers and areas
- educational services and information to ensure a strong cadre of agricultural researchers linked to well informed information specialists working with a better educated rural populace to access information as it relies less on extension agents

¹⁰⁶⁰ Poapongsakorn, Nipon (1995)

¹⁰⁶¹ Phongpaichit, Pasuk and Baker, C. (1995)

¹⁰⁶² United Nations (1995)

¹⁰⁶³ Sadoff, C.W. (1992)

¹⁰⁶⁴ Kaosaard, Mingsarn et al (1995)

- ensuring availability of essential factors of agricultural production including seeds, fertiliser, water, and insecticide through appropriate policy environments which assist the efficient performance of the private sector
- assisting risk and financial management of small farmers through ensuring availability of insurance and credit, and preventing diversion of services for small farmers to medium or large scale farmers, or agribusiness
- ensuring ability to equitably market produce.

These functions can be seen in the past and present structure of the Ministry of Agriculture and Cooperatives.

Origins of the Ministry of Agriculture and Cooperatives

Sukhothai records¹⁰⁶⁵ imply policies to maintain irrigation systems, protect forest in a manner found in other Tai¹⁰⁶⁶ groups, and to allow land ownership and inheritance. However, the concept of an agency concerned with the welfare of agriculturists is easily overstated. With absorption of adjoining cultures and the institutional arrangements, Ayutthaya created a position of *Khun Kasetratibodee* associated with the department *Krom Na*, the antecedent of a Ministry of Agriculture. *Krom Na* was primarily involved in disputes over paddy fields, farm equipment including animals, and title deeds. Subsequently, the development of abandoned land, irrigation schemes, draught animals, and collection of rice tailings from the royal barn became essential functions of *Krom Na*.¹⁰⁶⁷

Increasing sophistication of administrative structures led to the creation of further ministries which, by the late eighteenth century, were; Ministry of the North, Ministry of the South, Ministry of the Capital, Ministry of the Palace, Ministry of the Treasury and Foreign Affairs, Ministry of Lands, and *Chaophraya* of the *Uparaja*. The elite of Ayutthaya aristocracy ensured broad education and positioning of their families; the foreign-linked and highly influential Bunnag family provided six of the nine Ministers of *Krom Na* during the early Bangkok period of 1782 to 1892.¹⁰⁶⁸

Without effective leadership following power shifts of the 1890s, the *Krom Na* took various forms. It was restyled as a Ministry of Commercial Agriculture in 1892 with the integration of the Department of Ordinance Survey, although the primarily task was collection of agricultural fees, duties, and other taxes to support the modernising Kingdom.¹⁰⁶⁹ It was completely abolished for two years from 1896 when its vestigial responsibilities were exercised through the Ministry of Finance through a specially created Department of Farmers.¹⁰⁷⁰ In 1898, the three Ministry of Finance departments

¹⁰⁶⁵ MOAC (1992)

¹⁰⁶⁶ Sheng-Ji, Pei (1985)

¹⁰⁶⁷ MOAC (1992)

¹⁰⁶⁸ Wyatt, D.K. (1968)

¹⁰⁶⁹ MOAC (1992)

¹⁰⁷⁰ Wyatt, D.K. (1969)

of Farmers, Ordinance Survey, and Mineral Resources, were grouped to form a new Ministry of Agriculture.

The Department of Farmers investigated and issued replacement title deeds for farmlands, the Department of Ordinance Survey conducted land surveys and prepared maps, and the Department of Mineral Resources performed administrative functions. Eleven Land Registration offices improved issuance of title deeds and a Department of Land Registration was established around 1908, a prelude to a Land Act of 1936. A Department of Waterways was established in 1902 and a Department of Silk Worm Technicians, renamed the Department of Cultivation, was established in 1908 with a primary focus on the creation of mulberry plantations and silk worm raising. Further inter-ministerial trading of departments led to the Department of Ordinance Survey shifting to the Ministry of Defence, and the Department of Royal Mining, Industry and Geography shifting from the Ministry of Interior into the Department of Land Registration.¹⁰⁷¹

Rice, cotton, and animal competitions began in 1911. The Department of Waterways shifted to the Ministry of Civil Engineering in 1912, a veterinary surgical school was established under the Department of Cultivation in 1914, the Department of Forestry was transferred from the Ministry of Interior to the Ministry of Agriculture in 1921, the Department of Irrigation Supply was renamed the Department of Irrigation in 1927, and the Department of Cultivation was transferred to the Ministry of Commerce and Communications. The Ministries of Agriculture and Commerce, and Communications were merged to form the Ministry of Commercial Agriculture in 1932 with the Departments of Land Registration, Land Survey, Forestry, and Royal Mining Industry transferred to the Ministry of Interior.

Further reshuffling through the post-revolutionary period of the 1930s led to the Ministry of Commercial Agriculture being renamed the Ministry of Economic Affairs in 1933 with the Department of Farming Inspection renamed as the Department of Agriculture, the Department of Aquatic Animal Preservation renamed as the Department of Fisheries and in 1934, separating these units from the Ministry of Economic Affairs to form the Ministry of Agriculture once again in 1935. By 1938, the Departments within the Ministry of Agriculture were; Agriculture, Fisheries, Lands, and Mining Industry, the last of which was transferred to the Ministry of the Economy. In 1942, divisions within the Department of Agriculture relating to animal treatment and animal characteristics were grouped to form a new Department of Livestock and Draught Animals.¹⁰⁷² Creation of the agricultural university, Kasetsart, in the following year substantiated commitment to modern agriculture.

Continued renaming of Departments led to the Department of Agriculture becoming the Department of Farming, the Livestock and Draught Animals becoming Livestock, Kasetsart University becoming a department, and the Department of Cooperatives becoming the Ministry of Cooperatives in 1952. By 1953, the Division of Rice and

¹⁰⁷¹ MOAC (1992)

¹⁰⁷² MOAC (1992)

Experimentation within the Department of Farming was established as the Department of Rice, and the Department of Farming once again reverted to the departmental title of Agriculture. In 1959, the five existing universities of the Kingdom, namely Kasetsart, Chulalongkorn, Thammasat, Medical Science, and Silpakorn, were grouped under a new Ministry.

By the 1970s, structures which have carried into the present era became evident. The National Milk Cow Business Promotion organisation was created in 1971 within the Ministry of Agriculture, and the departments of Cooperatives Promotion, Cooperatives Audit, Irrigation, and Land Development were transferred to the renamed Ministry of Agriculture and Cooperatives upon dissolution of the Ministry of National Development. The Department of Agricultural Techniques was created as a combination of the departments of Farming and Rice in 1972 and, in 1974, the Marketing Organisation of Farmers was created as a State enterprise associated with the Ministry. The Agricultural Land Reform Office was created in 1975 to contribute to increased agricultural productivity through widening farmer land ownership in areas surrounding public forest lands,¹⁰⁷³ and the Office of Agricultural Economics was created in 1979.¹⁰⁷⁴

Present day structures within the MOAC reflect historic trends and external pressures, mainly from international finance institutions. Organisational units include; Office of the Secretary to the Minister, Office of the Permanent Secretary, Royal Irrigation Department, Royal Forestry Department, Department of Cooperatives Auditing, Department of Fisheries, Department of Livestock Development, Land Development Department, Department of Agriculture, Department of Agricultural Extension, Cooperatives Promotion Department, Agricultural Land Reform Office, and Office of Agricultural Economics. State enterprises which report through the MOAC include: Forest Industry Organisation, Rubber Estate Organisation, Fish Marketing Organisation, Government Cold Storage Organisation, Dairy Farming Promotion Organisation of Thailand, Office of Rubber Replanting Aid Fund, Thai Plywood Company Limited, and the Marketing Organisation of Farmers.

Within MOAC, six units operate provincial offices, the Agricultural Land Reform Office, and the departments of Fisheries, Livestock, Forestry, Cooperatives Promotion, and Agricultural Extension;¹⁰⁷⁵ all except ALRO also have district offices. The Department of Agricultural Extension also operates at sub-district level.

However, as an agricultural country, many aspects of government involve agriculture, even if this is not overt in policy statements. Government services which relate to agricultural development are listed in Table 12.1.

Table 12.1 Government Agricultural Development Services and Institutions¹⁰⁷⁶

¹⁰⁷³ Jutsuchon, Somchai (1989)

¹⁰⁷⁴ MOAC (1992)

¹⁰⁷⁵ NIDA (1980)

¹⁰⁷⁶ NIDA (1980)

Services	Government Agencies
Technology	<ul style="list-style-type: none"> • Department of Agriculture • Department of Livestock Development • Department of Fisheries • Department of Forestry • Department of Agricultural Extension • Universities and Colleges
Marketing	<ul style="list-style-type: none"> • Marketing Organisation of Farmers • Fish Marketing Organisation • Cold Storage Organisation • Dairy Farm Promotion Organisation
Supply	<ul style="list-style-type: none"> • Marketing Organisation of Farmers • Department of Agricultural Extension • Department of Fisheries • Department of Livestock • Department of Forestry
Transport	<ul style="list-style-type: none"> • Ministry of Communications • Accelerated Rural Development • Ministry of Defence • Public Transport Organisations • Local Government
Incentives	<ul style="list-style-type: none"> • Ministry of Commerce • MOAC Line Agencies • Provincial and Local Authorities - price support programs
Extension	<ul style="list-style-type: none"> • Department of Agricultural Extension • Department of Livestock • Department of Fisheries • Department of Forestry • Department of Community Development
Credit	<ul style="list-style-type: none"> • Bank of Agriculture and Agricultural Cooperatives • Bank of Thailand - agricultural bill discounting
Group Action	<ul style="list-style-type: none"> • Department of Cooperative Promotion • Department of Agricultural Extension - farmer groups • Fish Marketing Organisation
Irrigation and Land Development	<ul style="list-style-type: none"> • Department of Irrigation • Office of Land Reform • Department of Land Development • Department of Forestry • Department of Local Administration • Department of Public Welfare • Ministry of Defence • Inter-agency Committees • Kings' Project
Plans, Manpower and Budgets	<ul style="list-style-type: none"> • National Economic and Social Development Board • Civil Service Commission • Budget Bureau • Ministry of Agriculture and Cooperatives • Provincial Authorities • Inter-agency Committees

Reliance of new technology for agricultural innovation is evident in the development of Thai agriculture. To continue such innovation requires an ability to develop new technologies and to solve local problems through an active agricultural research sector, with an ability to ensure that innovations are appropriate to, and adopted by, farmers.

Agricultural Research

From the development period of the 1950s to the present day, the creation of a human resource base of highly trained researchers and administrators has formed a critical component of the development of the MOAC and agricultural education. Creating tensions with historic operational modes, the most consistent view has been espoused in documents influenced by Western thought, which provides a convenient approach for discussion. It is unlikely that the pre-1950s approach to agriculture would have moved in this direction of its own accord, considering persistent views that rural production in general could provide low-cost government revenue. Supportive comments about the research and extension bureaucracy¹⁰⁷⁷ contrast with most commentaries, and may reflect the large changes which occurred between the 1950s and 1970s. Nevertheless, substantial change remains an imperative.

The Western research approach has simply codified historic actions of civilisation, which in agricultural research focuses on understanding in areas of pure science, and development of technologies in areas of applied science in the four general areas of:

- genetic manipulation through traditional breeding and molecular biological techniques to adapt plants and animals to the production environment
- environmental manipulation to optimise soil, water, nutrients, temperature, and other external factors of plant or animal production while minimising deleterious natural effects on final yield through control of pests
- enhanced input and post-harvest technologies, which increase efficiencies of such inputs as fertilisers, pesticides, and machinery, and maximise harvest yields while minimising post-harvest losses during transport, storage, and preliminary processing
- processing which reduces losses, develops products to suit market demand, health, and preservation requirements, and the creation of new markets and products from commodities in which Thailand has a comparative production advantage, such as rice.

Within Thailand, the balance between types of research has reflected the apparent importance of individual industries,¹⁰⁷⁸ and has followed farmer initiatives rather than leading into new crops or efficiency-improving technologies in production, processing, or marketing.¹⁰⁷⁹ For example, biases against rice through the period of upland cropping expansion are clear from convenient departmental budget separations of the period; from 1959 to 1972, the total budget of the two concerned departments rose from 58 million to 124 million baht at 1962 prices with the balance between rice and agriculture shifting from around 50:50 to 34:66 (Table 12.2). The shift in allocations occurred towards the end of the upland cropping expansion indicating that research followed cropping patterns rather than a long term plan.

¹⁰⁷⁷ Grimble, R.J. (1976)

¹⁰⁷⁸ Setboonsarng, Suthad et al (1990)

¹⁰⁷⁹ Poapongsakorn, Nipon et al (1995)

Table 12.2 Departments of Rice, and Agriculture Budget Shares (%), 1959 - 1972¹⁰⁸⁰

Year	Department of Rice	Department of Agriculture
1959	50.3	49.6
1961	45.2	54.8
1963	45.5	54.5
1965	47.2	52.8
1967	44.9	55.1
1969	36.2	63.8
1971	33.1	66.9
1972	34.3	65.7

A tendency to invest in extension more than research is consistent with reliance on technology developed by farmers, transferred from abroad, or minimally adapted from foreign sources.¹⁰⁸¹ The MOAC allocated between 31 and 41 percent of its budget to the Department of Crop Extension compared to between 19 and 24 percent to crop research between 1982 to 1995.¹⁰⁸² Within the overall public allocation between 1977 to 1986,¹⁰⁸³ less than 10 percent was assigned to agriculture, half of which was for irrigation, primarily engineering works. The apparent bias towards rice¹⁰⁸⁴ produced little increase in productivity,¹⁰⁸⁵ thereby confirming the inadequacy of actual research investments of less than one percent in an agricultural economy

Rice research figures may be inflated by foreign, particularly USA, financial assistance.¹⁰⁸⁶ Nevertheless, the lagging nature of research shifted technology-testing risks to small-holders and limited researcher participation in cutting edge research, even for rice in which Thailand might be expected to be a world leader. The 1975 increases in Department of Agriculture budgets for horticulture, hailed as responsive to opportunities for Thailand, in fact followed farmer choices of the 1960s.¹⁰⁸⁷ Research allocations varied between years (Table 12.3) following such national policies as import substitution, presumably affecting long term research projects. Such swings undermined research quality.

Table 12.3 Research Expenditure per 10,000 Baht of Crop Value, 1987- 1988¹⁰⁸⁸

Crop	1987	1988
Exportable Crops		

¹⁰⁸⁰ OAE (1973)

¹⁰⁸¹ Poapongsakorn, Nipon et al (1995)

¹⁰⁸² Bureau of Budget (1997)

¹⁰⁸³ World Bank (1984)

¹⁰⁸⁴ Setboonsarng, Suthad (1987)

¹⁰⁸⁵ Siamwalla, Ammar (1986)

¹⁰⁸⁶ Pochanukul, Patamawadee (1992)

¹⁰⁸⁷ Trairatvoraleul, Pasarn (1981)

¹⁰⁸⁸ Setboonsarng, Suthad and Kaoborusisuth, T (1990)

Rice	49	37
Rubber	46	54
Maize	52	20
Cassava	20	18
Sugar Cane	43	23
Mung Bean	88	74
Sorghum	101	77
Importable Crops		
Soya Bean	79	66
Oil Palm	72	46
Cotton	435	230
Ground Nut	120	230

Significant successes of research include the breeding of adapted maize and rice varieties. In both cases, these have been associated with high level scientific and funding assistance from abroad, through the Rockefeller Foundation and the International Rice Research Institute. The Suwan 1 maize variety has been utilised in other countries as parent stock in maize breeding programs. This is a matter of pride to Thai researchers from one perspective, while from another an indication that the research conducted in Thailand was indeed part of a global research program under the auspices of the International Maize Research Centre (CIMMYT).

Strengthening agricultural research through the World Bank National Agricultural Research Project assisted to decentralise the Department of Agriculture to work through 19 regional research centres and to augment research and research management skills.¹⁰⁸⁹ The project was implemented over 12 years and continues to have impact, although by 1990, the proportion of staff holding doctoral degrees had not reached three percent, Masters Degrees were around 17 percent, and those with Bachelor Degrees were 37 percent. This relates in part to an under-supply of agricultural graduates suited to research.

In parallel with the National Agricultural Research Project, a National Agricultural Extension Project expanded the Department of Agricultural Extension to be the only agency within the Ministry of Agriculture and Cooperatives to operate down to sub-district level throughout the country. The large department so created requires technology to deliver through its operatives supported by Subject Matter Specialists who liaise with researchers in the Department of Agriculture. The centralised and hierarchical Training and Visit system introduced through the project required modification to suit Thailand, and has been criticised for its high cost and limited relevance to broad rural needs beyond agriculture. Review of the project concluded it to be overly ambitious in scope and rate of implementation.¹⁰⁹⁰

¹⁰⁸⁹ World Bank (1994)

¹⁰⁹⁰ World Bank (1986)

Lower rates of adoption than in similar countries¹⁰⁹¹ indicate low levels of extension efficiency, has led to farmers' involvement in planning as an acknowledgment of the risk which they assume,¹⁰⁹² and to reduce perceptions of officials' ignorance¹⁰⁹³ of village needs.¹⁰⁹⁴ Extension was predicted to be easier in Thailand,¹⁰⁹⁵ yet the urban-rural separation led to such assumptions as land titles and credit being required by farmers, when in fact they were probably seeking security of tenure rather than official recognition and access to credit.¹⁰⁹⁶ That the system of personal contact which limits the department to serving only one of the five million farming households suggests a role for electronic communication¹⁰⁹⁷ coupled with wider education to eventually replace conventional extension.

The year 2000 issue is wider than the Department or the MOAC. Under-supply of technical university graduates was assessed in 1995 as 3,120 graduates rising to 11,610 by 2001.¹⁰⁹⁸ Continued reliance on agribusiness rather than acknowledgment of the comparative advantage of the State's institutional capacity to improve agricultural development¹⁰⁹⁹ has reduced attention to this issue. Recent excesses of the Thai economy enhanced the private sector's image as the powerful force, as it enticed university graduates away from government. This produced an apparent decline in the calibre of candidates entering the civil service where the proportion scoring less than 2.5 out of 4.0 in the civil service entrance examinations rose from 29 percent in 1986 to 50 percent in 1993.¹¹⁰⁰ With no tradition of private sector research, Thailand's 1.3 science and technology researchers per 10,000 persons in the labour force compared to 41.8 in Taiwan and 27.0 in Korea in the early 1990s,¹¹⁰¹ highlights a severe human resource deficiency which has yet to be fully realised.

Reconsideration of the role of government in agriculture¹¹⁰² includes an emphasis through the Ministry of Science and Technology, including the creation of the Thai Research Fund in 1992 as a commitment to high quality applied research of direct relevance to Thai industries including agriculture.¹¹⁰³ New competitive funding mechanisms within government can aim to increase research quality only if the human resource is adequate, and researchers are recognised within the bureaucracy. The same issues affect livestock, fisheries, and forestry.

Livestock, Fisheries, and Forestry

¹⁰⁹¹ Siamwalla, Ammar (1986)

¹⁰⁹² Turton, A. (1987)

¹⁰⁹³ Siamwalla, Ammar (1986)

¹⁰⁹⁴ Garforth, C. (1994)

¹⁰⁹⁵ Silcock, T.H. (1970)

¹⁰⁹⁶ Feder, G. et al (1988)

¹⁰⁹⁷ TDRI (1987)

¹⁰⁹⁸ Khoman, Sirilaksana (1999)

¹⁰⁹⁹ Christensen, S.R. (1992)

¹¹⁰⁰ Siamwalla, Ammar (1999)

¹¹⁰¹ Sripaipan, Chatri (1992b)

¹¹⁰² Poapongsorn, Nipon (1995)

¹¹⁰³ Yuthavong, Yongyuth and Wojcik, A.M. (1997)

Allocation of research budgets on the basis of current crop areas has its corollary in the livestock sector where Department of Livestock Development budgets reflect the contribution of livestock to GDP, with periodic adjustments for new initiatives and disease outbreaks. In the case of Fisheries, environmentally costly developments to become the world's largest Black Tiger Prawn producer, and the demise of Gulf of Siam through over-fishing, justified an increase in the proportion of budget allocated to the Department from 15 to more than 21 percent over the period 1982 to 1995.¹¹⁰⁴ Forestry languished under unenforceable policies until recently, and enhanced allocations are expected under environmental initiatives.

The Department of Livestock Development aims to improve productivity and increase the quantity of livestock products for domestic consumption, to encourage production of livestock and livestock products to substitute for imports, and to increase alternatives and income for farmers.¹¹⁰⁵ As with crop research, an applied orientation is often associated with adapting foreign technologies.

Budgetary allocations for the Department from 1982 to 1995 increased faster than those for crop research and extension, and growth of livestock GDP. However, within the Department, research commanded less than six percent of the total budget which is a factor of 13 lower than the level of 0.5 percent of livestock GDP recommended by the World Food Conference. Livestock extension, 40 percent of which was disease control, commanded up to 73 percent of the Department's budget.

Livestock research through the 1980s was oriented to veterinary support of disease control programs. By the 1990s, the focus shifted to breeding, including artificial insemination, and nutrition; from a research share of 71 percent in the early 1980s, veterinary research declined to less than 10 percent by 1995. The refocus redressed past biases and recognised potential to improve animal management and nutrition in conjunction with judicious breeding programs, supported by a maintenance activity for disease control programs reliant on regional and global animal health strategies.¹¹⁰⁶

After disease control, production of bovine stock (32 percent) and forage crop extension (15 percent) were the largest programs, with a priority allocated to cattle. The focus on cattle and overall under-funding of research indicates a high reliance on imported technologies such as in the poultry and pig industries, which has been at the cost of indigenous breeds and small-holder self sufficient systems.

Poor coordination of livestock research, even in comparison to cropping, has perpetuated early misinformed opinion of the appropriateness of imported cattle, nutritional requirements of crossbred animals, and production systems of more developed countries. As a consequence, indigenous livestock have mainly been compared with imported breeds under unrealistically favourable conditions. Linkages between Kasetsart, other universities, and the Department has assisted to refocus livestock research. However,

¹¹⁰⁴ Poapongsakorn, Nipon et al (1995)

¹¹⁰⁵ DOLD (1997)

¹¹⁰⁶ Poapongsakorn, Nipon et al (1995)

research in universities has been slow to develop, and remains a minor component of post-graduate programs and academic staff performance appraisals.

The departments of Fisheries and Forestry are likewise concerned with regulation, research, and extension. Fisheries stations production of seed stock for aquaculture and river release; forestry produces seedlings for reforestation. Regulatory activities increasingly fall within natural resource rather than agricultural development sections of national plans.

Research Impact

Other assessments of the impact of Thai agricultural research have noted;¹¹⁰⁷

- limited evidence of new technology being introduced from fruit crop and vegetable research of the Department of Agriculture, as a result of the poor knowledge base from which such research began and low levels of research investment until recent years
- private sector adaptive research, including farmers' own research, has been an important component in the development of modern horticulture
- livestock research has possibly assisted agricultural diversification
- livestock disease control programs have indicated a positive economic benefit although control of foot and mouth disease, the major disease of pigs, cattle, and buffalo, failed due to poor vaccine supply lines and cross-border smuggling of cattle
- maize research provided higher returns than rice research¹¹⁰⁸
- rice research has focused on improvement of irrigated rice yields using outputs of the International Rice Research Institute, thus limiting impact to the 25 percent of Thailand's rice area which is irrigated¹¹⁰⁹.
- Thailand continues to produce rice yields lower than its neighbours from an environment generally considered to be superior, probably indicating unrealised research potential
- higher apparent returns to extension than research¹¹¹⁰ indicated the strong reliance on imported and simply adapted technologies, rather than research, and are masked by the overall unrealised potential of research
- areas for likely benefits from improved research and extension include labour cost savings and mechanisation, increasing yields to free up marginal lands to conservation, efficient utilisation of increasingly scarce water resources, ensuring compatibility with international trade partners in an increasingly competitive market place, and maintaining the agricultural sector's competitiveness within the Thai economy¹¹¹¹
- biotechnology fields of immediate importance include recombinant DNA technology, cell fusion, cell and tissue culture, embryo rescue, cloning, mono-clonal antibody

¹¹⁰⁷ Poapongsakorn, Nipon et al (1995)

¹¹⁰⁸ Setboonsarng, Suthad and Evenson, R. (1991)

¹¹⁰⁹ Siamwalla, Ammar et al (1992)

¹¹¹⁰ Setboonsarng, Suthad and Evenson, R. (1991)

¹¹¹¹ Siamwalla, Ammar et al (1992)

production, DNA and RNA probes, soma-clonal variation, fermentation, bio-sensitive elements, and bio-process engineering¹¹¹²

- there is a need for a single agency, the National Science and Technology Development Agency, to coordinate high technology research.¹¹¹³

From a tentative adoption of a foreign research ethic, Thailand has yet to realise its potential in agriculture. One of the continuing constraints is human resources, and the linkage of education to research and extension.

Agricultural Education

Agricultural education in Thailand traces its origins to technical and everyday life skills learned in the village and family environment, which was complemented by the traditional education through the temple.¹¹¹⁴ With the modernisation of Thai society, foreign forms of education became available to the elite, which itself became more diverse during the reign of King Chulalongkorn.¹¹¹⁵ Reforms in 1891 which prescribed ages of study and course lengths for schools, also charged some, where qualified teachers existed, with offering agriculture and commerce in addition to arts and crafts, and English.

By 1897, the influential and far sighted Prince Damrong had begun a program to compile text books for the study of agriculture and physics culminating in an 1899 recommendation for an industrial school to be created to offer instruction in agriculture, crafts, and domestic arts on a partial cost recovery basis. Delayed for several years, agricultural training was deemed similar to crafts able to be studied by students with only a primary education. Other fields of specialised training required a secondary education, such as the Normal School, the Law School, and the Civil Service School, the last of which had evolved from the Royal Pages School. By 1910, there was a total of 622 schools with an enrolment of 40,314, 95 percent of whom were males; of the seven schools with enrolments of 1,361 in Ministries other than Education, there was one College of Agriculture, with an exclusively male enrolment.¹¹¹⁶

The College of Agriculture evolved into Kasetsart College, meaning ‘College of Agricultural Science’, within the Ministry of Agriculture at Maejo in Chiang Mai, and in 1938 was ranked as a division within the iteration of the Department of Agriculture of the day. Offering three year post-secondary education programs, the college trained staff for employment within the Ministry, and eventually evolved into Kasetsart University. A parallel Ministry of Agriculture school of forestry in Phrae was institutionally joined with Kasetsart College in 1939 which, with its agricultural and the addition of cooperative sciences, removed to Bangkhen in Bangkok.¹¹¹⁷ With the creation of Kasetsart

¹¹¹² Sripaipan, Chatri et al (1992a)

¹¹¹³ Sripaipan, Chatri et al (1992b)

¹¹¹⁴ Wyatt, D.K. (1966)

¹¹¹⁵ Wyatt, D.K. (1975)

¹¹¹⁶ Wyatt, D.K. (1969)

¹¹¹⁷ Kasetsart University (1998)

University in 1943 the faculties of Agriculture and Forestry were complemented with faculties of Cooperative Science and Fisheries which were subsequently supplemented in 1955 by a Faculty of Veterinary Medicine transferred from the University of Medical Science, now Mahidol University, and the Faculty of Engineering from the Royal Irrigation Department within the Ministry.

Kasetsart University later opened a Faculty of Science and Arts in 1966 and a Graduate School in 1969. Other faculties established were: Education in 1969; Social Sciences in 1974; Agro-industry in 1980; faculties of Science and Humanities in 1981 by separating the Faculty of Science and Arts; faculties of Economics and Business Administration in 1992 by separating the Faculty of Economics and Business Administration; and a Faculty of Liberal Arts and Science at the Kampaengsaen campus in 1992.¹¹¹⁸ By 1995, the University was comprised of 14 Faculties, namely Agriculture, Agro-Industry, Business Administration, Economics, Education, Engineering, Fisheries, Forestry, Humanities, Liberal Arts and Science, Social Sciences, Veterinary Medicine, and the Graduate School.

The Ministry of Agriculture remained responsible for Kasetsart University until 1959 when it was shifted to the Office of the Prime Minister until, in 1972, the Bureau of State Universities was created in that office, eventually evolving into the Ministry of University Affairs in 1977. By 1998, Kasetsart University supported 16 research stations, five field stations, eight national and international centres, and some 25 internal research centres, and campuses at Bangkok, Kampaengsaen, Sriracha, Sakon Nakhon, Lopburi, Suphanburi, and Krabi with differing levels of activity and education.¹¹¹⁹ An external assessment of the university in 1998¹¹²⁰ highlighted:

- a need to re-conceptualise agricultural higher education
- a need for strategic planning to integrate faculties and disciplines around education and research priorities
- improved organisational structures to facilitate staff and student re-groupings as required
- increased university autonomy and accountability as a mechanism to enhance responsiveness to changing societal requirements
- strong incentives to foster the development of visionary and entrepreneurial leaders
- development of real international linkages between peer researchers and educators.

Today, agricultural education is undertaken through 11 provincial agricultural colleges and about 15 universities. University agricultural education, managed through the Ministry of University Affairs until its subsumption into a new Ministry of Education, Culture and Religion in 2000, is conducted to varying extents through most of the 24 public and 41 private universities, as agriculture, agribusiness and related social, technical, and economic fields continue to be final application of much of Thailand's education.

¹¹¹⁸ Kasetsart University (1995)

¹¹¹⁹ Kasetsart University (1998)

¹¹²⁰ Eriksen, J.H. et al (1998)

The origins of agricultural education form a major part of the short history of government education in Thailand. Beginning with medical, legal, administrative and engineering schools in the second half of the nineteenth century, the Civil Service College formed in 1917 evolved to Chulalongkorn University. Thammasat University was founded in 1933 with a focus on moral and political sciences surrounding political sentiments of the time. In 1943, the other three key institutional and educational components of Thai higher education were established, namely medicine through Mahidol University, fine arts through Silpakorn University, and agriculture through Kasetsart University. This was all part of the post-1932 revolutionary reforms where universities continued to serve the recruitment requirements of the bureaucracy. Thus all five were in Bangkok, with Chulalongkorn University and Thammasat University training administrators while Mahidol, Kasetsart, and Silpakorn covered the principle areas relevant to Thai culture and society, namely medicine, agriculture, and fine arts respectively.

Formal economic development plans noted regional expansion which led to universities being established in Chiang Mai in the North, Khon Kaen in the Northeast, and Songkhla in the South over the period 1964 - 1967. Each established major agricultural or natural resource management faculties. Further institutes were developed through the 1960s and 1970s including the National Institute of Development Administration and the Asian Institute of Technology. The opening of further universities included specialty agricultural facilities such as Maejo Institute of Agricultural Technology, and others with broadly based business, science, and art fields which complemented agricultural and rural development throughout the country. Open Universities were established in 1971 and 1979 to widen access to government university education.

With overall education in Thailand being vested in ten ministries, coordination has been difficult and efficiencies low. The MOAC maintains responsibility for an irrigation college, a veterinary school, and a cooperative school, while the Ministry of Education retains control of provincial agricultural colleges, and another 68 provincial technical colleges until 2001. The Ministry of University Affairs, and after 2000 the Ministry of Education, Culture, and Religion, is responsible for public and private universities.

Major providers of agricultural and related university education offer international programs. These includes the universities of Chiang Mai, King Mongkut University of Technology Thonburi, Kasetsart University, Khon Kaen University, Mahidol University, Suranaree University of Technology, Assumption University, and Asian University of Science and Technology.¹¹²¹ However, Kasetsart University continues as the major provider with faculties relating to agriculture including; agriculture, agro-industry, business administration, economics, fisheries, forestry, and veterinary medicine. It is internationally known having grown in repute from early assistance, predominantly from the USA to instil elements of the land grant college concept.¹¹²²

Thai agricultural education has developed more slowly and perhaps with less connection to the production base than that of its once colonially dominated neighbours. From the

¹¹²¹ MUA (1998)

¹¹²² Egan, A. and Falvey, L. (1996)

seventeenth century¹¹²³ in Britain and Europe through historical sites of education in Bohemia, Hungary¹¹²⁴, Florence,¹¹²⁵ Padua,¹¹²⁶ and Edinburgh,¹¹²⁷ the British vocational schools and US land grant colleges became the most influential on Thailand. The blossoming of Western agricultural education at around the same time as the colonial period allowed agricultural education to be part of a package of colonial administration which Thailand did not share. The innovative introduction of agricultural education to Thailand in the 1890s partly compensated for this competitive disadvantage, although it continues in the form of low levels of education participation in Thailand, the elite nature of university education, and an urban bias in all education.

Provincial and open universities widened the catchment for students, increased graduate numbers, and consequently broadened expectations of graduate careers¹¹²⁸. Nevertheless, universities remained a preserve of the wealthy. In common with other countries which placed agricultural education in urban locations, graduates with urban backgrounds exhibited little enthusiasm for rural careers. Regional universities have now demonstrated leadership in orienting research to regional development as a basis of instruction in the otherwise centrally controlled curricula, such as the integration of highland agricultural research outcomes into Chiang Mai University courses.¹¹²⁹

Low educational participation rates are indicated in comparisons of Thailand's economic growth, notwithstanding recent setbacks, against that predicted from global social indicators. For a country indicating the same levels of life expectancy and access to safe water, it is predicted that gross secondary enrolments would be around twice current levels, or 1996 GDP would have been about 40 percent less.¹¹³⁰ Rather than assume that such a happy outcome would continue, as may have once been espoused, the responsible approach has been to increased allocations to all levels of education. Thai agricultural education continues to require social, as well as economic and technical understanding, of integrated small-holder farming in a manner which uncommon in mainstream universities of more developed countries. As a consequence, usual areas for academic exchange between Thai and other agricultural universities are commercial agriculture and agribusiness including processing and marketing.

Agricultural research and education in support of continuous innovation forms part of a package with other development inputs, including cooperatives, credit, and marketing, each of which has had overriding government involvement.

Agricultural Cooperatives

¹¹²³ Creasey, J.S. (1995)

¹¹²⁴ True, A. C. (1929)

¹¹²⁵ Creasey, J.S. (1995)

¹¹²⁶ Beveridge, J.L. (1991)

¹¹²⁷ Fleming, I.J. and Robertson, N.F.(1990)

¹¹²⁸ Phongpaichait, Pasuk and Baker C. (1997)

¹¹²⁹ Angkasith, Pongsak (1996)

¹¹³⁰ Khoman, Sirilaksana (1999)

Agricultural cooperatives in Thailand have been strongly influenced by government. Beginning in 1916, government closely supervised a successful village credit cooperative which led to the 1928 promulgation of a Cooperative Societies Act, and the establishment of cooperatives in several provinces. Cooperative societies today vary little and are managed under groupings of; agriculture including dairy, fisheries, land settlement, consumer, service, thrift, and credit cooperatives, through local, provincial, and national, and apex units

With more than 70 agricultural cooperative federations at provincial level, government remains involved through; the Office of the Registrar of Cooperatives, the Cooperatives Promotion Department within the MOAC, and the Dairy Cooperatives Promotion section in the Department of Cooperative Development. Government agencies assist with training, surveying economies and sites of proposed cooperatives, technical support to established cooperatives, advising on purchases, international negotiations, linkages to other government agencies, and seeking project aid.¹¹³¹ In the case of dairy cooperatives, the program's success derives from a total development package which enabled producers to enter a new industry with appropriate cooperatively owned processing facilities, access to credit, technical advice, and guaranteed markets and prices, while limiting unfair competition.¹¹³²

However, the overall history of agricultural cooperatives has been characterised as 50 years of failures,¹¹³³ due to inadequacies in; feasibility studies, extension and research support, management and finance training, and member feelings of ownership, and over emphasis on physical facilities, excessive involvement of government and government financing, and a lack of a unified credit system. A Cooperative League of Thailand established in 1968 to assist in promotion and education of agricultural producers, and a National Agricultural Cooperatives Training Institute to coordinate seminars for cooperative leaders, managers, and officers in areas of credit, finance, and marketing, partly addressed these concerns. Farmer associations created in the 1970s assist farmers to determine whether they should form a cooperative,¹¹³⁴ with support from extension in recognition of the causes of past failures. The Farmers Federation of Thailand experienced a fillip from the 1974 political turmoil with membership expanding to 1.5 million, and a break from past passive acceptance of non-participatory policy formulation.¹¹³⁵

Lesson derived from this past are clear,¹¹³⁶ although current assumptions that these can be expected to not recur may be optimistic. The reasons for government involvement in cooperatives have and continue to change, and are increasingly related to other government entities concerned with extension and credit.

¹¹³¹ Anonymous (1987)

¹¹³² Falvey, L. and Chantalakhana, Charan (1999)

¹¹³³ Hughes, R.P. et al (1968)

¹¹³⁴ Yongkittikul, Twatchai (1983)

¹¹³⁵ Trace, P. (1981)

¹¹³⁶ Hutanuwatr, Nuntiya. (2000)

Bank of Agriculture and Agricultural Cooperatives

Government first provided subsidised credit to rural cooperatives before 1920, although outcomes were unsatisfactory until the formation of BAAC in 1966. BAAC's initial mandate to lend to farm households for agricultural activities was eventually expanded to include agribusiness.¹¹³⁷ By 1982, BAAC provided credit totalling some 12 billion baht to about half of all Thai farm families.¹¹³⁸

Close management and field supervision ensured the application of funds to their intended purposes, and that vouchers were not transferred for cash. Thus BAAC became involved in fertiliser purchase and distribution in a manner mimicking that of the Department of Cooperative Development. By 1998, BAAC distributed 20 percent of all fertiliser in Thailand, and almost 70 percent of the public sector's fertiliser distribution. Prices through private outlets fell and remained more stable through this market influence, for a period.¹¹³⁹

Private commercial banks which dominated the Thai financial sector through a narrow ownership base,¹¹⁴⁰ ensured that high levels of subsidy such as in the Philippines and Indonesia, were not provided by BAAC. Commercial banks were required to lend five percent of the total of their previous year's lending to agriculture from 1975 rising to 20 percent over subsequent years. Shortfalls in such lending were to be deposited with the BAAC and attract an interest rate below market levels. Private banks successfully expanded the definition of agriculture to include agribusiness and agro-industries although they failed to meet assigned quotas.¹¹⁴¹ No penalties were imposed and other government schemes were created to facilitate lending to small farmers such as the Small and Medium Sized Enterprises Scheme, and the Small Industries Finance Office. In 1992, the BAAC charter was amended to allow lending for agriculturally-related activities operated by farmers which, with assistance from an Asian Development Bank loan, quickly accelerated rural lending.

Requirements for loan collateral were utilised to justify accelerated land title issuance,¹¹⁴² which led to a decline in informal lending through middlemen.¹¹⁴³ The diverse services provided by middlemen, which were rewarded through the apparently higher interest rates, were assumed by BAAC through procuring and distributing agricultural inputs and technical advice at subsidised rates. BAAC even became involved in marketing of produce, thereby further assuming the role of middlemen. However, the middleman resident and integrated with a local community continued to maintain an advantage over institutionalised credit in such situations as emergency requirements for cash during a period of illness and other individual needs.

¹¹³⁷ Mingmaneeenakin, Wanrak (1988)

¹¹³⁸ Yongkittikul, Twatchai (1983)

¹¹³⁹ Siamwalla, Ammar (1992)

¹¹⁴⁰ Doner, R. and Unger, D. (1993)

¹¹⁴¹ Muscat, R.J. (1995)

¹¹⁴² Feder, G. (1988)

¹¹⁴³ Poapongsakorn, Nipon and Nettayarak, Prayong (1988)

BAAC proved flexible in times of rainfall or market failures,¹¹⁴⁴ and in lending to groups which were fostered to ensure high levels of repayment and to so build confidence in the bank. With administrative costs of around five percent of loans, BAAC achieved an enviable level of success for a subsidised credit distributor to small-holders, many of whom were previously considered uncreditworthy. Limits to the approach were reached in marginal agricultural areas where development needs were possibly the greatest; in common with similar institutions, BAAC served the better-off rural households. Marginal farmers who do engage significantly in commercial trade, may be better encouraged in self sufficient lifestyles, with any loans being participatory Grameen style microcredit,¹¹⁴⁵ rather than risk indebtedness.¹¹⁴⁶

Efficient BAAC operations¹¹⁴⁷ facilitated expansion; by 1995, 82 percent of revenue was from farmer repayments when 70 percent of expenses were interest and related expenses. Compared with commercial banks, BAAC received low returns from its low interest rates and subsidised services, although 1997 and 1998 international prices and weather combined to allow loan repayments to be maintained when commercial banks lost heavily from speculative loans. Debt repayment problems in the Northeast¹¹⁴⁸ and institutional duplication of government services in cooperatives support, extension, credit, marketing, and fertiliser distribution will determine the future activities of these organisations.

Marketing Organisation of Farmers

The MOF has subsidised and supplied, often late, more than one-third of fertilisers used by paddy farmers since 1977. A State enterprise, the MOF receives funding through the Farmer's Aid Fund free of interest, which it supplements with loans from commercial banks. The MOF has bartered crop produce to provide fertilisers below market prices, and when foreign aid funds have been used, it is claimed that only transport costs were subsidised rather than the acquisition price of fertiliser. Net subsidies are equivalent to the public MOF budget including aid, and given legal constraints farmers can sometimes receive a negative subsidy; in 1998 rice farmers appeared to subsidise government. Competition with BAAC is now seen as anachronistic, and past MOF associations with political patronage further indicate its incompatibility with modern governance systems.¹¹⁴⁹

Effectiveness and Small-holders

It is possible to conclude that Thai institutions have been supportive of agricultural development with variations in efficiency. This view is challenged by the historical orientations and roles in garnering central monies, and by recent analyses where the State

¹¹⁴⁴ Saimwalla, Ammar (1990)

¹¹⁴⁵ Yonis, M. (1999)

¹¹⁴⁶ Hirsch, P. (1990)

¹¹⁴⁷ Muraki, T. (1998)

¹¹⁴⁸ McGuire, P. B. and Conroy, J.D. (1998)

¹¹⁴⁹ Siamwalla, Ammar (1992)

has been shown to be ‘not benevolent, but predatory in nature’.¹¹⁵⁰ Dysfunction between institutions and a reliance on administrative law appears to have allocated unreasonable influence to elected and appointed officials with a concomitant increase in moral hazard. Inconstancies in policy choices, a less conspicuous form of such hazard than simple corrupt receipt of funds, has probably caused the decline in accountability, until the post-1997 governance changes introduced with some external insistence. In the case of cassava growers, failure to regulate institutional actions led to such irrational outcomes as increased grower poverty and inadequate education for informed and united bargaining with the State. The argument that such exceptions or excesses are ultimately resolved by international influence through aid and other means have been similarly challenged in the case of GATT,¹¹⁵¹ and intellectual property rights.¹¹⁵²

Attempts to assist small-holders have thus been constrained by the effectiveness of institutions. Those supporting agriculture can be understood from perspectives of the development process. For example, government policy to encourage farmer cooperatives has embodied two assumptions, that:

- the environment for successful cooperatives in other countries can be created by government
- small-holders can gradually be converted towards modern agribusiness through group organisation.

Government has therefore linked small-holders to supplying national and multinational agribusiness groups. Experiences have been positive and negative. Contract farming groups have been occasional beneficiaries from prices set marginally above farmer costs.¹¹⁵³ Dairy cooperatives, on the other hand, represent coordinated government policy across trade, fiscal, developmental, and social policies including cooperative formation for an industry which has globally benefited from cooperatives.

Farmers who are members of institutions such as cooperatives have higher standards of living than non-members. Such a justification for further farmer group formation has expanded subsidised inputs and enticed agribusiness guarantee markets in such government-agribusiness projects as; cashews, dairy, imported beef cattle, coffee, pigs, chickens, rice, and hybrid seed production. However, higher farmer standards of living is a clearer indicator of first adopters of opportunities, rather than a result of cooperatives themselves, even though many members feel that group membership provided benefits.¹¹⁵⁴

The commercialisation of small farmers is implied in the 1968 Cooperatives Law which corporatised and expanded cooperatives for functions of; credit, marketing, technology transfer, and product supply.¹¹⁵⁵ Later linkages facilitated by BAAC, the Cooperative League of Thailand, and the National Agricultural Cooperatives Training Institute, were

¹¹⁵⁰ Sirirprachai, Somboon. (1998)

¹¹⁵¹ Sirirprachai, Somboon. (1998)

¹¹⁵² Rerkasem, Benjawan. (1999)

¹¹⁵³ Dolinsky, D.J. (1992)

¹¹⁵⁴ Patanapongsa, Narinchai (1983)

¹¹⁵⁵ Yongkittikul, Twatchai (1983)

oriented to widening the commercial agricultural base. Successful examples of linking small-holder groups to agribusiness abound, however, marginalised farmers to whom poverty alleviation policies have been targeted have sometimes been assumed to be the same of commercial farmers forming part of a global agricultural market system.

Marginalised farmers are unsuited to a fully commercial approach, because:

- their primary focus is subsistence agriculture, or self-sufficiency
- their surplus production is unreliable for environmental, technological, and home consumption reasons
- well intentioned government policies tend to drift towards better-off beneficiaries, for example, collateral requirements for loans, and better-off farmers joining farmer groups
- efficient lobby from agribusiness can modify government policies to their benefit
- marginal farmers are poor and poorly educated, and thus easily exploited.

Assumptions that small-holder farmers can be linked to agribusiness in a single step towards modernising of agriculture in Thailand have proved invalid. Recognising research, education, and service needs of self-sufficient small-holders separate from commercially oriented farmers and agribusiness, will inform the continuing evolution of government institutions related to agriculture. Further consideration of agribusiness is presented in the following chapter.

Summary

Key points pertinent to an understanding of Thai agriculture which can be elicited from this discussion of agricultural institutions include:

- Embryonic agricultural institutions of Sukhothai were transcended by Ayutthaya systems, which allowed wide application of taxation and dispute resolution, culminating in the formation of organisational units in the 1890s that, through constant reorganisation with frequent foreign influence, created today's departmental structure.
- Institutional failures have been attributed to inadequacies in, and later entry to, modern research and education that, with an under-emphasis on agriculture and poorer initial links to systems of colonial powers, precluded Thai leadership in fields which might have been expected, with the consequence that adoption of new technology has been slower than in neighbouring countries.
- Service and input oriented agricultural institutions showed low levels of success in the field of cooperatives and fertiliser subsidy, until linked with credit and extension through the BAAC, thereby highlighting anachronistic institutional arrangements, and incidentally, the need for a more considered view of non-commercially oriented farmers.

Chapter 12

Agribusiness

From a strong agricultural base, Thai business supporting agricultural inputs, production, credit, processing, and marketing has grown to transcend Thailand's borders. Beginning as trading groups in the rice, teak, and rubber sectors, they have evolved into banks, finance companies, and agribusiness trading and investment houses. The first modern bank in Thailand, the Siam Commercial Bank, was founded in 1906 on agriculturally derived wealth, as were the Bangkok Bank of Commerce, the Bangkok Bank, the Bank of Ayutthaya, and the Thai Farmers' Bank. Over the period 1942 to 1945, timber, rice, sugar, and gunny sack¹¹⁵⁶ agribusiness houses linked agricultural production to international markets through processing, value-adding, financing, and clever negotiation. Thus the agribusiness component of Thai agriculture fuelled national economic growth over the past four decades.

Agribusiness has been unfairly blamed for rural poverty surrounding, for example, sugar cane factories, cassava processing points, large trading houses, and middlemen. The creation of landless peasants and destruction of a supposed egalitarian community centred on the temple¹¹⁵⁷ and religious law requires further analysis within the context of the economic structural adjustment necessitated by rapid population growth, and integration of Thailand into the global economy. Agribusiness is a logical outcome of modernisation; its profit orientation should be assumed, although the corollary, that effective government administration is maintaining social equity, requires more than such a simple assumption.

Detailed listings of the capacity and sites of agro-industrial enterprises across the country¹¹⁵⁸ and analyses of each industry,¹¹⁵⁹ provide information often fragmented between manufacturing and industrial statistics. Thai agribusiness is a formidable component of the economy, and its development is epitomised through the largest and most successful multinational group, CP; the sector also includes many other large companies, government enterprises, and complex relationships between private groups, government, and small-holders. The source of agribusiness expansion, and incidentally government forays into input supply, was the modernisation of agriculture with its demands for inputs.

Agricultural Inputs

Supply of agricultural inputs provided the first new profitable business area for agribusiness expansion, and has consequently involved private groups, as well as government redistribution initiatives through such agencies as the Marketing

¹¹⁵⁶ Arbhabhirama, Anat (1987)

¹¹⁵⁷ Vallibhotama, Srisakra (1989)

¹¹⁵⁸ Asawsophonkul, Anan., Sirayaporn, Piyanuch., and Yakham, Nantha. (1997)

¹¹⁵⁹ BTI (1999)

Organisation of Farmers and the BAAC. The expansion of agriculture, and in particular, the adoption of green revolution technologies, increased volumes of pesticide and fertiliser use substantially and provided a link between middleman services of the past and agribusiness-house growth post-1932, and post-1960. Pesticide use in Thailand has expanded from around 30,000 tons in 1981 to more than 40,000 tons in the 1990s and over the same period, imports of pesticides have declined from 50 percent of the market in 1980 to around 30 percent in the 1990s. Local production and local formulation have led to a tripling in local plants over the period.¹¹⁶⁰ as agribusiness sought to capture additional benefits.

Similarly, fertiliser use expanded (Table 14.1), and desires to capture the supposed benefits of local manufacture of fertiliser led to restrictions placed on urea importation to support a monopoly Thai Central Chemical Company that made a lower grade nitrogen fertiliser, ammonium phosphate; higher fertiliser prices and one of the highest ratios of fertiliser to rice price in Asia resulted.¹¹⁶¹

Table 14.1 Fertiliser Use for Rice and Other Crops (kg per rai)

Crop Year	Fertiliser for Paddy	Fertiliser for Other Crops
1970	3.9	4.0
1980	7.0	8.8
1990	16.2	32.3

From this base, modern agribusiness expanded, although its antecedents from Ayutthaya times provide a broader understanding of the cultural and entrepreneurial aspects of Thai agribusiness which have made it an international phenomenon as an adjunct to the national agricultural base.

The Agribusiness Story

The history of agribusiness has technological and business aspects. Technological innovations in input supply, agro-processing, and marketing, have been integrally linked with the business acumen of Chinese-Thai entrepreneurs as the economy expanded.

Foreign contact spurred early Ayutthaya agribusiness through trade of forest products and rice with foreigners providing services of credit, transportation of produce, establishment of mills and storage facilities, and forwarding. Chinese dominated domestic fields while Europeans dominated non-rice processing, until the Crown nationalised these new areas for its own revenue raising. Regional trade of valuable forest products including animal parts, herbs, barks, hides, resins, timber, thatch, and spices, followed trade routes which consolidated Ayutthaya as a major market force for much of the hinterland; trade routes linked Ayutthaya to Chiang Mai, Luang Prabang, and Kengtung through major centres at Vientiane and Sukhothai. As hinterland trade waned, immigrant Chinese traders¹¹⁶²

¹¹⁶⁰ Chuapanich, V. et al (1984)

¹¹⁶¹ Christensen, S. (1993)

¹¹⁶² Phongpaichit, Pasuk. and Baker, C. (1998)

assumed its control, and forest product exports to China dominated trade until the 1840s. Meanwhile, European trade sought sugar, pepper, tobacco, and rice, which created a need for consolidators and entrepreneurs, roles at which the Chinese excelled.

From Ayutthaya rice supplied to Malacca,¹¹⁶³ exports rose continuously, eventually attracting foreign investment in mechanised processing. Chinese provided increasing service in trade and government, obtaining monopolies and engaging in barter arrangements which placed them in a better position than the colonial Europeans. As tax agents, middleman, and bankers, they came to dominate retail and rice trading¹¹⁶⁴ until, denounced by the King in 1915, they quickly became Thai.¹¹⁶⁵

Thus Thai agribusiness arrived with trading, processing and vertically integrated industries, and was always associated with foreigners. Through to 1932, major European firms such as the Borneo Company, Windsor Redlich, Markwald, Arracan, and Franklin Blake thrived, while Chinese dominated rice processing and trading, until the 1920s' post-war depression. By the 1930s, new Chinese families emerged including those of; Wanglee, Lamsam, Bulasuk, Bulakun (later Mahboonkrong), Iamsuri, Setthapakdi, and Bunyarak.¹¹⁶⁶ Substituting for past arrangements of ancient Indian and Persian influence in the Court and Treasury, European and Chinese influence in the Thai economy and its development through schemes as the Rangsit Canal Project, suited Crown tax collection. Through such mechanisms, this open agriculturally-based country was unique in managing its political if not economic independence. Today, agribusiness in Thailand reflects these foreign origins, with government and business both investing in agribusiness.

The first investment in mechanisation of processing in Thailand was in rice mills, which were initially concentrated in Bangkok until railways penetrated the North and East. The first steam rice mill, introduced in 1858 by an American firm, failed and after several sales, came to Chinese-Thai ownership. By 1867, there were five rice mills in Bangkok, by 1889 23, by 1910 59, and by 1930 71. Outside Bangkok, the some 500 smaller rice mills in 1930 grew to some 800 by 1950, each with capacities of 30 to 40 ton per day compared to the 100 to 200 ton of the Bangkok steam-powered rice mills. Large mills provided economies of scale, including concentration of by-products, which were converted to animal feed through ever expanding feed mills. Large rice mills were eventually superseded by smaller portable mills which suited the independent nature of rice farmers,¹¹⁶⁷ by which time agribusiness had secured its supplies of a range of other feed ingredients.

In post-revolutionary Thailand, the socialist policies of Pridi culminated in a liaison with the large rice trading families of Bulasuk, Lamsam, and Wanglee, which led to the Thai Rice Company being managed by the first group, and the government leasing, rather than

¹¹⁶³ Wyatt, D.K. (1984)

¹¹⁶⁴ Trocki, C.A. (1992)

¹¹⁶⁵ Vella, W.F. (1978)

¹¹⁶⁶ Phongpaichit, Pasuk. and Baker, C. (1998)

¹¹⁶⁷ Ingram, J.C. (1971)

nationalising, mills owned by these families. The big five rice trading companies expanded through the post-revolutionary period until World War II. Significant benefits accrued to Thailand during the war albeit with some significant disruption from post-war reparation payments demands place on Thailand.¹¹⁶⁸

Large sugar mills began with government investment in Lampang in 1937 and Uttaradit in 1941. Both mills produced white sugar while four others produced brown sugar and molasses. Operated with the Ministry of Industries from 1946, sugar output was low and of variable quality; by 1950, total government sugar output was below that of small, simple, private factories. Even a heavy duty failed to make government mills profitable until sugar imports were banned in 1952.

The poor record of government agribusiness in sugar contrasts with the government tobacco monopoly created in 1941 to assume the properties of the British-American Tobacco Company. With the exclusive right to buy, sell, and manufacture all Virginia tobacco products, the monopoly operated buying stations and curing sheds throughout the North and Northeast, to provide a stable market for farmers taking production risks with the fickle tobacco crop. In the mood of the era and the wake of success of the tobacco monopoly, government in 1952 revealed plans for additional investments in the agro-industries of; rice milling, sugar refining, weaving, rubber manufacture, paper manufacture, salt manufacture, vegetable oil processing, tapioca production, fish storage, leather tanning, alcohol distillation, abattoirs, and gunny sack manufacture. However, government agribusiness was building on a small base where agribusiness manufacturing plants with more than 50 employees in 1949 numbered only 19 for rice mills, 18 for saw mills and eight for rubber and sugar plants.¹¹⁶⁹

As agribusinesses of the pre-World War II period generally failed to survive the hiatus until resumption of trade in the 1950s, government invested in agro-industrialisation as part of its modernisation policy. Continued reliance on the major export commodities of rice, rubber, and teak, with rice dominating although declining from 1950, confirmed the base from which lasting agribusiness would develop in Thailand, commodity trading. The post-World War II Chinese groups, utilising tightly knit community linkages, developed wholesale, rice milling and lending activities, which became a critical component of agriculture and agribusiness in Thailand.¹¹⁷⁰ Value-adding in agro-industry increased from ten percent of GNP to 15 percent over the period 1951 to 1969, mainly from food industries.

Freed from state control in the late 1950s, agribusiness groups expanded from their base of rice milling into a range of crop trading and processing activities. The Wanglee family grew to effectively control the cassava trade when it was one of Thailand's major export commodities; the Bulakun family expanded in cassava production, silos, and warehousing while the Metro group, which began from fertiliser imports, joint ventured with Japan to locally manufacture fertilisers while maintaining strong involvement in

¹¹⁶⁸ Phongpaichait, Pasuk and Baker C. (1997)

¹¹⁶⁹ Ingram, J.C. (1971)

¹¹⁷⁰ Ingram, J.C. (1971)

wheat flour silos and feed mills. The Sura Maharas distilling empire grew from a liquor wholesaling business of the Techaphaibun Family and the Thai Roong Ruang agribusiness conglomerate grew from the Asadathaon family sugar refining activity.¹¹⁷¹

The upland cropping expansion of the mid 1960s created opportunities for agribusiness, which led the Bangkok Bank becoming a major financier of agro-processing companies, in particular Charoen Pokaphand. The Thai Farmers' Bank supported the Lamsam group in crop exporting, warehousing, and joint venturing with multinationals including Dole from the USA, and the Australian Dairy Industry. The Bank of Ayutthaya associated with the Rattanak group in agro-processing, while the Techapaibun-Mahaguna group continued its expansion from distilling into brewing, sugar processing, glass manufacture, and chemicals associated with these industries.¹¹⁷² From input supply, agribusiness had moved to focus on agro-processing with production management systems on one side complemented by marketing acumen on the other; some processed products and their export values of the past two decades are presented in Table 14.2.

Table 14.2 Agro-processing Exports (million baht), 1975 - 1993¹¹⁷³

Agro-Processed Export		1975	1980	1985	1990	1993
Sugar	value	7,353	3,357	6,247	17,694	12,185
	%	21	4.7	4.9	6.7	3.6
Frozen Fowl	value	7	656	1,408	7,590	8,886
	%	0.02	0.9	1.1	2.9	2.7
Canned Fruit and Vegetable	value	388	1,728	5,114	12,349	16,439
	%	1.1	2.4	4.0	4.7	5.0
Canned Seafood	value	-	2,267	7,732	24,762	20,035
	%	-	3.2	6.0	9.4	9.0
Others	value	3,233	2,652	7,220	15,920	24,354
	%	9.2	3.7	5.6	6.0	7.3

Government policies of the 1950s and 1960s aimed to maintain agricultural expansion to provide income for continued urban growth. Government investments in rural roads and administrative infrastructures, for example, may have had security objectives yet incidentally and significantly assisted agribusiness. Continued urban growth led to Bangkok being some 35 times the size of the next largest town by 1960 although the agribusiness boom itself helped to marginally correct this imbalance and to create a new group of agribusiness-rich provincial businessmen.¹¹⁷⁴

The agribusiness and agriculture sector today constitutes an estimated 50 percent of the Thai economy.¹¹⁷⁵ In general, Thai industries based on value-adding to agriculture derive their strength from the availability of primary product more than technological or managerial advantage.¹¹⁷⁶ Hence, policy links have been weak between agriculture and

¹¹⁷¹ Phongpaichait, Pasuk and Baker C. (1997)

¹¹⁷² Phongpaichait, Pasuk and Baker C. (1997)

¹¹⁷³ Poapongsakorn, Nipon et al (1995)

¹¹⁷⁴ Phongpaichit, Pasuk and Baker, C. (1998)

¹¹⁷⁵ Trebuil, G. (1995)

¹¹⁷⁶ TDRI (1989)

manufacturing. Value-added per agribusiness worker is low as a function of seasonality of production, high labour availability, and the relatively simple processing needs of the major crops of rice, maize, cassava, and sugar cane. Once these crops are processed into tradeable commodities, any additional comparative advantage for Thailand is limited to market access or transportation. Thailand may thus not appear to have comparative advantage in such sectors as corn milling or feeding cassava to livestock,¹¹⁷⁷ and yet has demonstrated success through business acumen, labour rates, business contacts in the region, vertical integration, and use of unpriced natural resources.¹¹⁷⁸

Charoen Pokaphan

Private sector Thai agribusiness is often a synonym for the Charoen Pokaphan (CP) group. While incomplete, this description indicates the agribusiness origins and *modus operandi* with government and the market place. From its origins in 1921, CP's history is best known through a Bangkok Chinatown seed shop in 1940 and three Chinese born brothers of the Chiaravanont family. Having attended Thai schools, the Chinese-Thai entrepreneurs expanded to importing animal feed and fertiliser, which led to the development of their first feed mill in 1954. This proved a stepping stone to foreign joint ventures to gain chicken production technology modified to suit Thai conditions of; low farmer incomes, availability of feed and materials, a domestic market, and suitable location for export to Japan. Their company, CP, continued to expand until it monopolised the modern poultry market by the 1970s, and owned over 60 companies by the 1980s across a range of agribusinesses relating to animal feeds, pigs, and poultry.

Adding pork and shrimp through similar contract farming activities in the first instance, the CP Group was Asia's largest in the agro-industrial sector by 1993 when its annual sales exceeded \$5 billion, its workforce 50,000 excluding contracted farmers, and its corporate group comprising 200 companies across 16 countries. Their Kentucky Fried Chicken franchise for Thailand and, to an extent, other retail outlets, grew from the logic of expansion based on products which the group controlled. Expansion into large black tiger shrimp production in partnership with Mitsubishi Corporation of Japan,¹¹⁷⁹ and development of hybrid maize with Dekalb of the USA, led with other expansion measures, to the base of broiler production eventually being moved to China.

Continued expansion followed a proven model of vertical integration and close association with government and essential financing and market entities, and allowed entry into Indonesia, Hong Kong, Malaysia, Singapore, and Taiwan. The profits of agribusiness allowed CP to enter telecommunications and retailing and, most notably, to become one of the largest foreign investors in mainland China. By 1996, CP had become the largest agro-industrial enterprise in China with more than 100 feed mills and more than 170 other involvements, which together produced 30 percent of total group turnover.

¹¹⁷⁷ Siamwalla, Ammar (1991)

¹¹⁷⁸ Christensen, S.R. (1992)

¹¹⁷⁹ Suehiro, Akira (1992)

With more than 80,000 employees in 300 companies in 20 countries,¹¹⁸⁰ CP is one of the world's great agribusiness houses.

Like government, CP assumed that growth of the 1980s and 1990s was sustainable. Potentially unserviceable loans, countered somewhat in Thailand by devaluation of the baht, were compounded by CP's China agribusiness operations which lost \$18 million in the first half of 1998, an amount equal to its annual profit of 1997. Post-1997 consolidation around the agribusiness core has led to shedding of some extraneous businesses.¹¹⁸¹ CP's time-proven strategy of lobbying government for favourable policies which link to national development objectives is again in 2000 being employed to advocate lower interest rates to stimulate economic activity¹¹⁸².

CP's operations span animal feed, poultry, pigs, seafood, telephones, discount retail chains, polyvinylchloride manufacture, real estate, development, and motor vehicle manufacture, with major listed units on the stock exchanges of Bangkok, Shanghai, Hong Kong, and New York. Rationalisation of eleven Thai agribusiness operations under the company CP Feed Mill PLC,¹¹⁸³ and similar approaches in China and Indonesia, indicate a faith in continuing weak currencies and future economic growth which will favour vertically integrated agribusiness activities in Asia. Even in 1997, agribusiness operations across 12 countries contributed turnover of \$7 billion, more than 75 percent of the group's total.¹¹⁸⁴

The success of CP has provided Thailand with potential income and technology which has inspired other agribusiness groups, and some government policy. While Thai agribusiness is not just CP, the strong and not always transparent relations with government is a theme of Thai agriculture which has obvious business strengths revealed through profits, and some weaknesses associated with governmental responsibilities and small-holders. The small-holder agricultural base of Thailand necessitates close associations with business. Poultry, and to a extent pig, industries have refined contact and related farming arrangements in Thailand, and are discussed in chapter 9. CP has been the leader in such commercially successful arrangements, although it is noteworthy that the group was unable to successfully apply the same concept to rice.¹¹⁸⁵ Some of other variations in relationships are indicated in the shrimp, industrial forestry, rubber, and horticulture industries.

Shrimp Agribusiness

A new industry in its aquacultural form, Thai Black Tiger Shrimp production is almost twice that of Indonesia, which is the second largest producer. The industry's development was based on suitable investment conditions and environments,¹¹⁸⁶

¹¹⁸⁰ Phongpaichit, Pasuk and Baker, C. (1998)

¹¹⁸¹ Biers, D and Vatikiotis, M. (1999)

¹¹⁸² Vatikiotis, M. (1998)

¹¹⁸³ Biers, D and Vatikiotis, M. (1999)

¹¹⁸⁴ Vatikiotis, M. (1998)

¹¹⁸⁵ Phongpaichait, Pasuk and Baker C. (1997)

¹¹⁸⁶ Csavas, I. (1994)

particularly in the East and South gulf regions.¹¹⁸⁷ Upon full development,¹¹⁸⁸ intensification which relied on high capital to land ratios, and low labour intensities,¹¹⁸⁹ ignored sustainability principles¹¹⁹⁰ by introducing formulaic management systems.¹¹⁹¹ Small-holders were integral to ultimate success, although overriding concerns have focussed on environmental issues, which themselves would possibly have been substantially less with adequate enforcement of existing laws by government, and slower development of a socially balanced small-holder cooperative approach. However, protection of remaining mangrove areas was claimed as a benefit of intensification,¹¹⁹² and international development bank assistance¹¹⁹³ supported an industrial approach to further expansion in conjunction with agribusiness.¹¹⁹⁴

Through the Fifth and Sixth Plans, such groups as Cargill, for a time, were encouraged to invest in parallel with small-holder growers financed by the BAAC, Bangkok, Bank of Asia, and Thai Farmers' Bank. Growers with contracts from agribusiness groups were considered better lending risks,¹¹⁹⁵ and more likely to access new technologies.¹¹⁹⁶ Aquastar Limited and CP Aquaculture Business dominated, with Aquastar ostensibly more oriented to social and environmental principles, and CP adapting its vertical integration model from the poultry industry. Aquastar worked with small-holders directly, providing larvae, feed, marketing, and extension services, and subsequently joined with Bechtel Engineering to expand on a standard pond design basis, eventually selling to BP Nutrition.

CP Aquaculture was the fastest growing division of the CP Group; CP's shrimp aquaculture extended from China, Indonesia, India, Vietnam, Mexico, to Australia. From 1991 strategies to use feed mills products and food market network, CP grew to control some 5,000 coastal hectares through shrimp contract farming agreements with small-holders. The group processes shrimp through four facilities in Thailand and two in Indonesia and continues to seek wider access to suitable areas in other Asian countries.¹¹⁹⁷ The apparently reasonable returns to small-holders have yet to be weighed against the cost of an unsustainable practice which leaves final risks with the small-holder, or the wider economic cost of this modern form of shifting agriculture.¹¹⁹⁸

The CP Group funds twenty shrimp aquaculture extension centres throughout Thailand and a contract farming business involving some 10,000 farmers. Contracts limit costs of production from agribusiness' viewpoint, and cap returns from the growers'.

¹¹⁸⁷ Department of Fisheries (1995)

¹¹⁸⁸ Flaherty, M. and Karnjanakesorn, Choomjet (1995)

¹¹⁸⁹ NACA (1995)

¹¹⁹⁰ Pathranarakul, Pairote (1995)

¹¹⁹¹ Norgaard, R.B. (1994)

¹¹⁹² Panayotou, T. and Sussengkarn, Chalongsob (1992)

¹¹⁹³ Skladany, M. and Harris, C. (1995)

¹¹⁹⁴ USDA (1992)

¹¹⁹⁵ Gronski, R.T. (1997)

¹¹⁹⁶ Glover, D. J. and Kusterer, K.C. (1990)

¹¹⁹⁷ Gronski, R.T. (1997)

¹¹⁹⁸ Weber, M.L. (1996)

Nevertheless, growers rejected cooperative approaches after experience with poor market prices, possibly due to inadequate quality control resulting particular from simple feeding and chemical regimes. Improvements in management based rules to limit consolidation of ponds by a large operators produced the apparently viable income sharing arrangements in contracts. Processing, including ice water shocking for live restaurant delivery within hours of harvesting, links small-holders to a market which they could not otherwise access, inevitably disadvantaging growers remote from major shrimp processing and distribution facilities. Shrimp processing plants in the South, for example, are located at; Caotiwat at Hadyai (40 tons); TPCC (CP Group) at Ranot (30 tons); Aquastar at Sathing (20 tons); Fortune at Ranot (20 Tons), and Thai Fisheries at Songkhla (8 tons).¹¹⁹⁹

Demand for shrimp feed increased from around 5,000 ton in the early 1980s to around 700,000 ton by 1997. CP produces some 70 percent of the total, seven times the second largest producer, thereby reflecting the main cost of feed, which constitutes about 70 percent of operating costs. CP's involvements in processing and marketing, coupled with its dominance of the feedmill sector has meant that Thai shrimp aquaculture, like poultry, has been effectively determined by one group.

Forest Agribusiness

Forest agribusiness concerns plantations of fast growing species and the processing of timber, and in particular for pulp. It also includes logging, saw milling, and forest products. Saw milling capacity has reduced with the prohibition on logging and the location of new mills in border areas suggest utilisation of logs from outside Thailand.¹²⁰⁰ *Eucalyptus* species introduced to Chiang Mai around 1950, were later promoted for afforestation of the harsh alternately wet and dry plains of Thung Kula Rong Hai of the Northeast. The Royal Forestry Department suspended promotion of the species in response to protests, although other arms of government separately promoted investment by agribusiness through lowered land rentals, and subsidised credit for small-holder growers to supply agribusiness.

Agribusiness interest in reforestation with fast growing tree species began in the late 1970s as government aimed to reduce the costs of importing of pulp and paper. The Royal Forestry Department determined *Eucalyptus camandulensis* to be the most suitable species and granted 30 year land concessions to agribusiness firms for rents of one baht per rai per year, later raised to 10 baht. Policies for reforestation showed a 40 percent total national forest cover with 25 percent being commercial plantations, a policy supported through tax privileges for investment in paper mills, pulp companies, and plantation development. Global rises in pulp prices attracted such companies as CP, Kaset Roong Ruang, and Shell, as well as at least 15 Japanese, and several Taiwanese joint ventures.¹²⁰¹

¹¹⁹⁹ Gronski, R.T. (1997)

¹²⁰⁰ Sadoff, C.W. (1992)

¹²⁰¹ Phongpaichait, Pasuk and Baker C. (1997)

Encroachment into forest reserves by the Kaset Roong Ruang group uncovered political linkages to a Minister of the time, which the rising resistance to commercial forestry used to invoke environmental arguments against *Eucalyptus* plantations. The environmental arguments of the time masked perhaps more serious social equity issues, where rural dwellers were excluded from traditional forest essential to their livelihood. In any case, *Eucalyptus* shortages prompted the Phoenix Pulp and Company to contract small-holders to supply raw material.¹²⁰² Pulp from rice, straw, grasses, and bamboo produced inferior short fibre paper further stimulating the demand for fast growing trees for long fibre pulp.¹²⁰³ Misgivings continued as small-holders remained ignorant of the wide changes occurring in the Thai economy, not the least of which was the end of agricultural expansion through opening of new lands. Value-adding and agribusiness disrupted the balance between land, labour, and capital, with capital gaining precedence, at times even subsidised by government.¹²⁰⁴

Now integrated as a component of reforestation policies of government, some 20 million rai (32,000 square kilometre) of *Eucalyptus* are expected to be planted for management on a rotational basis to supply the local pulp industry; demand is expected to grow to 55 million cubic metre by 2015. A proposed Chinese joint venture has advised of requirements for 200,000 rai of *Eucalyptus* grown through reforestation of degraded areas, to produce some 700,000 ton of pulp per annum.

The Sino-Thai Pulp and Paper Joint Venture Project suggest a continuation of government facilitation of small-holder grower support of agribusiness. Experience of its pioneering predecessor, the problem plagued Phoenix Pulp and Paper Plant in Khon Kaen, provides lessons concerning social equity, when company margins are squeezed and the only flexible contract is with the small-holder. Delivery of *Eucalyptus* logs to the Phoenix Pulp and Paper Plant includes costs of some 130 baht for tree cutting labour and 300 baht for daily rental of a truck, with trucks caused to queue for up to a week, and the company paying three months in arrears. The role of government continues to evolve.

Rubber Agribusiness

First introduced in 1901,¹²⁰⁵ rubber plantings emerged as an industry around 1918.¹²⁰⁶ With colonial firms extending from Malaya seeking land rights, the Thai government sought to exclude large foreign groups, thereby providing a financial advantage to Malaysia. However, beneficiaries of the policy were Thai small-holder rubber producers whose expansion created demand for inputs supply, credit, consolidation, and marketing, which again entrepreneurial immigrant Chinese filled. The absence of colonial laws that protected foreign investment which had led to Thailand failing to fully develop many of its agribusiness industries, did not constrain small-holder rubber development.¹²⁰⁷

¹²⁰² Bello, W., Cunningham, S. and Kheng Poh, L. (1998)

¹²⁰³ Phantumvanit, Dhira (1988)

¹²⁰⁴ Phongpaichait, Pasuk and Baker C. (1997)

¹²⁰⁵ Ungphakorn, Puey and Yossundara, Suparb (1955)

¹²⁰⁶ Thompson, V. (1967)

¹²⁰⁷ Phongpaichait, Pasuk and Baker C. (1997)

The independence of operation in the South favoured innovative approaches which Chinese businessmen with planters from Malaya built into a small-holder rubber industry, until entrepreneurial Chinese were ejected by government in the 1950s.¹²⁰⁸ Initially receiving a lower price for poorer quality products, Thai rubber progressively improved while at the same time seizing each opportunity to increase its export quota; by 1935, Thailand had achieved permission to export more than 30,000 ton, four times its 1934 allowance.¹²⁰⁹ World War I allowed expansion as British colonies were prohibited to trade rubber, and World War II and the Korean War similarly encouraged further increases in planting.¹²¹⁰ Competition from synthetic rubbers¹²¹¹ finally stimulated government support for replanting with Malaysian developed lines¹²¹² through the 1950s and later.

The Thai rubber industry of the era was 80 percent managed through small-holdings of less than 50 rai; estates exceeding 250 rai represented less than 10 percent, and foreign ownership was negligible.¹²¹³ Government assistance to further improve came through international assistance from the 1950s,¹²¹⁴ which confirmed the further potential¹²¹⁵ and ultimately led to Thailand becoming the third largest producer by the early 1970s,¹²¹⁶ and the largest by the 1980s.

The relationship between small-holders and agribusiness allowed responsive expansion of planting, while the relationship between agribusiness and government allowed manipulation of the international agreements which culminated in the International Natural Rubber Organisation. The Organisation was wound up in 1999 by Thailand's withdrawal as it sought to raise rubber prices.¹²¹⁷ The success of the government-agribusiness-small-holder relationship in the rubber industry, included a political element related to the Muslim South, which served in part to maintain government attention to social equity.

Horticulture, Textiles, and Technology

Agribusiness also appears to have been critical in the success of horticulture exports, for example, in the Lam Nam Oon Contract Farming Project in Sakon Nakhon province in the Northeast. Central to that success was the provision of irrigation water to expand wet season production, the introduction of dry season agriculture, and the introduction of non-traditional crops of high marketability supported by technical advice. Based on such crops as asparagus, sweet corn, gherkins, string beans, peas, baby corn, tomatoes, and

¹²⁰⁸ Silcock, T.H. (1970)

¹²⁰⁹ McFadyen, A. (1944)

¹²¹⁰ Silcock, T.H. (1970)

¹²¹¹ McHale, T.R. (1961)

¹²¹² Fisk, E.K. (1967)

¹²¹³ Ministry of Agriculture (1961)

¹²¹⁴ FAO (1954)

¹²¹⁵ Ministry of Agriculture (1961)

¹²¹⁶ FAO (1972)

¹²¹⁷ FEE (1999)

cantaloupe grown under contract, the scheme was particularly effective for the contract growing of tomatoes for a private processing plant, also supported through BAAC and other finance. Repayment of farmers' loans to the BAAC were settled through the processing firm upon sale of tomatoes.¹²¹⁸

With expansion to four companies in tomato contract growing activities, one in tomato seed growing, one in fresh consumable tomatoes, and two in tomato paste, inevitable disputes about spoilages, factory shut-downs, and other unforeseen problems were resolved through mutual benefit contracts. The viability of the government-agribusiness-small-holder relationship in this case was ascribed to government investment in necessary infrastructure through road construction, a sound understanding by farmers of the contract farming concept, efficient coordination of government agencies operating in the area, transparency in the development of procedures involving farmers, and timely supervision and advice by staff of the firms and government officials.¹²¹⁹

Less successful was an Agricultural Land Reform Office and BAAC program with the agribusiness company Maboongkrong Srichai Cashew Company Limited. BAAC supplied Northeast small-holders with credit for company-supplied cashew tree seedlings and grafted trees, some essential inputs, and technical advice. Aiming to cover 175,000 rai in 1990, and expanding through subsequent years to 300,000 rai and more than 31,000 farm households, initial planting targets were exceeded until the rapid spread of thrip and mealy bug and a drought reduced yields below targets while farmers accumulated debt. Research conducted by the company and the Department of Agriculture had identified suitable sites in the wetter East, however, government programs targeted the Northeast, thus the combined inputs of agribusiness and government only seemed to be available for that region.¹²²⁰ Poor feasibility analysis and an absence of regionally specific research results thus introduced risks which unfairly accrued to small-holders.

Cotton and to an extent, silk and other fibres, might have been expected to follow the successful agribusiness models which acquire technology, build on domestic production or processing, and meet local demand in the first instance. However, import substitution in the textile and clothing sector has not been a success of agribusiness. The major foreign exchange earner since 1985, the textile and clothing sector exported some \$6.4 billion of product made mainly from imported raw material in 1995. The relatively late development of Thailand's modern textile industry and open policies for the sale of foreign cloth in Thailand since Ayutthaya times has continued reliance on imported raw material. Government investment in 1936 in 72 looms and more than 3,000 spindles from Germany stimulated a 1946 private investment which rose to a capacity of some 43,000 spindles by 1952. Low-cost imports from Pakistan in the 1950s stimulated government protection through the mid- and late-1950s, until joint venture companies with Japanese and Chinese entrepreneurs introduced blends with artificial fibres. Inadequate supply of domestic product has been addressed less successfully than use of low cost labour under protected conditions, producing an industry of high apparent value

¹²¹⁸ Poapongsakorn, Nipon et al (1995)

¹²¹⁹ Poapongsakorn, Nipon et al (1995)

¹²²⁰ Poapongsakorn, Nipon et al (1995)

which masks the potential foregone for something akin to the vertical integration of the poultry industry.¹²²¹

A common reason for such failures as the textile industry has been the inability to reliably produce quality raw material in Thailand. This conclusion is not supported by the evidence which contains only experience from inadequate research funding and uncoordinated policies. In fact, the ability of agribusiness to acquire new technology has been a key to its continued growth, when supported by appropriate government policies, long term planning, and reliable government regulatory services. High levels of technology, acquisition, and innovation by agribusiness have been shown for aquaculture and animal feeds, seeds, dairy, and ornamental plants. An estimate of the potential for impact of new bio-technology indicates the highest likely returns to plants and seeds (75 percent), and insecticides and herbicides (50 percent), above pharmaceutical and chemical sectors.¹²²² Realising such potential relies on higher levels of education than current agriculture and agribusiness emphasis on bachelor rather than higher degrees.¹²²³

Small-holders have acquired and applied new technology through contract farming more than traditional extension mechanisms in many instances. Beginning in the sugar cane and tobacco industries, contracts schedule deliveries of specified quality raw material to processing facilities.¹²²⁴ Vegetable processing successfully adopted the approach; for example, potato processing introduced in Chiang Mai in 1979 expanded to larger processing companies such as United Foods through contract farming. High prices attracted growers through a phase of competing processing companies until one company, Food Processing, dominated and contract prices consolidated.¹²²⁵ Small-holders gained new skills through the demands of contracts, although research remains underfunded and uncoordinated.

Contract farming has been shown to provide similar returns to the adoption of a new successful technology; as Thai adoption rates have traditionally been low, government support to agribusiness may seem justified as an alternative extension arm through provision of stability, infrastructure development, and access to information.¹²²⁶ Nevertheless, the role of government to control exploitation of agribusiness' superior bargaining position with farmers, particularly when contracts are renewed and farmers are committed to long term debt, precludes major or uncontrolled reliance on agribusiness as the means of developing small-holder agriculture. Compounding government's deliberations over these conflicting interests are those government agribusiness institutions created for political or development reasons of the past.

Government Agribusiness

¹²²¹ Suphachalasai, Suphat (1997)

¹²²² Smithson, L.H. (1988)

¹²²³ TDRI (1989)

¹²²⁴ Siamwalla, Ammar et al (1986)

¹²²⁵ Ornberg, L. (1998)

¹²²⁶ Dolinsky, D.J. (1992)

Government use of agribusiness in development can appear anomalous with respect to government enterprises which act as agribusiness houses. Board of Investment privileges which link government to supporting business can also be a form of protection where it results in some non-agricultural sectors being subsidised by agriculture, and some agribusiness being subsidised by the agricultural production sector.¹²²⁷ The separation of manufacturing from agriculture also exposes producers to export market risks without apparent influence over the price they receive when international prices rise.¹²²⁸ Reform of the Ministries of Agriculture and Cooperatives, and Finance, as well as the Bank of Thailand¹²²⁹ as a result of the crisis of 1997, provides an opportunity to revisit the State enterprises related to agriculture, and other sectors.

State enterprises, although supervised by a relevant Ministry, enjoy a high degree of operational autonomy with limited accountability. Those supervised by the Ministry of Agriculture and Cooperatives indicated a small profit of 355 million baht from a revenue of 5.3 billion in 1982, and a loss of 64 million baht from a revenue base of 6.4 billion in 1988.

Within the top 20 profit making public enterprises over the period 1979 to 1988, those related to agriculture and agribusiness, although not necessarily supervised by the Ministry of Agriculture and Cooperatives were: the Thailand Tobacco Monopoly, Forest Industry Organisation, Bank for Agriculture and Agricultural Cooperatives, Thai Plywood Company Limited, and Marketing Organisation for Farmers. Public enterprises relating to the agriculture sector in general include:¹²³⁰

- Bank for Agriculture and Agricultural Cooperatives
- Dairy Farming Promotion Organisation of Thailand
- Fish Marketing Organisation
- Forest Industry Organisation
- Government Cold Storage Organisation
- Lampon Provincial Company Limited
- Marketing Organisation
- Marketing Organisation for Farmers
- Northeast Jute Mill Company Limited
- Office of Rubber Replanting Aid Fund
- Prachin Buri Provincial Company Limited
- Preserved Food Organisation
- Public Warehouse Organisation
- Rubber Estate Organisation
- Sugar Factory, Department of Industrial Work
- Surin Provincial Company Limited
- Tanning Organisation
- Thai Plywood Company Limited
- Thailand Tobacco Monopoly

¹²²⁷ Jutsuchon, Somchai (1989)

¹²²⁸ Siamwalla, Ammar (1991)

¹²²⁹ Christensen, S.R. (1992)

¹²³⁰ Dhiratayakinant, Kraiyudht (1993)

Government participation in agribusiness can confuse the role of government; for example, in the seed industry government provides services of foundation seed, multiplication, distribution of improved seeds and selected crops, quality control, investment privileges, and export-import control. The vegetable seed market is dominated by the private sector and while the public sector has concentrated on open-pollinated crops such as rice, soya beans, and ground nuts. However, it is now seeking to expand into the vegetable seed market. Patent legislation, global trends of privatisation of benefits, and government regulatory roles may lead to a reconsideration of the extent of government participation in production fields.¹²³¹

Fertiliser and pesticide procurement and distribution by government agencies also overlaps with private agribusiness. Government has procured and distributed fertilisers through the Bank of Agriculture and Agricultural Cooperatives, the Rubber Replanting Aid Fund, and the Marketing Organisation for Farmers. It became involved in fertiliser production through the unsuccessful Mae Moh plant which aimed to use lignite as a fuel; initially 49.9 percent government owned, continued losses and lack of confidence led to public ownership rising to 98 percent until its bankruptcy in 1978. Again in 1982, the National Fertiliser Corporation was established with 45.9 percent government ownership to utilise the newly discovered natural gas of the Gulf of Thailand. High domestic prices for natural gas affected the company's viability and the project was abandoned in 1991. By 1992, the Thai Central Chemical Company Limited dominated the local industry mixing 90 percent of fertiliser product. By contrast, pesticide demand, which increased with fertiliser use, was profitably met with private sector establishing local mixing plants.

A tidy separation between government and private agribusiness may not be necessary, although some review of the ongoing utility of organisations created for purposes which may no longer exist is warranted. Agricultural credit through the BAAC, irrigation, water allocation and charges, and agricultural cooperatives, among other fields, span the two production sectors of Thai agriculture and hence possibly confuse the role of government.¹²³² The essential role of government in regulation, and provision of services of public benefit is providing a clearer guideline in the gradual improvement of institutions. Economic planning and foreign support appears to emphasise commercial agriculture more than self-sufficiency. Recognition that these two types of agriculture are likely to continue for the foreseeable future will assist government reorganisation to meet social, environmental, and economic objectives.

Future Agribusiness

The two Thai agricultural production sectors, non- or semi-commercial and requiring government's broader attention, and the commercial with which agribusiness identifies, cannot be served by single policies. For the commercial sector, the emergence of agribusiness houses such as CP may be seen as both a policy and Chinese-Thai commercial success. Success is evident in profits; however, the economic benefits are

¹²³¹ Setboonsarng, Suthad et al (1985)

¹²³² Siamwalla, Ammar (1992)

wider. From no inherent advantage in processing most primary products,¹²³³ agribusiness has created efficiencies through linking primary production advantages to such fields as processing of cereal products, raising and processing of chickens, and marketing of chicken products. The major chicken feed ingredient, maize was also a significant export commodity until boneless chicken exports to Japan allowed value-adding at a time when cereals showed a long term downward price trend, such that maize exports of 45 percent of production in 1980 declined to 20 percent in 1989,¹²³⁴ while chicken exports rose. Success in the self sufficient small-holder sector is less easily quantified, and its importance is emphasised in the next chapter.

The role of government in maintaining an appropriate legislative and regulatory environment remains an issue when development requires close relations with agribusiness. This concern, raised by foreign financiers in the post-1997 crisis period, is linked to resolve in policing of regulations as a step towards improved effectiveness of governance. Past assumptions that agribusiness will seek to avoid such regulations, and that government is a more responsible owner of economic facilities, have been shown to be false. For example, an examination of the reasons for abatement of polluting practices by paper mills in four Asian countries including Thailand concluded that:¹²³⁵

- action is stimulated by technical and economic information, and external pressure
- competitiveness is positively correlated to state of the art environmental practices
- government ownership is negatively correlated to pollution abatement
- community participation facilitates abatement procedures, especially in poor areas
- there is no difference between local and foreign ownership.

With such experience and a free market philosophy among international financiers of Thailand post-1997, agricultural development plans are utilising \$1.2 billion of international funds to enhance three Thai agribusinesses areas. These are oriented to improved government services for the food and animal feed, rubber and rubber products, and wooden products and furniture industries. Assistance in the form of provision of high quality rice seed is expected to lead to increased export of high quality Thai rice. The major Thai rice exporters in 1997, Soon Hua Seng Rice, Chaiyaporn Rice, Thai Fah, Kamolkij, Jiameng, Rice International, Siam Rice, Thai Mapan, and Uthai Produce which export 70 percent of the total Thai export of 5.2 billion tons, will be major beneficiaries. Cassava improvement based on higher yielding varieties, rubber price enhancement, improved environmental management of coastal shrimp farms, and greater use of domestically produced animal feeds,¹²³⁶ will similarly benefit private agribusiness. Government revenue raising through taxation clearly forms part of other foreign packages to ensure viability of these loans. Inputs to research, education, import substitution, and value adding complement the agricultural plan.

Thai agribusiness is one of the nation's success stories, which when considered together with the strength of the agricultural production sector, represents the source of Thailand's

¹²³³ Siamwalla, Ammar (1991)

¹²³⁴ Siamwalla, Ammar et al (1992)

¹²³⁵ Hartman, R.S. (1997)

¹²³⁶ Lebel, L. (1998)

wealth from the past, as it does today, and into the immediate future. The future of agribusiness involves a clearer separation of government from private sector roles, and recognition of the role of small-holders, as discussed further in the following chapter.

Summary

Key points pertinent to Thai agriculture which may be elicited from this discussion of agribusiness include:

- Agribusiness growth from private input suppliers built on Ayutthaya's reliance on colonial European groups until contemporaneous Chinese traders proved more adaptable in remote areas and as Crown agents, gaining ownership of the first European rice mill and other processing facilities, with government following suit.
- Government agribusiness enterprises established after World War II showed variable outcomes, while private agribusiness expanded rapidly in the 1960s with upland cropping through bank and agribusiness alliances which soon transcended Thailand's markets, such that the wider agriculture sector forms more than half of the economy.
- Government supported private agribusiness to contract small-holder production which highlighted conflicts with government's social and environmental objectives, and anomalous State agribusiness enterprises, thereby clarifying the need to view future agribusiness as part of commercial agriculture, and for separate policies for self-sufficient agriculture.

Chapter 13

Small-holders and Development

Agriculture in Thailand is both a major export income source and a social welfare system. Small-holders produce the majority of agricultural products, the raw materials utilised by agribusiness, and contribute most of the labour.¹²³⁷ Thus polarisation of Thai agriculture into commercial and self-sufficient types necessarily involves small-holders in both categories. Development will ultimately address the social needs of all small-holders. However, the convenient separation between agribusiness and small-holders allows consideration of issues not evident in discussions with a commercial orientation. This chapter therefore introduces arguments for specific policies and programs relevant to small-holders as a primary responsibility of government in both social and economic sectors.

Policies which supported agribusiness as an instrument of national development assumed that resulting innovation would meet wider government objectives. However, the diffuse benefits of agricultural research discouraged agribusiness to assume a creative role, and interpretations of declining comparative advantage in agriculture with rising labour and resource costs, led to reduced investment as small-holders became increasingly associated with poverty.¹²³⁸

Marginalisation of small-holders arose from foreign development systems which contained forgotten assumptions that sound government systems, efficient legal environments, and practical social welfare programs were common to countries such as Thailand. This may be more clearly expressed by considering the specific economic context in which small-holders operate, while noting the sharing some characteristics of family farms across cultures. Differences between small-holder integrated farms and agribusiness monocultures require research and other support services, with government ensuring that public good research continues, while encouraging funding by agribusiness of research which generates capturable benefits. Elements of traditional or risk management agriculture which remain in small-holder agriculture as misnamed 'low input' systems, which appear to include means for improving environmental management, social well-being, and yields.¹²³⁹ Such non economic factors are already as important as economic aspects of the sector, even if not recognised.

Thailand's special case as a nation with a small-holder base providing the primary historical material of national wealth creation has possibly been under-emphasised in

¹²³⁷ Suphanchaimat, Nongluck. (1998)

¹²³⁸ Christensen, S. (1992)

¹²³⁹ Uphoff, N. and Fernades, E. (1999)

development plans built on a generic industrialisation model. The compounding factor of an urban bias, reflected in the haiku,¹²⁴⁰

*sitting on top of the rice heap
marvelling how distant peasants toil*

describes part of a socio-economic context which culturally values small-holders while often overlooking their share of national wealth. However, economic development approaches have perhaps been most significant is setting the context for small-holders in recent decades.

Economic Context

Models for agricultural development in less developed countries focus on one of:

- social issues associated with agriculture and rural dwellers in industrialised countries
- producing a higher proportion of domestic foods in food-deficit developing countries
- economic and political interventions for major food industrialised exporters.

A fourth category, the major agricultural exporting developing country, has often been an assemblage of the above models, rather one than suited to the special case which is Thailand.

Human, natural environment, and economic factors form part of any comparison of alternative policies. The natural environment is assumed to be stable, although it has been substantially modified through irrigation and other interventions. The economic environment for Thai agriculture is characterised by changes in domestic markets, fixed marketing costs such as transport, access to international markets, and inferior negotiating power in an over-supplied global economy.¹²⁴¹

Thai capital has been oriented to manufacturing and industry as these appeared to provide higher economic returns. Such adopted policies have included implicit assumptions of economic surplus and international negotiating power and, in incidentally, a low proportion of agricultural producers in the labour force; this is clearly not the case for Thailand. In addition, the model assumes a free market and that agricultural productivity will increase continually; this occurs where research and education support expansion, such as in Australia where agricultural productivity rises faster than most other sectors of the economy and thus can support an acceptable standard of living.

In Thailand, increases in agricultural productivity have not matched those of manufacturing and industry, creating a concentration of poverty around small-holder agriculture. The employment role of agriculture for more than 70 percent of the workforce, and its limited returns, introduce social policy imperatives which do not naturally arise from conventional models. Developing countries more commonly can fall back on the link between food production priorities to reduce a national food deficit, through such means as price setting which incidentally assists small-holders. Thailand, again does not fit this mould.

¹²⁴⁰ Klausner, W. J. (1997)

¹²⁴¹ Malcolm, B., Sale, P., and Egan, A. (1996)

Thai institutions ostensibly oriented to assisting small-holders have been constrained by the historical orientations of government and roles in garnering central monies, and by what recent analyses have considered predatory State behaviour. Inconstant policy choices have favoured minority objectives and reduced public accountability resulting in, for example, increased cassava grower poverty and relative reductions in educational access, which might otherwise have allowed informed bargaining with the State.¹²⁴² This institutional constraint has not been specifically addressed through aid financing organisations, and has been exacerbated by other economic conditions which impact on producers.

Thailand's small-holders are caught in a wider economic context which includes the factors of:

- an inferior international negotiating position in political and agricultural commodity price terms
- poor government regulation leading to potential for exploitation of less educated rural dwellers
- a history of taxing rural surpluses to support national, and particularly, urban programs with minimal social investment into agricultural areas
- a conceptual, knowledge, and empathic separation between central planning oriented more to the region and the world than to the hinterland
- industrialisation policies which favour foreign firms seeking low-cost skilled labour, with supporting government-related funds and finance
- assumptions that agriculture represents less than 20 percent of economic activity when the combined sector may comprise as more than 50 percent.

The link between agriculture and the Thai economy has been clear through the recent financial crisis;¹²⁴³ in such times it limits economic contraction, in other times, it funds growth.

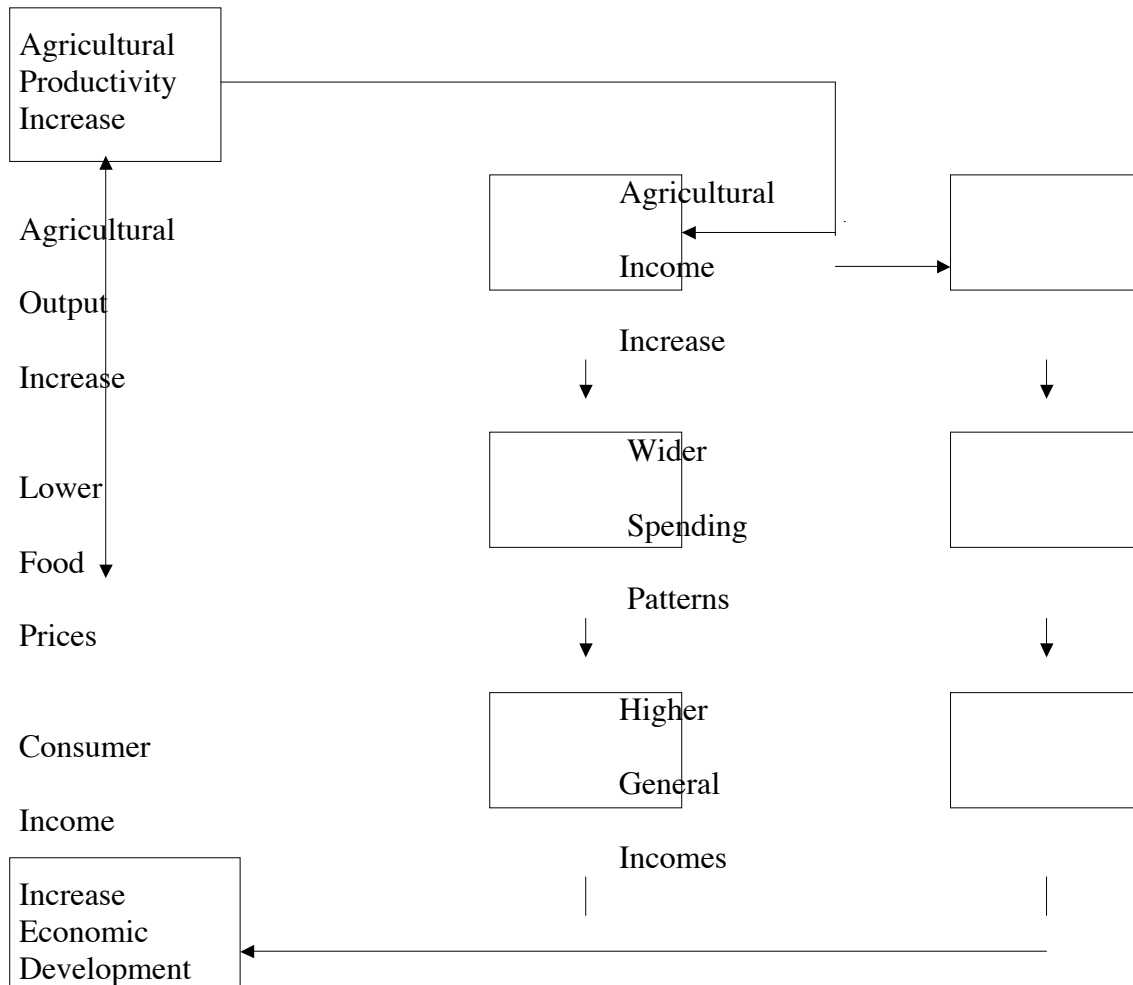
Agriculture and Growth

In creating growth, Thai agriculture has provided a rising range of goods that have benefited all, particularly the urban populace. The common path of development is based on agricultural surplus being invested in manufacturing, usually agro-industries, to create further surpluses for investment in other industries, with the increased national wealth so generated creating demand for manufactured products. This is the model of agriculture as the engine of economic growth (Figure 13.1).

¹²⁴² Sirirprachai, Somboon. (1998)

¹²⁴³ ADB (1999)

Figure 13.1 The Agricultural Engine of Economic Development¹²⁴⁴



Following from this agriculturally-created economic growth, the rising proportion of the work-force engaged in, and economic output of, the industrial sector, necessarily leads to a declining proportion of the work-force engaged in agriculture. Agriculture as a proportion of total value within the economy also declines while agricultural output per unit of labour in agriculture increases. In industrialised countries, the rate of change will be largely determined by the relative returns that can be received in the industrial, compared to the agricultural sector.

Assumptions of the past two decades, that a significant decline in the numbers engaged in agriculture in Thailand would be associated with rising employment in the manufacturing and industrial sectors, confirm adherence to the Western industrialised economic development model. This may yet prove to be valid, although the export orientation of Thai agriculture and agribusiness, and the high proportion of the population engaged in the sector, indicate that the change will be slow. Small-holder production systems, high

¹²⁴⁴ Falvey, L. (1996)

rural populations, urban policy biases, inequities in agricultural land ownership,¹²⁴⁵ and poor access to capital, among other factors have led to a higher relative rate of poverty in rural areas. Unlike Thailand, occurrence of such an outcome in an industrialised country is usually addressed through broad social welfare policies and continual increases in agricultural output efficiency; the dotted line in Figure 13.1 stresses the need for agricultural producers to benefit from national economic growth in a viable development model.

In industrialised countries such as the USA and Western Europe, domestic demand for agricultural products did not respond markedly to price changes in the agricultural sector. This outcome, caused by low price elasticities, high levels of competitive production, rapid technological change, and relative immobility of production resources in agriculture, produced declining net incomes in agriculture compared to industrial sectors. Expansion of an economy leads to a declining proportion of additional income being allocated to food and other agricultural commodities. The response in industrialised countries is one of rising technological innovation to increase efficiency of agricultural output, in order to allow producers to maintain income levels. This treadmill is accelerated by rises in agricultural production and oversupply, which in turn further drives down agricultural prices, leading to global competition for development, ownership, and application of innovations in agriculture.

Major agricultural nations such as Thailand require constant technological innovation in an age when their ownership limits access and necessitates high levels of research investment.¹²⁴⁶ Agronomic techniques, use of disease controlling organisms and varieties, continuous breed improvement strategies, market research, storage enhancement, as well as genetic modification of crops and a range of other outputs from high cost and high management-demand agricultural research programs, highlight imperatives for both government and private investment.

Farmers in industrialised countries may choose to remain in agriculture despite these pressures and declining incomes, either in response to lack of alternatives for their skills and the assets of their farms, or because of intangible benefits associated with a rural lifestyle, supported by social equity policies. However, increased output per unit of input allows maintenance or increases in commercial farmer incomes, as the total number of farmers declines. The industrialised country model for economic development and agriculture requires close government monitoring; an alternative is the recognition of the different rates of growth of the industrial and agriculture sectors, and increased public desire for perceived improvements in management of the natural environment, and hence direct subsidy of farmers by tax payers and consumers.

The option of subsidising farmers through price support requires even greater government skill. As adopted in the USA and Western Europe, this approach can stimulate surplus production with unfortunate consequences for other major agricultural

¹²⁴⁵ Feder, G., Onchan, Tongroj., and Hongladorom, Chira. (1987)

¹²⁴⁶ Malcolm, B., Sale, P., and Egan, A. (1996)

countries which operate on world market prices. Countries such as Thailand, may well be excluded from these and other high priced markets.

Where one country's volume of product does not significantly depress global prices, such a situation can be tolerated. However, if one country is the main supplier, and particularly if the commodity is its major agricultural product, as is the case of rice for Thailand, the full impact of being a global price taker with an inferior negotiating position may accrue to small-holders. In addition, government intervention the markets for rice, sugar, maize, and rubber have, at different times, caused small-holders to react in a manner unfavourable to their interests, and those of the country.¹²⁴⁷ The logical economic response suggested by the conventional model might be for large numbers of farmers to exit from the industry; however, such an option is not possible in Thailand where alternative forms of employment, once promised from an industrialising economy, have yet to develop.

The pattern of a declining proportion of national income and employment deriving from agriculture is common to wealthy nations, and is a major influence on economic approaches to agriculture and rural development. However, to suggest that Thai agriculture will decline in importance and that within one decade the 70 percent of the population associated with agricultural production will decline to 4 percent¹²⁴⁸ seems at best, unrealistic. Hence small-holders are of continuing critical importance to Thai agriculture, and the economy.

Small-holders as Family Farmers

Visions of a future Thai agriculture operated by agribusiness on large holdings applying ever new technologies appear to assume economies of scale in agriculture analogous with manufacturing processes. In fact, the majority of farms, even in industrialised countries, remain as family units employing minimal additional labour, because opportunities to reduce average costs by increasing the size and introducing job specialisation are few in the biological and human fields of farming. Sequential tasks that provide economies of scale in manufacturing are uncommon in agriculture beyond a farm size manageable by a family, except in industries with high levels of mechanisation, and in intensive agricultural industries.

Farm size is also limited by the levels of risk manageable within an enterprise. Debt servicing ability is affected by seasonal and market variations, with rising levels of borrowing incurring higher interest rates. Requirements of around 80 percent equity¹²⁴⁹ in a farm enterprise, to maintain viability in the cost-price conditions of unsubsidised agriculture, further calls into question some small-holder credit-based development strategies in Thailand.

¹²⁴⁷ Siamwalla, Ammar. and Setboonsarng, Suthad. (1989)

¹²⁴⁸ Bello, W., Cunningham, S. and Kheng Poh, L. (1998)

¹²⁴⁹ Malcolm, L.R., and Lloyd, A.G. (1996)

Contract farming has been assumed in some projections to be an interim stage to industrialised agriculture. Instances in the Chiang Mai valley, indicate that a diversified product base can encourage small-holders to enter into supply contracts in order to gain the requisite skills and contacts to also trade in the open market themselves. Variations occur according to the individual small-holder and crop type; for example, tomato and potato crops are tradeable in the local market and Japanese cucumber and hybrid maize seed are not, while contract vegetable soybean requires large uniform pods, rejects of which can be sold on the local market.¹²⁵⁰ Such contracts suit larger farmers in better areas. Small-holders in poorer areas may lack both the requisite initiative and investment for joining agribusiness, which itself will invest first in higher potential areas in terms of management, marketing, and productivity.

Small-holder farmers seek to avoid price and seasonal risks through farming systems which have evolved sophisticated management approaches viable under sometimes oppressive economic conditions. Thus, economic development models derived from the different conditions of industrialised countries are not necessarily the only viable approach for agriculture.¹²⁵¹ Small-holder farmers who tolerate the impact of their own poor decisions and the unforeseen circumstances may fail under policy environments which assume a level of formal education uncommon in rural Thailand. The first and major input for improvements in agriculture, whether following the modernisation path or one of self-sufficiency, remains improvement of the ability of small-holder farmers to access and use information.

The intensive care which a small-holder can invest in individual plants or animals contribute to the sustainability of the farming system. By contrast, industrialised agriculture, covering large areas through mechanisation, relies on judicious yet widespread use of chemicals which fuel concerns of environmental contamination and food safety. In a global agricultural trading economy, free market platitudes can easily be confounded by chemical residue levels in food products. However, the natural advantage of small-holders being able to use less chemicals to produce a quality product is not realised where high technology packages form a critical part of a national agricultural development strategy. Integrated pest management seeks to gain the benefits of both approaches, and provides a partial solution; another part is effective marketing investment.

In discussing small-holder agriculture, some analyses have focussed on small land holdings and the crops which are grown on them. A wider view acknowledges the integrated nature of small-holder farms and the impossibility of segregating crop from animal production from social well-being. Consideration of small-holder farming from the perspective of livestock in a total farming system provides a view of integration with cropping and social aspects.

Integrated Crops and Livestock

¹²⁵⁰ Wiboonpoone, Aree. Et al (1998)

¹²⁵¹ Berhman, J. R. (1967)

Small-holder production systems show low outputs of conventional items such as meat, fibre, and milk. For this reason, past development policies have assumed that output efficiencies can be improved by changing small-holder systems to intensive monocultural systems. That such approaches have been largely unsuccessful has been seen as a failure of government investment in technology transfer; in fact, the costs can be greater in terms of the loss of the real benefits of integrated small-holder agriculture, as can be illustrated in such industries as poultry. The use of by-products as feed, and multiple outputs such as draught and social functions, can be shown to exceed the production efficiencies of intensive animal mono-cultures. Likewise, improvement of small-holder systems need not rely on replacement by intensive production approaches; for example, rather than intensive Western dairy complexes, increases in milk production from working cows can be effected from feeding to meet nitrogen needs according to the cow's physiological state, work needs, and age.¹²⁵²

In the same way, the two to five buffalo per small-holder which graze rice straw and stubble and receive traditional medical attention, provide draught power, fertiliser for rice fields, clearing of stubbles, and weed control as an integral component of small-holder family life. The 40 million ton of rice straw and stubble available annually for bovine consumption¹²⁵³ otherwise contributes substantially to the annual Southeast Asian smoke haze.¹²⁵⁴ Nevertheless, mechanisation of irrigated agriculture under the Sixth and Seventh Plans¹²⁵⁵ led to a decrease in buffalo numbers by about 60 percent by 1999, as BAAC credit for two-wheeled tractors, engines, four-wheeled tractors, simple farm trucks, threshers, sprayers, water pumps, and mowers spread, even to rainfed where some buffalo were used in conjunction with two-wheeled tractors.¹²⁵⁶ Buffalo cows substituted for males and were valued above their cost,¹²⁵⁷ in reflection of the intangible benefits of integrated systems,¹²⁵⁸ which while common,¹²⁵⁹ have usually been undervalued in national planning analyses.

Small-holder chickens and pigs meet short term cash requirements while bovines can be long-term saving devices against crop failure and family emergencies. Traditional companionship between buffalo and small-holders, where buffalo are named instead of branded, where children spend school holidays playing with the family buffalo, and where farmers contemplate a trip in terms of their reluctance to entrust their buffalo to another's care, demonstrate the archetypal role of Thai buffalo, of which less than one percent are raised on ranches.¹²⁶⁰

Small-holders raise cattle as the preferred bovine meat associated with its loin cut size and marbling, which have been enhanced with Brahman and other cross-breeding.

¹²⁵² Zerbini and Wold (1999)

¹²⁵³ Chantalakhana, Charan (1993)

¹²⁵⁴ Kaosaard, Mingsarn and Rerkasam, Benjawan (1999)

¹²⁵⁵ Rijk, A.G. and van der Meer, C.L.J. (1984)

¹²⁵⁶ Bunyavetchewin, P., Singdid, S. and Chantalakhana, C. (1994)

¹²⁵⁷ Chantalakhana, Charan (1995)

¹²⁵⁸ Chantalakhana, Charan (1994)

¹²⁵⁹ Chantalakhana, Charan (1996)

¹²⁶⁰ Chantalakhana, Charan (1995)

However, small-holder risk perceptions¹²⁶¹ have led to low levels of technology uptake, with less than one percent adopting 18 of 24 simple available technologies, and with only one technology, traditional castration, being conducted by more than 50 percent.¹²⁶² Such observations can now be related to reconsideration of indigenous cattle,¹²⁶³ which have been subject to research biases which overlooked such advantages as early maturity and small size. Weighing less than 70 percent of, and maturing earlier than, crossbreds¹²⁶⁴ can allow indigenous breeds to show higher live weight production per hectare, and represent a more easily divisible asset which can produce a smaller whole steak for a rising market. Demand for meat and milk in less developed countries¹²⁶⁵ appears to offer small-holder systems with their labour and feed-base efficiencies, a prosperous future which can extend to marginal areas with appropriate research and policy development.¹²⁶⁶

Small-holder pigs are mainly imported breeds raised on rice bran, cooking refuse, and weeds. Being more closely linked to commercial production demonstrates the disadvantage of small-holders competing with agribusiness. Infectious diseases including Foot and Mouth Disease and hog cholera as well as internal parasites, require investment by small-holders who have limited access to either higher technology or full market price, and whom government programs appear to view as adjuncts of the commercial industry.¹²⁶⁷ By contrast, indigenous chickens attract a 30 to 50 percent market premium for taste and texture. The more than 120 million Thai village chicken flock which suffers high mortality from endemic infectious diseases each year, including Newcastle Disease and fowl cholera. Vaccination services cover less than ten percent of chickens which, from more than 50 eggs per bird per year and 80 percent hatchability and 80 percent chick survival, could have a much larger impact, even allowing semi-commercial production of native chickens instead of their replacement with high input imported breeds.¹²⁶⁸

Small-holder calving rates reportedly vary from 30 to 50 percent, calf mortality rates from 10 to 30 percent, and live weight gain from 100 gram to one kilogram per day, although records are often incorrect. Improvement of feed base, utilisation of by-products, new technologies, animal health services, use of appropriate bulls, and improved harnessing systems for draught and traction, can improve productivity substantially within small-holder systems.¹²⁶⁹ Uncommon success in the non-traditionally Thai industry of dairying has been attributed to its integration with small-holder practices. Colonies of small-holders use crossbred cattle, artificial insemination, forage crops, and supplementary feeding to produce fresh milk for increasing market demand.

¹²⁶¹ Jeamsinkul, Maneeratana. (1989)

¹²⁶² Chantalakhana, Charan (1990)

¹²⁶³ Ministry of Agriculture and Cooperatives (1999)

¹²⁶⁴ Yodseranee, S., Naphuket, S.R. and Oonyavong, R. (1963)

¹²⁶⁵ Delgado, C. et al (1999)

¹²⁶⁶ Vercoe, J., Coffey S., Farrell, D.J., Rutherford, A. and Winter, W.H. (1997)

¹²⁶⁷ Chantalakhana, Charan and Bunyavejchewin, Pakapun (1993)

¹²⁶⁸ Chantalakhana, Charan and Bunyavejchewin, Pakapun (1993)

¹²⁶⁹ Falvey, L. (1981)

Government has created an external environment for small-holder acceptance of risks¹²⁷⁰ while a milk drinking populace developed,¹²⁷¹ which has in turn improved child nutrition and stimulated imports of milk products,¹²⁷² while simultaneously assisting small-holders

The integration of livestock in small-holder agricultural systems provides an example for consideration in development plans. Other examples could be elicited such as mixed cropping to minimise the rainfall and price risks of monoculture, rice and fish systems which can also integrate with livestock to reduce fertiliser and feed requirements, and interplanting of green manure or forage crops in maturing rice fields to increase soil organic matter and reduce fertiliser needs. Some are attracting attention as alternative forms of agriculture, such as discussed later. Seeking viable means of enhancing integrated small-holder agriculture therefore cannot rely on spin-offs from industrial agricultural research; a specific research focus is required, such as now evident in Thai Research Fund programs.

Research and Development

Effective small-holder agricultural research and education will acknowledge integrated systems and the role of small-holders, when researchable technical parameters including cost-effective alternative development approaches,¹²⁷³ are being considered.

Small-holders system needs not met by simple importing of technology require local applied research initiatives. Their continued adequate funding relies on an understanding by national planners and analysts of the benefits of small-holder systems. These may be grouped as:

- potential for year round engagement of rural and peri-urban labor
- high levels of biological efficiency through utilisation of by-products
- risk minimisation through integrated diversification, which reduces government relief
- chemical fertiliser minimisation through farm-produced manure application
- maintaining rural populations *in situ*, with an adequate diet
- potential for integrated supply to commercial agriculture
- retention of national ruminant herds as multi-purpose work animals
- potential for development of new niche products and organic produce
- landless persons engaging in small-holder industries such as dairying
- maintaining Thai values which are easily subverted to market forces.

Treating small-holder agriculture as a phase to be transcended by industrial agriculture has led to rural adjustment programs that encourage small-holders migration to urban centres, while incidentally widening the rural and urban gap.¹²⁷⁴ Recent acknowledgment of small-holders as a continuing component of Thai society seems to owe as much to their new association with poverty and urban migration, as to wider understanding of

¹²⁷⁰ Chantalakhana, Charan (1995)

¹²⁷¹ Office of Agricultural Economics (1995)

¹²⁷² Chantalakhana, Charan (1995)

¹²⁷³ Cornell University (1999)

¹²⁷⁴ Ieosriwong, Nithi. (1993)

their economic contributions. Thus small-holder agriculture may well receive increased research attention as a significant component of domestic and export primary production.

Research needs extend beyond technical and economic considerations into social requirements. Social equity programs for small-holders are warranted as a result of low commodity prices partly caused by welfare payments to farmers in richer nations, historical biases in Thailand of investment to non-agricultural sector, and the need for greater access to basic government services. These have already stimulated policies to improve equity in land ownership, employment, education, and health care. Credit based programs which aim to improve small-holder well-being through increased agricultural incomes require favourable market environments before they can be effective, and enhanced rural employment opportunities may well be a required parallel program which allows small-holder choice in modes of income production from a farm residential base.¹²⁷⁵ Such realisations have stimulated consideration of alternatives to commercial agriculture.

Alternatives and Self-Sufficiency

Most so-called alternative approaches are merely an alternative to conceptions of conventional agricultural scientists. Small-holders have once known or practiced many of the techniques now popularly promulgated by concerned development specialists. Such techniques can produce higher yields from lower imported inputs in some circumstances,¹²⁷⁶ and thereby allow small-holder contributions to the commercial agricultural sector. In other cases, they can allow a higher quality of life in a self-sufficient production system. Most importantly, rational consideration of a broader context for improved agriculture, allows small-holders a greater choice. Choice, productive work, and access to social infrastructure are elements of rural investment which can contribute to real development and political stability in Thailand.

Alternatives to intensive commercial agriculture are discussed in terms of religious and social context and origins in the following chapter; a summary of some systems trialed in Thailand is introduced below as a context for current trends affecting Thai small-holder agriculture. Low input, ecologically considerate forms of food production¹²⁷⁷ which incorporate essential human values¹²⁷⁸ including self-reliance,¹²⁷⁹ and healthy lifestyles and diets, while providing the possibility of some income, have been imported in various forms to Thailand.¹²⁸⁰

The Fukuoka farming system, for example, which emphasises spiritual aspects in subsistence farming, failed in Thailand's tropical environment. Similarly, the Kyusei

¹²⁷⁵ Chaipon, Chaiwat. (1994)

¹²⁷⁶ Uphoff, N. and Fernades, E. (1999)

¹²⁷⁷ Schaller, N. (1993)

¹²⁷⁸ Beus, C.E. and Dunlap, R.E. (1990)

¹²⁷⁹ Pretty, J.N. (1995)

¹²⁸⁰ Udagawa, T. (1993)

Nature Farming system¹²⁸¹ which uses microbial inoculants to improve soil quality and plant growth was not adopted widely, probably for both cultural and technical reasons. Adoption of alternative agricultural approaches based on religious or spiritual objectives appears likely to be limited to adherents, such as the natural systems of the Santi Asoke sect.¹²⁸²

Permaculture¹²⁸³ remains poorly understood and difficult to distinguish from existing integrated Thai agriculture.¹²⁸⁴ On the other hand, an agri-aqua-culture system with modest chemical usage, has evolved to appeal to many Thai farmers and extension agents,¹²⁸⁵ as has the idea organic farming. Organic farming requires sound managerial and marketing skills, and access to capital, which has to date limited adoption in Thailand compared to, for example, Japan.¹²⁸⁶

A system of producing for the family without major external inputs while adhering to what are seen as Thai and Buddhist values, has become known in Thailand as self-sufficiency.¹²⁸⁷ Buddhist principles within a global ethic¹²⁸⁸ are invoked to re-join man and nature¹²⁸⁹ in contrast with selfish commercial behaviour at both individual and institutional levels.¹²⁹⁰ Balancing material with social and spiritual needs¹²⁹¹ within an environmental context, goals of peaceful coexistence¹²⁹² and national security are linked to historical religious principles of governance, implicitly including the doctrine that 'the whole realm dwells in happiness if the King lives aright'.¹²⁹³ Among the unique aspects of Thai agriculture is the incomparably wise influence of His Majesty the King,¹²⁹⁴ who has evoked an ethic of self sufficiency for all, not only small farmers.

Within the embracing philosophy of self sufficiency, a rural component is expressed in terms of recommended land use for a small family farm. Cooperative action in collective bargaining, sharing of capital items, and negotiation with outside parties including government officials and commercial interests,¹²⁹⁵ forms part of the approach. Building on statements of His Majesty the King that participatory forestry as the only viable means of reforestation in populated areas,¹²⁹⁶ the forgotten social aspects of agriculture are given prominence. A continuing concern of the approach is attitudes within the civil service and agri-business.

¹²⁸¹ Matsumoto, Y. (1993)

¹²⁸² Wasi, Prawase (1988)

¹²⁸³ Mollison, B. (1988)

¹²⁸⁴ Sheng-ji, Pei (1985)

¹²⁸⁵ Wetchaguran, K. (1980)

¹²⁸⁶ IRRI (1992)

¹²⁸⁷ Wasi, Prawase (1990)

¹²⁸⁸ Nakasone, Y (1985)

¹²⁸⁹ Sakharin, Rapee (1998)

¹²⁹⁰ Sakharin, Rapee (1997)

¹²⁹¹ Wichiarajote, Puntape (Weerayudh) (1998)

¹²⁹² Wasi, Prawase (1998)

¹²⁹³ *Digha Nikaya* Volume 3:85

¹²⁹⁴ Board of the Royal Projects (1999)

¹²⁹⁵ Board of the Royal Projects (1999)

¹²⁹⁶ Adulyadej, Bhumibol. (1997)

Self sufficiency has always been a theme of Thai agriculture at small-holder level, and is likely to remain so. In its present conception as a means of re-educating the whole society, it may receive a higher funding profile through social equity programs. As a whole-life philosophy, it retains eternal appeal. Within agriculture *per se*, it not only provides an timely message, it allows sensible consideration of traditional and small-holder agricultural practices. In a materialistic era, such a message can be under-valued unless its adherents can also indicate wider benefits, as is being attempted in 1999 Thailand. Coincident with a growing global appreciation of small-holder solutions for commercial agricultural problems, this link between Thailand's two agricultures can work against further marginalisation of small-holder farmers.

De-marginalising Small-holder Agriculture

Small-holder agriculture is easily assumed to be a low technology and inferior form of production to which the attendant biases against physical labour accrue, in contrast to the modern commercial agriculture sector with its separate business vocabulary. For Thailand, the two types of agriculture may well persist, with a rising respect for self-sufficiency¹²⁹⁷ as international interest widens in scientific interpretation of the hitherto denied benefits of alternatives.¹²⁹⁸

Incipient adoption of a modern 'scientific' worldview¹²⁹⁹ emanating from the West has encouraged an association between quality of life and consumable goods, and that all problems, including those of health and the environment, have technical solutions. Small-holders and their actions and language are thus seen as primitive. The Thai word for agriculture *kaset*, recalls its Indic derivation from the Sanskrit and Pali of words for plough work *krsi*, and even modern imports of Latin derived terms of agriculture, such as *ager*, now connote manual field work. Such associations contribute to the inferior status accorded those engaged in the sector including government officials.¹³⁰⁰ Thus all production agriculturists is marginalised, especially small-holders.

Well-intentioned research and development activities have tacitly assumed that the agriculture of the more developed world contains the essence for global agricultural improvement. The successful green revolution¹³⁰¹ relied on improvements of yields through, for example, plant breeding which had conferred such benefits in more developed countries. However, small integrated farmers do not rely on the production of one commodity, even rice; they depend on, among other actions, the integration of backyard gardens, fish in rice paddies, shade and orchard trees, and livestock in an overall production system. Improving the output of one component in such systems requires compensation for any consequent losses from the total system. For this reason,

¹²⁹⁷ Board of the Royal Projects (1999)

¹²⁹⁸ Cornell University (1999)

¹²⁹⁹ Stace, W.T. (1952)

¹³⁰⁰ Uphoff, N. and Fernandes, E. (1999)

¹³⁰¹ CGIAR (2000)

high yielding cereals with high grain to stalk ratios were not universally popular¹³⁰² where small-holders relied on straw as livestock feed, water conserving mulch in gardens, and for other domestic purposes. Small-holders in marginal areas are easily further marginalised by generic recommendations of such apparently superior technologies.

Single crop research can also inadvertently add to small-holder and environmental challenges as externalities such as declining watershed viability impact. Agro-ecological approaches advocated by latter-day green revolutionaries¹³⁰³ may thus evolve to an 'agro-socio-ecological approach'. The scientific method requires such criticism of the green revolution as a vital continuous questioning which leads to new knowledge; thus, rather than a belittling of the coordinated international intellectual effort which devised means of feeding millions otherwise destined to starve, current criticism may be used as a constructive input to current research. Science relies on such constant cognitive re-orientations; perhaps one example may yet be a return to small-holder practices of early transplanting and wide spacing to stimulate tiller and roots growth and hence grain production sites and nutrient uptake per plant in areas suited to hand harvesting.¹³⁰⁴

Intensive monoculture substitutes capital, through tractors and chemicals, for labour, producing images of efficient modern agriculture with tidy symmetric vistas which contrast with the apparently unplanned mix of enterprises on an integrated small farm. Clean, ploughed US corn fields for example, became a benchmark which the mulch-strewn plots of Thai small-holders failed to meet, even though they may represent a biologically, environmentally, and agriculturally more efficient system¹³⁰⁵ which can offer technologies to improve commercial systems.¹³⁰⁶ The beginnings of this meeting of small-holder practices and commercial agriculture may be seen in modern corn harvesters which chop stalks, husks, and cobs as mulch, and the re-discovery of 'conservation tillage'.¹³⁰⁷ Demarginalising of small-holders might occur if the source of such research outcomes were fully attributed.

Integrated pest management practices, organic fertiliser, prescriptive chemical fertiliser application, root to plant biomass ratios, and improved water use are seen as new scientific insights that can further enhance commercial agriculture, yet each has its antecedents in the type of agriculture practiced by small-holders. These farmers have long known or simply assumed; that hand removal of undesirable insects and judicious use of insecticides is more effective and cheaper, that manure and plant residues enhance fertility and soil structure, that wider spacing of plants increases the yield of individual plants, and that watering and concentrated fertilisers should be oriented to the needs of individual plants. So, the link between small-holders and commercial agriculture, rather than an assumption of a superior-inferior relationship, can assist in demarginalising small-holders.

¹³⁰² Lund, S. and Fafchamps, M. (1997)

¹³⁰³ Altieri, M. (1995)

¹³⁰⁴ Uphoff, N. and Fernandes, E. (1999)

¹³⁰⁵ Steiner, K. (1996)

¹³⁰⁶ O'Connell, P. (1999)

¹³⁰⁷ Avery, D. and Avery, A. (1996)

In areas with poorer natural resource endowments, higher population densities, and inferior support services, such as sections of the Northeast, the primary development consideration after social equity is the ensuring of livelihoods. Hence, self-sufficiency, and sensitive improvement of small-holder practices where possible, constitute the main approaches to small-holder development. This relies on active engagement of small-holders in research and project planning in a manner which can be edifying and humbling to the development expert,¹³⁰⁸ and help retain the interest of young people in rural communities and perhaps arrest their emigration.¹³⁰⁹

The role of small-holders in Thai agriculture appears secure, with sensible self-sufficient approaches providing not only release from inappropriate economic forces, but also a focus for research based on a two way respect of knowledge flow. That small-holder farmers continue to exist in more developed countries, often as a matter of personal choice where financial returns are not the overriding objective, should cause pause in any policy makers who seek to commercialise all aspects of Thai agriculture. Small-holders provide a cultural and traditional harbour for Thai agriculture and society as it struggles to accommodate foreign values that compromise perceptions of religious and cultural norms; these matters are discussed in the following chapter.

Summary

Key points pertinent to Thai agriculture which arise from the discussion of small-holders include:

- Small-holders underpin the economy through exported and domestic product, supporting their 70 percent of the population, without government welfare, from agriculture as largest form of employment, although unique social needs of a middle-income, major agricultural exporting country which is unlikely to rapidly industrialise continue to require redressing.
- As the engine of economic growth, family farming cannot be viewed as a phase toward industrial agriculture, especially when the global efficiency of such systems is high if debt is low, and innovation, supported by education and research, allows continual increases in efficiency, which can frequently exceed those of industry.
- Intensive small-holder agriculture permits production of high quality produce, efficient use of by- and waste-products in integrated systems, and maintenance of cultural values which may be periodically recalled by urban society, although in need of an ennobling of views of agricultural production activities and lifestyle.

¹³⁰⁸ Merrill-Sands, D. and Collion, M. (1995)

¹³⁰⁹ Uphoff, N., Esman, M and Krishna, A. (1998)

Chapter 14

Agriculture, Environment, and Values

The origins of Thai agriculture and environmental management, and socio-cultural aspects of both commercial and small-holder agriculture described in the preceding chapters provide a context for a discussion of traditional agriculture and the evident link between rural poverty and environmental decline.¹³¹⁰ While the private sector may assist sustainable agriculture,¹³¹¹ policy-maker attitudes toward marginal poor small-holders will now need to consider enduring human values. This broad subject is approached in a hierarchical and integrated manner, perhaps contentious in its implications.

The chapter differs from others in being highly synoptic, as indicated by many paragraphs containing several references that each draw on hundreds of pages of others' thoughts. Conceptually, the chapter follows the book's theme of an evolution of Thai agriculture from environmental and social perspectives. Thus the progressive globalisation of agriculture is discussed through global food requirements and their inevitable impact on the natural environment, and the globalisation of economies and values, experienced in Thailand's case through international development practice. Deficiencies of the economic development model resulting from partial adoption of the underpinning essentials of development have accrued as costs to Thailand, in turn stimulating the domestic intelligencia to debate moral values ascribed to tradition and religion, which has produced embryonic practical outcomes in self-sufficient agriculture.

Global Agriculture and Environment

Thai agriculture has significantly changed the natural environment as one part of global food production. As a major agricultural exporter, further modification of the natural environment is likely, even with improved resource regulations and environmental research and education. Romantic views of environmentally sensitive traditional forms of agriculture must ultimately acknowledge the realities of a higher global population density. Reliance on export income has irreversibly made Thailand part of this global culture, which relies as much on over-production as over-consumption among the wealthy of the world. Stability gained through appeasement of the urban elite has allowed an increasing gap between urban and rural persons. Current debates acknowledge Thailand's global position, as well as international views on environmental care, and the redefinition of agriculture as a social sector involving the majority of the population. The environmental context for Thai agriculture is thus both affected both by global influences and Thai culture.

Thai culture instils a respect for authority which can enhance dissemination of embracing environmental views, as is clearly personified in His Majesty the King. Likewise, spiritual insights are probably more acceptable to a older Thai world-view than to a

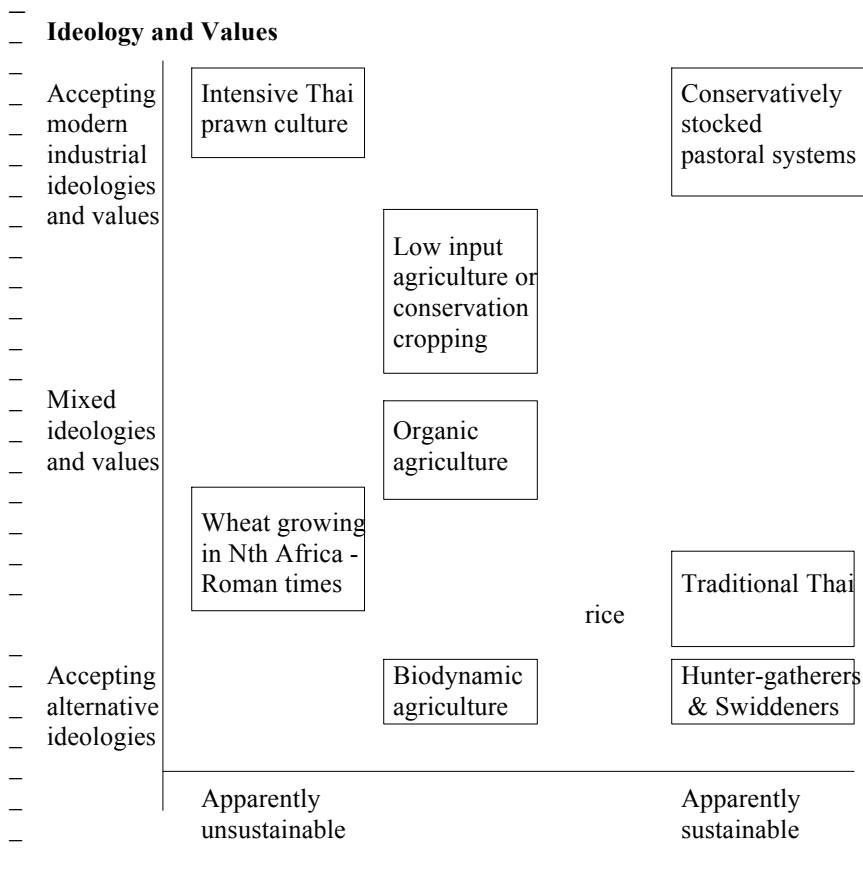
¹³¹⁰ CGIAR (1999)

¹³¹¹ FAO (1996)

wholly materialist view.¹³¹² Yet mystics and scientists share views often overlooked in technical solution-oriented cultures.¹³¹³ Scientists seek knowledge and probably share an awe and reverence for the universe, partly expressed as care for the environment.¹³¹⁴ However, popular quasi-religious replacement of scientists for lost superstitions¹³¹⁵ produces such fallacious beliefs as knowledge being sufficient to produce future global food requirements from chemical-free farming. Sustainable food and fibre production has long required new technologies and ideas,¹³¹⁶ and these have long transcended individual cultures.

Sustaining productivity is a responsibility beyond agricultural planners or any one group, involving moral values concerning natural resources and their care on behalf of future generations.¹³¹⁷ Ideally, an environmentally educated populace could allow individuals to arrive at informed view;¹³¹⁸ however, in Thailand, polarised opinions can raise environmental issues without prior analysis.

Figure 14.2 Map of Agricultural Systems by Sustainability and Ideology



¹³¹² Capra, F (1991)

¹³¹³ Stace, W.T. (1952)

¹³¹⁴ Knudtson, P. and Suzuki D. (1992).

¹³¹⁵ Stace, W.T. (1952)

¹³¹⁶ Rostow, W. W. (1987)

¹³¹⁷ NZNHF (1995)

¹³¹⁸ Falvey, L. (1996)

Sustainability

Likely perceptions, derived from elsewhere,¹³¹⁹ of the probable sustainability of an agricultural system, (Figure 14.1) indicate that low input wet rice culture may be considered more sustainable than other modern intensive cropping systems. Thailand's lower input system compared to its exporting competitors suggests higher levels of sustainability. Informed education in the principles of natural resource management¹³²⁰ already requires a higher scientific input in Thailand. Wealth from Thai wet rice produced today's dominance by a city society, which is now separated from the past society-wide ethic of land management and ignorant of the environmental approaches of informed farmers. Agriculture is critical to the materialistic development of Thailand and to feeding the world, and in common with all agriculture, significantly changes the natural environment.

State of the Thai Environment

Ecological modification in Thailand has followed the usual trends of; genetic manipulation of plants and animals to suit an environment, modification of the environment through such mechanisms as greenhouses, and persistent interventions through management techniques as simple as ploughing. Modernisation of Thai agriculture has led to a research, education, and extension system which outwardly mimics effective systems of countries in which there is now active care for environment. However, just as current institutions struggle to meet today's needs, so today's concerns represent only a partial awareness of the impact of human actions on the Thai environment. Some examples from rice agriculture, soil degradation, chemical and water use, dams, forest encroachment, and biodiversity serve to introduce the need for informed Thai understanding of agriculture and the environment.

Ancient rice breeding and modification of environment to favour wet rice is one of the world's significant human environmental interventions, probably of greater impact than present day issues. Nevertheless, intelligent consideration of such recent impacts as; soil degradation, chemical contamination, dams, forest destruction, aquatic plants and animals, Green House Gas emissions, and reductions in biodiversity is essential to ongoing improvements to agriculture. Intensification of Thai agriculture has degraded soils such that, by 1990, 27 percent were very seriously eroded, 29 percent severely eroded, and 18 percent moderately eroded, with salinity, organic matter loss, and structural changes rising in incidence.¹³²¹ Local rice varieties have reduced from several thousand to a few hundred planted by less than five percent of farmers¹³²² while fertiliser and pesticide use have increased¹³²³ without environmental or health regulatory controls.¹³²⁴ Loss of indigenous agricultural practices¹³²⁵ with adoption of credit-based

¹³¹⁹ Reeve, I. (1992)

¹³²⁰ Falvey, L. (1995)

¹³²¹ Trebuil, G. (1995)

¹³²² Choice, W. (1995)

¹³²³ Siamwalla, Ammar (1992)

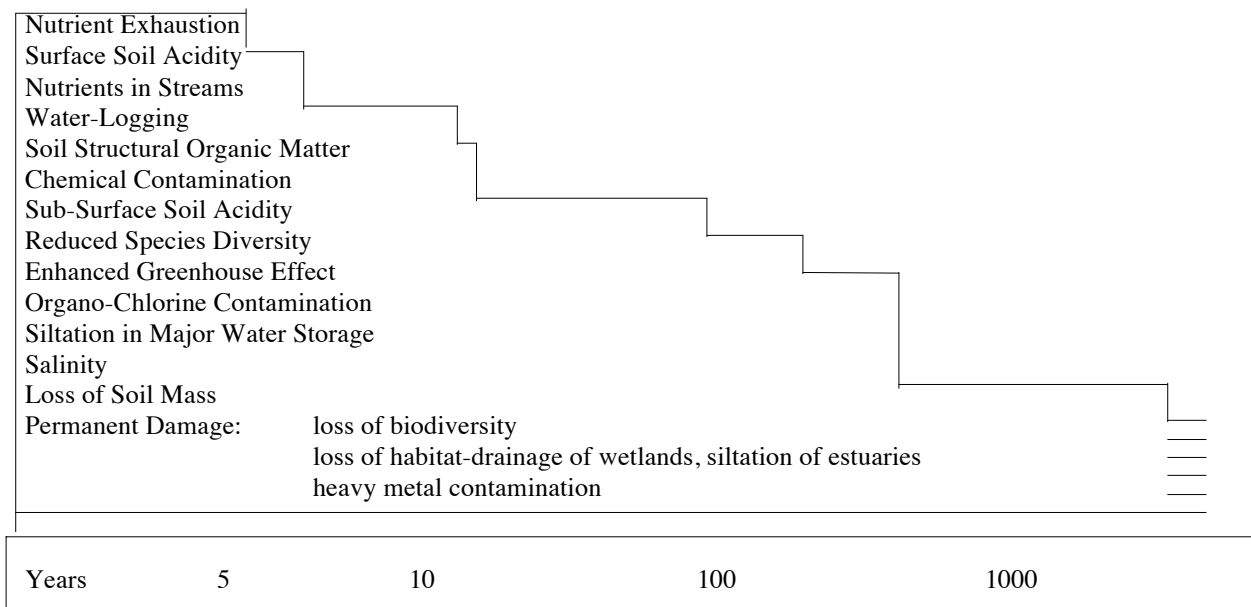
¹³²⁴ AAF (1992)

¹³²⁵ Lucas, B. and de Buque, T.L. (1993)

cash cropping has been extended to situations where a self-reliant agriculture would have been more suitable.¹³²⁶ Northern Thailand, once faunally diverse and abundant is now said to be a near faunal desert.¹³²⁷ Each of these examples is but a symptom of a deeper complacency which flows through agricultural expansionism.

Expansion of agriculture through opening new lands can now only access marginal and fragile soils, including steep, shallow and skeletal soils, with limited nutrients and moisture. Fertile, deep, relatively flat, well-drained soils of high natural organic matter¹³²⁸ have been degraded, and regeneration will be according to biological or geological time frames, (Figure 14.2) their sometimes faster apparent regeneration in the tropics belying their higher fragility to mismanagement.

Figure 14.2 - Restoration Periods for Various Forms of Soil Degradation¹³²⁹



Chemical herbicides utilised in Thai agriculture are of rising public concern; while residues are a trade and health issue, contamination of soil and water is the primary environmental impact. Extrapolating from other environments, seven of ten commonly used chemicals presently critical to food production systems will be found moving through Thailand's soil and water. Volatile organic chemicals such as pesticides are suspected of being transported through the atmosphere¹³³⁰ and, in USA agriculture, atrazine has been confirmed¹³³¹ in rainfall.¹³³²

¹³²⁶ Pretty, J.N. (1995)

¹³²⁷ Dearden, P. (1995)

¹³²⁸ IFAP (1991)

¹³²⁹ Roberts, B (1995)

¹³³⁰ Atlas, V. and Giam, C.S. (1988)

¹³³¹ Nations, B. K. and Hallberg, G. R. (1992)

¹³³² Hatfield, J L and Karlen, D L (1993)

Water use and availability problems in Thailand are widely under-estimated and require resource pricing to stimulate sensible use and adoption of appropriate techniques. Thai farmers till wet paddies to facilitate transplanting of seedlings, and to assist land levelling, ploughing of weeds and stubble, and soil conditions for plant growth. Some irrigated cracking soils can lose up to 60 percent of water to permeable subsoils, yet simple post-harvest tilling can fill cracks and reduce both irrigation and chemical needs.¹³³³ As rice is expected to feed more than half of the world's population over the next thirty years through yield increases of more than 40 percent, the world's largest rice exporter should be at the forefront of such water saving techniques as:¹³³⁴

- wet seeding - pre-germination of seeds by soaking for 24 hours prior to being direct sown onto muddied fields
- intermittent irrigation - rather than constant flooding, irrigation is applied only when soil has nearly dried out, on a continuing basis until harvest
- land levelling - eliminating land depressions which require additional water
- weed management - flooding fields to suppress weeds before planting can be replaced by alternative cultural, mechanical or chemical means
- management of cracked soils - straw mulching and shallow surface tillage during the fallow period reduces subsoil and lateral water losses.

Water storage proposals with Thailand's neighbours suggest an orientation to current practices; Laos has supplied Thai electricity since 1970 and Thailand continues to lobby for additional capacity. Proposals also include: a dam on the upper Salween River with the Myanmar government; diversion of waters from the lower Salween into the northern Thailand river Mae Taeng; and the larger scale Pa Mon Dam project on the Mekong River with an eight dam cascade, or diversion of Mekong River waters to hydro-electric generating facilities in Thailand.¹³³⁵ More than 20,000 square kilometres of forest lost to dams since 1960,¹³³⁶ illegal logging conflicts,¹³³⁷ underestimates of silt loads, filling rates, evaporation rates, urban and rural water conflicts,¹³³⁸ and reduced fish catches,¹³³⁹ have yet to fully accounted in these proposals.

Rubber plantations in the South are a form of reforestation, which like other monocultures, support low levels of bio-diversity; by 1986, some 35 percent of rubber was within designated native forest areas.¹³⁴⁰ Likewise, oil palms were expanded by government provisions for private leasing of degraded forests. The extensive mangrove forests degraded in recent decades by pollution, logging, and fishing, have been decimated by conversion to prawn farms. Over the period 1961 to 1992 mangrove areas

¹³³³ IRR (1995)

¹³³⁴ IRR (1999)

¹³³⁵ Bello, W., Cunningham, S. and Kheng Poh, L. (1998)

¹³³⁶ Hubbel, D. (1992)

¹³³⁷ MIDAS (1991)

¹³³⁸ Sukkarnert, Decharat (1998)

¹³³⁹ Roberts, T. (1996)

¹³⁴⁰ MIDAS (1991)

declined from 2.3 to 1.1 million rai; an estimated 90 percent of mangrove wood was processed into high grade charcoal.¹³⁴¹

Prawn aquaculture exemplifies technology exceeding ecosystem management ability. In addition to mangrove destruction, chemical treatment to extend pond life inhibits organisms which consume residual feeds and wastes, allowing nutrients to accumulate until algal blooms occur and consume available oxygen. Ponds abandoned for new mangrove areas are constituting a form of shifting aqua-cultivation;¹³⁴² costs are only beginning to be estimated.¹³⁴³ Agribusiness in the white paper and sugar industries have also polluted unnecessarily with dioxin and molasses releases respectively into the Phong River near Khon Kaen, apparently without contravening existing regulations¹³⁴⁴

Destruction of Thailand's forests, rice cultivation, and ruminant husbandry are said to contribute to regional CO₂ and CO levels,¹³⁴⁵ although the main sources of such greenhouse gases (GHG) are the highly industrialised countries. Thailand produces less than one percent of global GHG emissions, which could be reduced through known technological innovations for rice¹³⁴⁶ and ruminants.¹³⁴⁷ Current reliance on a narrow gene pool in Thai agriculture is a risk in itself¹³⁴⁸ as such reduced biodiversity creates vulnerability to climate changes, and reduced wild gene pools which limits ready genetic modification of major food crops. Of the some 300,000 plant species, between 10,000 and 50,000 may be edible, and 5,000 are used as human food; yet only three species, rice, wheat, and maize provide almost 60 percent of the global human diet. Within these species, breeding has eroded their genetic composition and hence their adaptability to new environments.¹³⁴⁹ A casualty of modern Thai agriculture,¹³⁵⁰ biodiversity cannot be recreated on demand as suggested by some suggest¹³⁵¹ as current knowledge of future genetic needs is limited and assumptions of omniscient and responsible social behaviour have always proved false.

As the issue is global, Thailand's consideration of solutions must include:

- the consequences of importing short term economic solutions to agriculture without adequate controls as used in the country of origin of technologies
- whether development to a level similar to, for example, Singapore, is possible in the Thai culture with a large and poor rural population producing raw materials for technologically more advanced countries
- the viability of relying on research concentrated in more developed countries and oriented more to agribusiness than to the economies of subsistence,

¹³⁴¹ Jitsanguan, Thanwa (1993)

¹³⁴² Weber, M.L. (1996)

¹³⁴³ Jitsanguan, Thanwa. (2000)

¹³⁴⁴ Bello, W., Cunningham, S. and Kheng Poh, L. (1998)

¹³⁴⁵ Arrhenius, E and Waltz, T U (1990)

¹³⁴⁶ IRRI (1995)

¹³⁴⁷ Gibbs, M.J. and Lewis, L. (1989)

¹³⁴⁸ Rosenberg, N. and Scott, M. (1993)

¹³⁴⁹ Tribe, D. (1994)

¹³⁵⁰ Srivastava, J., Smith, N J H and Forno, D.(1995)

¹³⁵¹ Huber, P (1992)

- the applicability of research that is concentrated on developing know-how for tomorrow while Thailand has not yet integrated present technologies;
- the effect of technology imports in inhibiting the development of local technology.

Emotive environmental discussions cloud balanced consideration of human needs and environmental tolerance, even when changed environments do not suit modern sensitivities. For example, objections to programs supporting agribusiness plantations of *Eucalyptus* at the expense of small-holder forest access have invoked environmental arguments reminiscent of medieval England superstitions in agriculture.¹³⁵² Rational discussion is thus difficult although an opportunity for informed and responsible academics continues to exist. Just as rice culture dramatically changed the natural environment, so new tree species will lead to change. Subverting social equity and rural development to a quasi-environmental issue has reduced government and agribusiness focus on both social and environmental responsibilities. Such Western-influenced environmental interest should widen to an understanding of related social equity views, which will inevitably cause some consideration of the shifts in Thai attitudes to the environment, and global forces on these in recent times.

Tracing Thai Attitudinal Shifts

Attitudes to peasants and the environment are influenced by commerce; in Thai agriculture, foreign contact and goods from the early export markets of Ayutthaya, marked the beginning of a shift from traditional Tai cultural values. Ayutthayan skill in creating effective institutions allowed domination of other Kingdoms; one of these institutions, the predecessor of the Ministry of Agriculture and Cooperatives, oversaw contentious issues affecting Crown revenue raising from agriculture. By the early Bangkok period, the *Krom Na* formed one of seven key ministries¹³⁵³ which separated worldly-wise aristocrats from peasants, who thus became *de facto* repositories of traditional environmental and other values.

Values of peasant self-sufficiency began to shift toward commercial production under King Chulalongkorn's modernisation,¹³⁵⁴ although adherence to traditions by semi-subsistence small-holders remained significant through to the 1970s. Traditions also subtly shifted through the social mobility offered by monkhood education which linked aristocrats and peasants while supporting social stability¹³⁵⁵ and conveying basic Buddhist values of right livelihood and reverence for life. Adoption of Western schooling from about 1900¹³⁵⁶ initially included a religious ethic but soon was oriented to the foreign skills which proved more personally rewarding in the expanding and prestigious civil service. Thus environmental traditions in education from pre-Buddhist times were blended with Buddhist values which in turn were subjugated to Western influences at central level.

¹³⁵² Huber, P.W. (1993)

¹³⁵³ Wyatt, D.K. (1968)

¹³⁵⁴ Dilokvidhyarat, Lae (1995)

¹³⁵⁵ Wyatt, D.K. (1966)

¹³⁵⁶ Wyatt, D.K. (1975)

Increased demand for practical skills produced vocational training as an antecedent to modern education, with token links to religious values. Agricultural education, emerging with the 1900s modernisation, expanded rapidly in the 1940s and adopted a production orientation which has, globally, strayed from its philosophical and moral foundations.¹³⁵⁷ Education in Thailand can thus be seen as both an indicator, and a product, of shifts in cultural attitudes. The influence of Western education and associated economic forces of recent decades has forced Thailand to conform with global developments, which had a differing underlying approach to environmental management.

Global Development Forces

Global economic development has been assumed in policies of international development agencies¹³⁵⁸ with environmental matters added after experience with narrowly based programs. Global commercial networks¹³⁵⁹ have suited Thailand's modernisation objectives,¹³⁶⁰ allowing dominant trans-national and national agro-food complexes¹³⁶¹ to determine commercial production systems in concert with structural adjustment policies of the 1980s.¹³⁶² Mobility of capital renders reliance on this system risky; for example, contract growing can link small-holders to global price variations while exposing them to risks of transnational relocation of investments.¹³⁶³ A tendency towards over-production which reduces prices, while theoretically not an output of efficient systems,¹³⁶⁴ introduces further price and market risks.

Small-holders, the majority of Thai farmers, have long been lobbied through extension promises; a current one is sustainability. New ideologies, justifications for unsustainable practices such shrimp aquaculture, and renewal of Thai Buddhist principles, have all used this new catch cry.¹³⁶⁵ The concept originated from good intent¹³⁶⁶ to balance Keynesian economics with social welfare, and continues to assume that the Western capitalist model is reproducible.¹³⁶⁷ As small-holders have become a distant and uninformed component of a global trading system, their traditional environmental practices have been replaced by so-called Western attitudes of nature domination.¹³⁶⁸

Rather than Western or any society developing nature exploitation ethic, it originated as a by-product of political development in post-agrarian societies.¹³⁶⁹ Emergence from

¹³⁵⁷ Falvey, L. (1996)

¹³⁵⁸ Biot et al (1995)

¹³⁵⁹ Mikesell (1992)

¹³⁶⁰ Reus-Smit (1996)

¹³⁶¹ Bonanno (1991)

¹³⁶² Reed (1992)

¹³⁶³ Mikesell (1992)

¹³⁶⁴ Jacobs (1991)

¹³⁶⁵ Payutto, P.A. (Phra Thamtidok) (1995)

¹³⁶⁶ WCED (1987)

¹³⁶⁷ McMichael (1996)

¹³⁶⁸ Murphy (1994)

¹³⁶⁹ Kuper and Kuper (1985)

feudal societies allowed individuals to become intellectual and economic entities which incidentally allowed a separation of socio-cultural matters from the natural environment.¹³⁷⁰ In place of superstitions, science and economics evolved into such ideologies as fundamental ecology¹³⁷¹ and related political thought¹³⁷², albeit it with some questioning of the approach.¹³⁷³

Concurrent emergence of regional markets does not appear to have arisen from simple aggregation of local systems; rather, it was probably a system imposed by dominant entrepreneurs, eventually covering most of the globe.¹³⁷⁴ Success of the free market approach separated economic from environmental interests,¹³⁷⁵ effectively downgrading environmental concern¹³⁷⁶ as a matter of social choice¹³⁷⁷ which money and skilled technologists¹³⁷⁸ could address at any time in regulated systems.¹³⁷⁹ However, the separation of individuals from their natural environment stimulated neo-Marxist emphasis on responsibility in ecological management¹³⁸⁰ which evoked views that society may have evolved through householder resource-sharing prior to transformation by market mechanisms.¹³⁸¹ These differing views led to central economic planning in systems upholding individual freedom supported by curbing of human excesses through education of the whole society.

Failures to balance long and short terms societal needs is manifested in environmental decline¹³⁸² and its treatment as a technological problem, which supports a belief in continuous economic development, in Thailand's case through intensification of agriculture.¹³⁸³ Application of Western development theory beginning with the US Marshall Plan successes in post-World War II Europe,¹³⁸⁴ used State economic planning,¹³⁸⁵ which assumed adequate education levels, rule of law, and codification of moral values; as each was subsequently found to differ between countries, interest in the social values of specific cultures arose.¹³⁸⁶ The evident social and environmental costs then caused development specialists to reconsider the simple Western model through emotive analysis which produced often impractical social and individual choice models,¹³⁸⁷ and worthwhile commitments to basic human values.¹³⁸⁸ The early intuitive

¹³⁷⁰ Murphy (1994)

¹³⁷¹ Naess (1989)

¹³⁷² Merchant (1982)

¹³⁷³ Shiva (1990)

¹³⁷⁴ Friedland and Robertson (1990)

¹³⁷⁵ Redclift and Woodgate (1994)

¹³⁷⁶ Dryzek (1987)

¹³⁷⁷ Smith (1986)

¹³⁷⁸ Pearce et al (1990)

¹³⁷⁹ Smith (1986)

¹³⁸⁰ O'Connor (1994)

¹³⁸¹ Polanyi (1957)

¹³⁸² Murphy (1994)

¹³⁸³ Mol and Spaargaren (1993)

¹³⁸⁴ Falvey, L. (1994)

¹³⁸⁵ Leys (1996)

¹³⁸⁶ Leake, J.E. (2000)

¹³⁸⁷ Serageldin, I. (1996)

link between development projects and local requirements¹³⁸⁹ was thus shown to be appropriate in the resulting two-tiered development approach where the first tier concerned national structural adjustment including legislation,¹³⁹⁰ and the second aimed at specific local needs.

The Asian crisis highlighted the forgotten assumption of adequate governance, thereby completing the circle of social-economic factors long earlier been defined by Adam Smith.¹³⁹¹ Sustainable development may therefore be conceived as a recollection of past insights into human behaviour and experience in international development. However, an entrenched technological orientation focussed on understanding the limits of sustainability,¹³⁹² and exaggerated claims of the superiority 'sustainability' of a technology undermined the credibility of technologists. The truth is that, in Thailand as elsewhere, little is known of the relative sustainability of intensive agricultural practices. Sustained rice production across millennia does not indicate the sustainability of modern rice systems, and both the Thai economy and projected world food consumption¹³⁹³ rely on these modern systems.

Agricultural exporters are affected by global forces¹³⁹⁴ which themselves encourage sustainable practices. Transnational companies can no longer expect to exploit one area and move to another with impunity. International development agencies can no longer plan projects in isolation from related developments globally, and national planners can no longer ignore legal, social equity, and environmental needs.¹³⁹⁵ Thus environmental values are added to economic models¹³⁹⁶ as social needs were before them. Notwithstanding neo-Malthusian spectres,¹³⁹⁷ and public environmental concerns, development specialists should be optimistic about Thailand with sound assimilation of imported knowledge in all arms of government as a function of four decades of post-graduate education in Western countries.

World Bank analysis of the past 50 years of international development produced four conclusions,¹³⁹⁸ viz:

- macro-economic stability is an essential pre-requisite to achieve the economic growth essential to development
- economic growth does not filter down to poorer elements in a society which must be addressed through specific human needs projects and programs
- a comprehensive group of integrated policies is essential to stimulate development
- sustained development requires socially inclusive and responsive institutions.

¹³⁸⁸ Long and Van der Poley (1994)

¹³⁸⁹ Streeten (1995)

¹³⁹⁰ Reed (1995)

¹³⁹¹ Smith, A. (1986)

¹³⁹² Redclift (1987)

¹³⁹³ Falvey, L. (1996)

¹³⁹⁴ Giddens (1990)

¹³⁹⁵ Mol and Spaargaren (1993)

¹³⁹⁶ Daly and Cobb (1994)

¹³⁹⁷ Falvey, L. (1996)

¹³⁹⁸ World Bank (1999)

Accordingly, the World Bank has embraced sustainable development, including improvement of the quality of life through improved health and education, greater public involvement in government, inter-generational equity, and good governance in civil societies.

The preceding international development overview omits broader views of the over-consumption and its links to control of the new engines of growth, knowledge and technology. The indicators of concern may already be excessively generous intellectual property laws, and alienation of millions from new communication technologies.¹³⁹⁹ It also omits the effects the development experience in Thailand. Imported advice and policies can now be seen to have placed undue emphasis on financial costs and benefits to the detriment of social and environmental values, in what was an imbalanced and partial approach to development. Such imbalance introduced costs greater than benefits in many cases, such as for small-holders. Nevertheless, future interpretations are likely to note the resilience of the development model through its ability to accommodate new challenges as societal values are costed.

Missing the Middle Path

Thai agriculture in the year 2000 is dominated by poor small-holder producers. Nevertheless, analyses of Thai agriculture focus on commercial agriculture and agribusiness as products of modern economics and science, with economics narrowly portrayed as a means for planning wealth creation. Development Plans even noted that social inequities arising from industrialisation would be addressed through greater national wealth benefiting the whole populace. Science likewise was portrayed as applied problem-solving technology to increase and sustain wealth generation, and as scheduled discovery of transferable proprietary techniques. By contrast, environmental values ascribed to Thai Buddhist traditions are romantically said to reside in once 'noble' peasants; of course, such depictions are each but part of the whole of economics, science, and Thai Buddhism.

Importing of development planning to Thailand without the cultural associations which created the economic paradigm allowed contextless expectation of theoretical outcomes. Keynes' warnings against the subordination of matters of greater and more permanent significance¹⁴⁰⁰ were not heeded in technically oriented development practice, and the deliberately narrow methodology of economics to interpret past interactions were trusted as forecasts. Human factors and natural resources were thus unwittingly valued at zero, and it was assumed that all income was of the same value regardless of whether it was derived by human effort or speculative activities.

Of course, economic analysis allows such items as sustainably produced food, mined natural resources, or labour in primary, manufacturing, and services sectors to be valued on the any agreed basis. Emotive views that economists know the cost of everything and

¹³⁹⁹UNCTAD (2000)

¹⁴⁰⁰Schumacher, E.F. (1973)

the value of nothing¹⁴⁰¹ are belied by natural resource and welfare economics, which could estimate the efficient price for a resource as the marginal cost of; supplying a resource to a user, plus any lost ecological functions, co-lateral pollution, lost future options, and lost existence and bequest value. However, this is still a partial recognition of values ascribed to life-style, culture, and other costs of development.

Science approaches imported to Thailand have similarly been misinterpreted into a belief system which delivers eternal consumer improvement. Its treatment in isolation from the humanities separated it from parallel Western moral precepts once maintained through religion, such that life is characterised in terms of scientific solutions to mental and physical health, and environmental problems. This precarious interpretation applies to all materialistic societies which assume continuous technological development and the honesty of the market place; for Thailand, it means that sustainable development cannot be expected from simple adoption of a foreign model. Nevertheless, Thailand was shepherded into the industrialisation model from this position of unbalanced views of economics and science.

Competing with other low-middle income countries¹⁴⁰² to join industrialised countries which consume a disproportionate amount of global non-renewable primary resources, is anathema to Buddhist economics. Forty years of experience since the Marshall Plan in Europe¹⁴⁰³ had showed that rapid resurgence in Germany and Japan was possible because essential foundations existed, including broadly based education, relatively equitable and working political and legal systems, and values which linked development to social stability. Thailand's adoption of the accoutrements of industrialisation without such essential elements limited its development to being an adjunct of industrialised countries and requiring foreign management personnel, while rely on cheap labour, and becoming a price taker to larger industrial groups.

Balanced development in Thailand would have included broadly based and effective education, social welfare policies, the rule of law, and adoption of a materialistic ethic in place of traditional values.¹⁴⁰⁴ If Buddhist ethics suggest that means are more important than ends, output oriented policies seem anti-cultural; valued and valuable work opportunities might thus be worth more than production of weapons, for example. To suggest that Thailand eschew social policies until industrialised wealth can redress social inequities¹⁴⁰⁵ placed ends above means, and recalls Keynes¹⁴⁰⁶ prescient and perhaps cynical advice that traditional virtues should be sacrificed to avarice and usury until economic growth had been achieved when a return to enduring values would be possible. Imbalance produced Thailand's quandary of apparently outstanding growth followed by rapid decline.

¹⁴⁰¹ Young, M.D. (1993)

¹⁴⁰² World Bank (2000)

¹⁴⁰³ Falvey, L. (1994)

¹⁴⁰⁴ Schumacher, E.F. (1973)

¹⁴⁰⁵ NESDB (1988)

¹⁴⁰⁶ Schumacher, E.F. (1973)

World-leading economic growth obscured concern over the loss of traditional values, unsustainable environmental exploitation, and corruption which exceeded the generous cultural levels of tolerance. With economic crisis has arrived a reconsideration of views propounded by philosophically informed persons who have sought to redirect Thai society to its traditions, and to link these to Buddhist environmental values. A curious development which evokes emotion and argument around its inconsistencies, it holds practical opportunities for Thai agriculture, small-holders, and the environment. The first, although not critical step, has been to highlight Thai environmental traditions.

Seeking Environmental Traditions

The usually irresistible forces of economic development waned slightly from 1997 allowing some balanced views to be aired among recriminations about financial management. These views had been formulated against the success of the wealth creation model and were sufficiently formed to allow significant Thai contributions to a rising Buddhist environmental ethic. Before tracing the impact of popular Buddhist thought on agriculture, a cursory addition to the earlier discussion of Thai environmental views of is helpful.

Chapter 2 has indicated that traditional Thai environmental management pragmatically modified the environment to suit rice production,¹⁴⁰⁷ which co-existed with other more benign systems such as shifting cultivation. All involved appeasement of spirits in the natural environment combined with practical husbandry¹⁴⁰⁸ to produced a new and stable ecosystem.¹⁴⁰⁹ Successfully living in harmony with nature¹⁴¹⁰ appears to have been a Thai ethic from this anthropocentric perspective, as suggested from Ramkamhaeng's description of human arranged landscapes,¹⁴¹¹ the Sibsongbanna Tai ideal of holy hills and village forests,¹⁴¹² and ancient Thai literature eulogising nature's bounty.¹⁴¹³ Environmentally related beliefs and ceremonies such as *Naak Hai Nam*, *Phra Mae Thoranee*, *Phra Mae Khongkha*, *Pharajaphithi Lai Ruea*, *Pharajaphithi Lai Nam*, *Pharajaphiti Phirunsat*, *Bang Fai*, *Songkran*,¹⁴¹⁴ and *Pharya Mae Phosob*, as expanded on elsewhere, as well as a range of folk sayings¹⁴¹⁵, confirm the primary link of environmental traditions to agriculture rather than conservation *per se*.

In seeking Thai environmental traditions in residual superstitions, practices, and unconscious actions, some plants long associated with Tai Buddhism spread along trade routes through Thailand,¹⁴¹⁶ may indicate a tenuous environmental interest. Yet the agriculturists' wont to improve on the natural environment is evident in superstitions

¹⁴⁰⁷ Falvey, L. (1996)

¹⁴⁰⁸ Kunstadter, P. et al (1978)

¹⁴⁰⁹ Geertz, C. (1959)

¹⁴¹⁰ Kriengkraipetch, S. (1989)

¹⁴¹¹ Khanittanan, W. (1989)

¹⁴¹² Sheng-ji, Pei (1985)

¹⁴¹³ Rutnin, C.L. (1989)

¹⁴¹⁴ Sriwatanapongse, S. (1997)

¹⁴¹⁵ Senanarong, Ampon (1997)

¹⁴¹⁶ Needham, J. (1956)

concerning plants which have evolved to decoration and landscaping. For example, plants with foreign names which, in the Thai language, have unfortunate connotations, are allocated specific sites - some such plants are:¹⁴¹⁷:

Thai Name	Botanical Name	Thai Belief
Tau rang	<i>Caryota mitis-palmae</i>	'Rang' sounds similar to 'deserted' or 'abandoned'
Sala, rakam	<i>Zallaca Wallichiana-palmae</i>	Spines; sala = 'forsaken'; rakan = 'affliction'
Soak	<i>Saraka indica</i>	Soak = 'sorrow' (despite positive Pali origins)
Lanthom	<i>Frangipani</i>	Sounds similar to 'agony'
Anga	<i>Canagium odoratum</i>	Easily broken branches can damage houses
Champa	<i>Micajlia champaka</i>	Easily broken branches can damage houses
Chaba	<i>Hibiscus rosa</i>	Associated with convicts
Malakaw	<i>Caricapapaya</i>	Shallow rooted, susceptible to falling
Mayom	<i>Phyllantus distichus-euphopiaceaea</i>	Sounds similar to the Indian God of Death

However, rice is the central component of Thai tradition. Its spirit allows avoidance of famine,¹⁴¹⁸ a concept implied in the sophisticated old Mon language of rice culture and associated philosophical concepts derived from introduced Buddhism,¹⁴¹⁹ and made real through continued advances in rice irrigation.¹⁴²⁰ Respect for rice, formalised through everyday rituals akin to saying of grace in Western cultures, acknowledged *Mae Phosop*, the Rice Mother in the raising of one's right hand while one's mouth held rice, and by a *wai* at the end of the meal. Appropriate reverence throughout planting, harvesting, threshing, pounding, polishing, transporting, and storing of rice ensured good harvests. Animistic references to rice being 'pregnant', similarly reflect assumption of the vital spirit of rice;¹⁴²¹ more virtues were once nominally ascribed to *Mae Phosop* than to the Buddha by northern Thai persons. An extensive range of rituals varying by region across all months of the year to a total of more than ninety ceremonies and actions have been documented.¹⁴²²

With the shift from traditional to institutionalised irrigation systems, a reduction in the perceived influence of spirits on the control of natural events occurred leading to a reduction in ceremonies to the Great Mountain Lord *Jao Khao Luang*, Lord of One Hundred Thousand Elephants *Jao Saen Chang*, Lord of the Golden House *Jao Ho Kham*, Lord of the Iron Wrist *Jao Kho Mu Lek*, and ceremonies on specific days of the waxing moon of selected months. Irrigation managers who had organised these ceremonies accordingly lost their power as the *kamnan*, an institutionally approved locally elected leader, assumed authority; villagers perceived increased frequency of flooding, siltation of irrigation systems, and variations in rainfall regimes and attributed these to a progressive reduction in the power of the spirits as the Royal Irrigation Department assumed authority.¹⁴²³ Interestingly, some ceremonies have been absorbed into modern Thai institutions.¹⁴²⁴

¹⁴¹⁷ Rajadhon, Anuman (1961)

¹⁴¹⁸ Izikowitz, K.V. (1951)

¹⁴¹⁹ Luce, G.H. (1965)

¹⁴²⁰ Plagden, G.O. (1906)

¹⁴²¹ Rajadhon, Anuman (1955)

¹⁴²² Suratanakavikul, Puangpheap et al (1997)

¹⁴²³ Lando, R.P. (1983)

¹⁴²⁴ Chunnapiya, Supatra (1997)

As the spirits lost power to officials, once acceptable practices, such as lower social status conferring lower levels of duty, led to reductions in maintenance of irrigation canals, protection of public forests, and even tidiness of communal areas.¹⁴²⁵ Moral and religious silence on environmental matters falsely assumed continued sensible behaviour; merit making rituals performed for traditional reasons remained unconnected to environmental matters.¹⁴²⁶ By the 1970s, diversification away from rice became policy,¹⁴²⁷ severing the remaining link between animistic belief, and economic and environmental well-being.

Upland export crops¹⁴²⁸ introduced from the 1960s had few traditional associations, and the overriding influence of cash incomes favoured acceptance of the view of continued economic growth supported by faith that science¹⁴²⁹ could solve all problems, including environmental problems. From this perspective, modern Thai environmental thought may be seen as derived from the West rather than a direct outcome of tradition. Coincidentally, attempts to find a Thai eco-Buddhism in popular interpretations of ancient teachings, may unwittingly be also drawing on Western thought.

Popular Buddhist Thought

Thai environmental thought has been strongly influenced by Western ideas.¹⁴³⁰ Local environmental arguments against intensive agriculture have sought a value base in Thai Buddhism¹⁴³¹ and modern perceptions of traditional Thai values¹⁴³² of environmental respect. Thus the following can be read as both an emerging Thai environmentalism in the face of undesirable foreign influence, and as the balancing forces of Western environmental and materialistic thought pervading an Asian culture.

Buddhism might be seen as seeking to unite man with life and himself, while the unenlightened majority remain ununited and hence strive to solve recurring conflicts as ... *a stranger and afraid, in a world I never made*.¹⁴³³ Such transcending of the common intellectual and emotional approaches to life suggests cessation of categorisation into familiar frameworks which, by separating subject and object, precludes unity in understanding. A technological society seeking solutions to problems through reductionist approaches contrasts with the wholeness view of Buddhism, even the simpler codified principles for the laity. Medieval Western subordination of individuality to an ultimate meaning might have been more holistic yet is difficult to recall today when individual freedom pervades and is separate from minority interest in spiritual matters. However, popular thought is less concerned with philosophy than the meaning for everyday worldly life, where faith in codes and rules is the main form of religion.

¹⁴²⁵ Hafner, J.L. (1973)

¹⁴²⁶ Mulder, J.A.N. (1968)

¹⁴²⁷ Muscat (1994)

¹⁴²⁸ Christensen (1992)

¹⁴²⁹ Stace, W.T. (1952)

¹⁴³⁰ Rigg, J. (1995)

¹⁴³¹ Harris, I. (1995)

¹⁴³² Sheng-Ji, Pei (1985)

¹⁴³³ Phillips, B. (1962)

Buddhist love of nature is likened to respect and friendship with a fellow being seeking spiritual growth and hence essentially part of the same entity, which in worldly terms, might be considered the external environment.¹⁴³⁴ Species eradication, economic development, individual acquisitiveness, technological control, and anthropocentrism ascribed to Western values are easily contrasted with Buddhist views of; humans as part of nature, non-violence, mental awareness, conscious action, and ego extinction.¹⁴³⁵

Claiming a long tradition of environmental awareness amongst forest monks¹⁴³⁶ devoted to hermitic personal meditation as distinct from urban-based monks reliant on text learning, provides a convenient metaphor for rural and urban values; yet the essence of forest monkhood has been separation from worldly society. Some might therefore see the proposed environmental education roles for forest monasteries such as Suan Mokkhaphalaram¹⁴³⁷ as a modern protest rather than as revival of a tradition. Likewise, promoting temples as havens for endangered animals¹⁴³⁸ and highlighting apocryphal Buddhist stories concerning the cutting of trees,¹⁴³⁹ appears to suit modern environmental messages yet may be ex-contextual. Notwithstanding purist concerns, a popular Buddhist environmental movement has begun. Even if only a fraction of the some 250,000 temples in Thailand¹⁴⁴⁰ assumed such a moral orientation to worldly conservation, one might expect a general change in lay persons attitudes to recent actions.¹⁴⁴¹

For those who decry such manipulation of Buddhism in Thailand as an instrument of national integration, the unification of various aspects of Theravada Buddhism to form a national religious system in the early 1900s might be seen as the first error. However, this helped to create the nation of Thailand, and for this reason appears consistent with religious support for moral national objectives, including balanced economic development and assimilation of tribal peoples. Nevertheless, alignment with national policy may have reduced the religion's subsequent influence in Thai society.¹⁴⁴² Recent popular thought in Thailand has caused its emergence as a leader in modern Buddhist environmental thought, notwithstanding the difficulties inherent in claiming canonical authority for new religious ideas.

Conservative Canons

The mixed objectives variously ascribed to Buddhism, which surround increased environmental awareness, social responsibility, and sustainable agriculture, rely on interpretation of the Pali canon. The question as to whether Buddhism advocates an

¹⁴³⁴ Suzuki, D. (1962)

¹⁴³⁵ Sponsel, L.E. and Natadecha-Sponsel, P. (1995)

¹⁴³⁶ Rigg, J. (1995)

¹⁴³⁷ Visalo, Phaisan (1990)

¹⁴³⁸ Kabilsingh, Chatsumarn (1987)

¹⁴³⁹ Bhutagama, Vagga, Pacittiya (no date)

¹⁴⁴⁰ Kabilsingh, Chatsumarn (1990)

¹⁴⁴¹ INEB (1990)

¹⁴⁴² Charles F. Keyes, C. F. (1971)

environmental ethic, is ambivalent to the environment, or in fact contributes to environmental degradation, can perhaps be addressed through such discussion.¹⁴⁴³

Buddhologists differ over the extent of the religion's environmental ethics¹⁴⁴⁴ which are confused by adoption of anthropocentric interpretations. If Buddhism advocates individual release from ego, and other teachings are interpreted as means to assist this end, including a correct world-view attained through contemplation, then original Buddhism can be interpreted as affirming the world rather than escaping it;¹⁴⁴⁵ however, others consider that Buddhism accommodates human values before those of other creatures and plants.¹⁴⁴⁶

As the environmental issues discussed today were not conceived when Buddhist texts were written, explicit Pali statements on current issues cannot be expected. However, to remain a vital social force, the religion probably needs to address current issues through modern exegesis of traditional teachings. Traditional teachings appear to consider care for nature as a spontaneous outcome of an individual's spiritual development, but not as a valued activity in its own right. The state of the environment might therefore be interpreted as a karmic outcome of the actions of individuals and groups.¹⁴⁴⁷

The most common invocation of Buddhist teaching as environmentally enlightened is the prohibition of killing sentient beings. To argue these as environmental ethics within original teachings requires uncommon objectivity, especially if precepts are seen as preparatory moral steps toward wisdom.¹⁴⁴⁸ In terms of evaluation of existence, Buddhist texts seem to be ambivalent, seeking only to liberate from suffering. Likewise, the mystical doctrine of causal dependence can hardly be claimed as a specific prescient statement of ecological interdependence.¹⁴⁴⁹

Removal of suffering by eliminating desire, including greed for material possessions, social prestige, and perhaps even sexual gratification when linked to population growth, may reduce environmental destruction. Teachings on loving-kindness and consequent unification with other living beings similarly impart incidental environmental benefit, although minimising pain to individual animals relates poorly to biodiversity concerns. Thus early Buddhist teachings may incidentally promote environmental care.¹⁴⁵⁰

However, objective consideration must also include teachings which conflict with current environmental values, such as killing introduced animals to return an environment to a modern perception of its original form. Individual Buddhist teachings which prohibit injury to plants because they house insects, or pollution of water because it contains small animals, can be used to both support and criticise sustainable agriculture approaches

¹⁴⁴³ Schmithausen, L. (1999)

¹⁴⁴⁴ Harris, I. (1995)

¹⁴⁴⁵ Macy, J (1990)

¹⁴⁴⁶ Hakamaya, N. (1990)

¹⁴⁴⁷ Schmithausen, L. (1999)

¹⁴⁴⁸ Schmithausen, L. (1999)

¹⁴⁴⁹ Macy, J (1990)

¹⁴⁵⁰ Batchelor, M. and Brown, K. (1992)

within an ecosystem. Such worldly impractical teachings have led to lay propitiation for essential agricultural actions, such as killing small animals and insects, through meritorious deeds, and to allocation of killing for meat to other persons in the Thai society.¹⁴⁵¹

Another strand of Buddhist writings with environmental references relates to remote forest monks whose spiritual search is intensified by the attendant dangers as wild animals. As introduced earlier, Thai forest monks support environmental protection today, although the original association derives from times when forests were abundant, and it was probably inconceivable that they would one day be threatened. Purists note that the tradition is derived from Hindu practices, as may be the anthropocentric adaptation of environments to suit mankind¹⁴⁵² which pervade Thai environmental history. Modern views of animal species preservation are unsupported by Buddhist texts which view animals as a lower life form than man with concomitant greater levels of suffering. The more popular Jataka texts anthropomorphise animals and allow some to be considered more worthy than others. While precepts which prohibit killing may appear to favour conservation,¹⁴⁵³ human population growth which causes the demise of wild animals takes precedence.¹⁴⁵⁴

Early Buddhist sources present an ideal world as populated by villages and wealthy cities which are wary of nature, reminiscent of Western fear of nature.¹⁴⁵⁵ However, the Discourse on True Blessing, *Mangalasutta*, also assumes that individual morality is essential to an ideal society that would exhibit a constructive and harmonious environment in visual and auditory terms, and ensure excellent education, income, and public services for all members who would retain an excellent ideology;¹⁴⁵⁶ the parallels with modern advocations of good governance are clear, with incidental environmental benefits. Many ideas were absorbed into Buddhism from Indian civilisations of the time; the same era of Indian spiritual development also influenced Western thought. As discussed below, the wheel has turned with the West influencing modern Buddhist environmental thought.

These, perhaps eclectic, examples about Buddhism's view of nature indicate that it is not domination, but transcendence of all such views through detachment which is the religion's concern.¹⁴⁵⁷ Such negation of nature includes negation of civilisation; nature is thus not treated separately in higher teachings. So, while essential Buddhism did not acknowledge ecology in the modern manner, many of its lay values enhance environmental care, particularly compassion. Modern Thai Buddhism contrasts with some early teachings simply because the issues of today were not foreseen and hence not

¹⁴⁵¹ Spiro, M. (1982)

¹⁴⁵² Schmithausen, L. (1999)

¹⁴⁵³ Sober, E. (1986)

¹⁴⁵⁴ Schmithausen, L. (1999)

¹⁴⁵⁵ Schmithausen, L. (1999)

¹⁴⁵⁶ Chandra-ngarm, Saeng (1998)

¹⁴⁵⁷ Otto, R. (1932)

used as examples to explain desirable moral codes for lay persons. Seen in this light, there may be no reason to seek further textual derivations for modern eco-Buddhism.

Rising Eco-Buddhism

If the link between Buddhism and environmental consciousness is thought to lie in modern thought, then the origins of eco-Buddhism deserve consideration. Stumbling-blocks such as the doctrine of causation might be ignored as a separation between mystical insight and religious practice, as occurs in all religions. In Thailand's case, the close relationship of State and religion in Thailand appears to facilitate development of an intellectual eco-Buddhism.

Five intellectual groupings of eco-Buddhist thought have been elicited from recent writings, viz.^{1458,1459}

- authoritative endorsement, including by The Dali Lama, without canonical reference¹⁴⁶⁰
- endorsements by scholars and activists referenced to Buddhist doctrine¹⁴⁶¹
- actions by high profile monks, nuns, and lay persons, particularly in Thailand¹⁴⁶²
- concern about doctrinally validity coupled with sympathy and support¹⁴⁶³
- objection on the grounds of canonical inconsistency.¹⁴⁶⁴

Notwithstanding doctrinal problems, eco-Buddhism is widely supported. Accepting change, Buddhism denies the universal purposive intent of other religions and hence is silent on the maintenance of an environment¹⁴⁶⁵ suited to humans and ascribable to God. Leaning more to a pragmatic 'scientific' world-view than a purposive teleological view of the world in Stace's definition,¹⁴⁶⁶ eco-Buddhism draws on a Western¹⁴⁶⁷ philosophical and intellectual base, as part of rising global eco-religiosity, building on liberal Christian philosophy from the 1960s.¹⁴⁶⁸

Inter-religion dialogue over the past three decades found a common and unthreatening theme in the environment.¹⁴⁶⁹ The interconnectedness of mankind is reflected in global environmental issues, discussion of which facilitated intellectual congruence in fora removed from cultural and historical sensitivities of each world religion.¹⁴⁷⁰ The

¹⁴⁵⁸ Harris, I. (1994)

¹⁴⁵⁹ Harris, I. (1995)

¹⁴⁶⁰ Gyatso, Tenzin (1986)

¹⁴⁶¹ Macy, J (1990)

¹⁴⁶² Buddhadasa (1956)

¹⁴⁶³ Schmithausen, L. (1999)

¹⁴⁶⁴ Hakamaya, N. (1990)

¹⁴⁶⁵ Harris, I. (1991)

¹⁴⁶⁶ Stace, W.T. (1952)

¹⁴⁶⁷ Harris, I. (1994)

¹⁴⁶⁸ Harris, I. (1995)

¹⁴⁶⁹ Beyer, P. (1994)

¹⁴⁷⁰ Harris, I. (1995)

evolution of religions toward all encompassing philosophy is clearly attractive to many, and some even suggest an outcome of a future unified eco-religion itself.¹⁴⁷¹

Categories of eco-religious thought include:¹⁴⁷²

- eco-spirituality with an holistic view of the universe¹⁴⁷³
- eco-justice with a political and social orientation to global equity¹⁴⁷⁴
- eco-traditionalism, resource stewardship, associated with past superior values¹⁴⁷⁵

The first category has Buddhist and Christian advocates whose similar views possibly arise from earlier dialogues, yet are attributed to the nature of an essential truth. The third category suits most Christian sensitivities and also idealistic views in Buddhism.

Eco-justice views have been evident in Thailand among social activists who link sustainability of society to Buddhist principles. Post-economic crisis emotions have allowed these views to be widely canvassed as an antidote to excessive consumption, and to advocate attenuated industrial development as part of moderation and personal responsibility. Activists have been able to invoke authority through, for example, respected monks ordaining threatened trees which, while causing conflict within the *Sangha*,¹⁴⁷⁶ has been politically effective.

At the heart of eco-Buddhism approaches is the stumbling block of the intellectual tool of separating subject and object in relativistic comparisons.¹⁴⁷⁷ This very facility which allows human material development, impedes spiritual development according to mystics of all great religions.¹⁴⁷⁸ Worldly approaches which seek to accommodate such unintelligible truths in, for example, practical agriculture will therefore inevitably produce conflict; nevertheless, recognition of different approaches for commercial and self-sufficient agriculture is producing outcomes that may yet attach some unique qualities to future Thai agriculture.

Thai social activists through eco-Buddhism and liberal Christian eco-justice advocates are linked through some NGO development philosophies, which in fact lends credibility to these new religious views. However, extreme measures to motivate environmental action, such as warnings of an apocalyptic environmental catastrophe are more easily accommodated in Western than Buddhist thought. Ironically, in accepting the approach of eco-justice, Thai activists may have accepted a largely Western philosophy to counter the perceived unsuitability of Western economic approaches of recent decades. Such considerations presumably support conclusions that development activities are self-perpetuating and a threat to the poor.¹⁴⁷⁹ In any case, pragmatic Thai Buddhism may well embrace such global environmental views as the outcome appears beneficial, and the cost

¹⁴⁷¹ Falvey, L. (1998)

¹⁴⁷² Harris, I. (1995)

¹⁴⁷³ Berry, T. (1988)

¹⁴⁷⁴ World Council of Churches (1991)

¹⁴⁷⁵ Granberg-Michaelson, W. (1992)

¹⁴⁷⁶ Harris, I. (1995)

¹⁴⁷⁷ Suzuki, D.T. (1962)

¹⁴⁷⁸ Suzuki, D.T. (1962)

¹⁴⁷⁹ Hershock, P. (1999)

of acquiescence low. In so doing, Thailand would be part of wider revisions which seek to produce practical approaches.

Practical Approaches

Practical outcomes derived from mystical experiences of all great religions necessarily creates various worldly interpretations. Within Buddhism, this has been explained in terms of two types of truth, ultimate truths derived through personal mystical experience and incommunicable to those who without such experience, and conventional truths interpreted by insightful mystics who have attempted to assist others in their personal spiritual development. An essential component of conventional truth, that the world is not as it is perceived through the human senses but rather is an outcome of physical and psychological effects,¹⁴⁸⁰ provides a context for common environmental teachings.¹⁴⁸¹

In environmental terms, treating nature as separate from humans, is said to neglect individual spiritual development to the detriment of both individuals and society.¹⁴⁸² From this integrated perspective, economics, environmental concern, and human existence are inseparable, and consequently economic activity must ensure that it does not harm society in the broadest sense. Practical outcomes of such thoughts include the eight components of the Buddhist Path which aim to curb human desires and support teachings that all should engage in honourable, fulfilling, and creative activities, and that government economic success should be absence of poverty rather than high national income.¹⁴⁸³ This practical view shows the illusory character of economic growth based on environmental destruction¹⁴⁸⁴ and rising rural poverty and unemployment.¹⁴⁸⁵

Buddhist principles, long interpreted flexibly, have inhibited rather than prohibited meat consumption, although the bulk of Thai dietary energy and protein has been derived from rice, and to a lesser extent fish,¹⁴⁸⁶ until recently. Moral and religious pragmatism in Thai subsistence agriculture continues in rural communities with some cultural memory of migration, for example the Tai Yong in the North consciously observe the need for recreation and reproduction as well as transitory aspects of being and non-violence in the composition and presentation of the meal.¹⁴⁸⁷ Symbolically, the matri-focal Thai culture intertwined with religious values in self-sufficient agriculture is recalled through the embracing word *khropkhrua* (family) incorporating the word *khrua* (kitchen) in the manner of home-and-hearth.

Practical interpretations of Buddhism also derive curiously from dissatisfaction with divergence of institutionalised Thai, Sri Lankan, and Indian forms from original teachings, leading to new sects of 'Protestant Buddhism'; the term has no connection to

¹⁴⁸⁰ Dhamma, Reweta (Bhikku), (1990)

¹⁴⁸¹ Gyatso, Tenzin (1986)

¹⁴⁸² Payutto, P.O. (no date)

¹⁴⁸³ Payutto, P.A. (1994)

¹⁴⁸⁴ Payutto, P.A. (no date)

¹⁴⁸⁵ Bello, W., Cunningham, S. and Kheng Poh, L. (1998)

¹⁴⁸⁶ Hasek, H.M., Seatsaneh, Saovanee and Hanks, J.R. (1958)

¹⁴⁸⁷ Trankell, I.B. (1995)

Christian sects. Environmental concern is one unifying factor in these sects, which in Thailand, have also highlighted related behavioural excesses of some monks, politicians, and businessmen. Restating the moral benefit of practical religious guidelines for common lay persons, this reformed Buddhism also tempers the effects of materialism through insightful thinkers, unconstrained by culture as advocated in the *Kalamasutta*,¹⁴⁸⁸ who have advanced a form of Buddhist economics.¹⁴⁸⁹

Buddhist Economics

One Buddhist conception of economic systems, views work as a means to employ and develop inherent faculties and to reduce ego-dominance by cooperating in common tasks while providing essential components for life. The expected outcomes of human dignity, freedom, and spiritual well-being contrast with the economic planning which values outputs above intangible human welfare benefits such as creative activity. This approach may, for example; rank full self-fulfilling employment as a higher objective than increased GNP, ascribe a high value to the natural environment, and require industries to compensate for environmental incursions.

Application of the approach to Thai agriculture leads to equally radical outcomes. For example, as is clear to those experienced with small-holders, a working animal has a broader inherent value than a tractor; why then would mere work output determine the relative values of tractors and buffalo? If the animal and tractor are considered a metaphor for agricultural and industrial development, the paucity of understanding about agriculture engendered by its treatment solely as an economic activity may be clearer. Buddhist agriculture values working with soil, being involved with countless living organisms in the soil, plants and animals, and the interaction of humans as part of the biological process, above the repetitive, machine-dominated, and sterile environments of industry with its reliance on supervision, management, sick leave, holidays, and a diversionary-based lifestyle outside the factory. The difference is inadequately captured in such terms as 'rural life'.

Practical religious thought, including new economic perspectives, have attracted attention within and outside Thailand. One bridge between apparently conflicting human and environmental views has been consideration of alternative agricultural production systems.¹⁴⁹⁰ A practical interpretation of such alternatives as a middle path for poor small-holders in Thailand, has been promoted and trialed with varying success.

Alternative Agriculture

Concern that intensive agriculture¹⁴⁹¹ neglects beneficial components from traditional farming systems¹⁴⁹² is likely to lead to absorption of alternative agriculture into

¹⁴⁸⁸ Chandra-ngarm, Saeng (1998)

¹⁴⁸⁹ Payutto, P.A. (1994)

¹⁴⁹⁰ Cornell University (1999)

¹⁴⁹¹ Wasi, Prawase (1996)

¹⁴⁹² Conway, G. (1997)

institutional definitions of sustainable agriculture.¹⁴⁹³ Technologies to increase food production and divert famine¹⁴⁹⁴ may have reached a peak,¹⁴⁹⁵ thereby suggesting potential for traditional or alternative agricultural practices to complement Green Revolution technologies in the next step of agricultural research and development in less developed countries. Agro-ecological approaches already attempt this by reducing costs for socially¹⁴⁹⁶ and environmentally informed technologies which do not assume lower yields.¹⁴⁹⁷

Alternatives to intensive commercial agriculture¹⁴⁹⁸ may be profitably considered in terms of their origin, application, and success in either more developed, or less developed, countries. Self-sufficiency implies quite different qualities of life in different countries in terms of health services, access to education, opportunities for one's children, and communication. As a lower middle income country¹⁴⁹⁹ unlikely to achieve rapid industrialisation of a sustainable or highly profitable type in the next decade, Thailand's tentative moves to greater social equity might indicate some acceptance of the values introduced above.¹⁵⁰⁰

Alternative agriculture is associated with low input and ecologically considerate forms of food production¹⁵⁰¹ which incorporate essential human values¹⁵⁰² including self-reliance,¹⁵⁰³ healthy food, and some income.¹⁵⁰⁴ One approach tried in Thailand was the Japanese Fukuoka¹⁵⁰⁵ farming system which eschews ploughing, weeding, commercial fertilisers and pesticides, and pruning, while emphasising spiritual aspects of the practice of farming and producing sufficient food for the family, possibly with a small surplus for security or sale. Developed in a temperate climate, its application to Thailand suffered from rapid tropical weed growth. A modification, the Kyusei Nature Farming system, aimed to produce high quality food while meeting economic and spiritual objectives for both farmers and consumers¹⁵⁰⁶ through use of microbial inoculants to improve soil quality and plant growth. Relying on a well developed delivery infrastructure, and some doubt of the efficacy of the micro-organisms in the Thai environment, the system was not adopted widely in Thailand.

Permaculture,¹⁵⁰⁷ a system based on industrial chemical-free integration of forestry with agriculture, a multi-crop mix, and hydroponics linked to aquaculture, has been tried with

¹⁴⁹³ Altieri, M. and Uphoff, N. (1999)

¹⁴⁹⁴ Crosson, P. and Anderson J. (1999)

¹⁴⁹⁵ Pingali, P., Hossein, M. and Gerpacio, R.V. (1995)

¹⁴⁹⁶ Thurston, H.D. (1994)

¹⁴⁹⁷ Francis, C.A. (1986)

¹⁴⁹⁸ Wasi, Prawase (1996)

¹⁴⁹⁹ World Bank (1999)

¹⁵⁰⁰ Payutto, P.A. (1994)

¹⁵⁰¹ Schaller, N. (1993)

¹⁵⁰² Beus, C.E. and Dunlap, R.E. (1990)

¹⁵⁰³ Pretty, J.N. (1995)

¹⁵⁰⁴ Udagawa, T. (1993)

¹⁵⁰⁵ Wasi, Prawase (1988).

¹⁵⁰⁶ Matsumoto, Y. (1993)

¹⁵⁰⁷ Mollison, B. (1988)

limited impact in Thailand, possibly because it is hard to distinguish its benefits from those of existing integrated agriculture. A Thai variation based on a symbiotic agri-aquaculture system utilising reduced levels of industrial fertilisers and pesticides has proven more culturally acceptable to both Thai farmers and extension agents.¹⁵⁰⁸ Farming systems research and extension approaches in Thailand have also embodied elements common to alternative agriculture.¹⁵⁰⁹

One successful alternative agricultural approach seems to be organic farming. Hardly new in any traditional agricultural society, its modern guise was foreshadowed in Thailand in the 1950s,¹⁵¹⁰ and expanded to the use of natural fertilisers, nutrient recycling, and weed control without industrial chemicals to service a middle class market. Pesticide free rice products and organic fruits and vegetables to be exported from Thailand should benefit from certification of organic produce which became possible from 1998 with the passing of the Alternative Agriculture Certification Act.¹⁵¹¹ Differing from self-sufficiency systems, organic farming requires high managerial skills and access to capital. Opening of organic produce outlets in Thailand has highlighted the higher marketing costs for such specialised goods compared to the usual bulk commodity trading. It has also revealed the distinction between, for example, Japan and Thailand, in domestic rice pricing.¹⁵¹²

Perhaps the closest association of alternative agriculture with Thai Buddhism has been through the Santi Asoke sect which adapted Japanese Nature Farming with the additional stipulation of avoiding the deliberate killing of pests through any means including non-chemical approaches. Produce is sold through the sect's vegetarian restaurants with profits allocated to charitable activities. Adoption of this alternative agricultural approach is most likely to remain restricted to members of the sect,¹⁵¹³ which is tolerated by the Thai *Sangha* as a renegade religious group which substitutes work for meditation and maintains political affiliations,¹⁵¹⁴ yet appeals to values espoused by many eco-Buddhists.

Another alternative is to reduce input costs rather than binding small farmers solely to chemicals, credit, and forest encroachment to produce commodities such as cassava, sugar, and kenaf which offer declining returns in global markets. A further step based on producing one's own family food without major chemical inputs in an integrated farming system has been described in Thailand as one element of self-sufficiency.¹⁵¹⁵ Viewing man as part of this integrated system, Buddhist principles are made practical for millions of Thai small-holders within a global ethic.¹⁵¹⁶ The value of all individuals in the society, of physical work associated with producing one's food, and of a broader philosophical

¹⁵⁰⁸ Wetchaguran, K. (1980)

¹⁵⁰⁹ Shinawatra, Benchaphun (1991)

¹⁵¹⁰ Smith, H.L. (1969)

¹⁵¹¹ Liamjamrun, Wirajit (1996)

¹⁵¹² IRRI (1992)

¹⁵¹³ Wasi, Prawase (1988)

¹⁵¹⁴ Fukushima, M. (1999)

¹⁵¹⁵ Wasi, Prawase (1990)

¹⁵¹⁶ Nakasone, Y.(1985)

understanding of the true nature of the world, offers a means of enhancing small-holder agriculture.

Small-holder agriculture has been ill served by the systems which supported the separation of man from nature through destruction of forests,¹⁵¹⁷ and adopted foreign culture without valuing the loss of traditions, leading to abuses of power in Thai society. For example: inappropriate policies to prohibit export of genetic material of tropical fruits lost valuable patenting opportunities on behalf of Thai farmers, and created an illicit trade and import barriers in countries seeking open trade; the absence of humanities subjects in agricultural courses allowed small-holder agriculture to be considered in isolation from small-holders as it created technicians without a broad knowledge of the real nature of the world; promotion of new crops to small-holders exposed them to unexpected markets risks, and coordination between ministries and departments has ignored the primary purpose of government agencies.¹⁵¹⁸ While such views are not new to Thailand, official interest in balanced development may be.

Seeking a balance between social, spiritual, and material needs¹⁵¹⁹ and maintaining cohesiveness of connections between human beings, the environment and the various aspects which make up life, are assisting realistic consideration of small-holder self-sufficiency. Rather than focusing on economic development or even environmental remediation, these are seen as natural outcomes from a goal of peaceful coexistence.¹⁵²⁰ Conceptually difficult for decision makers inculcated with materialist values, there appears sufficient respect for such a philosophy residual in Thailand for self-sufficient agriculture to be seriously considered in the next decade.

The exemplary role of His Majesty the King in advocating self-sufficiency in the style of ... 'the whole realm dwells in happiness if the King lives aright',¹⁵²¹ provides hope for re-evaluation of the role of small-holder agriculture. Such ancient responsibilities have long been shifted to government and its agents with the creation of a constitutional monarchy and righteous governance is perhaps the aim of popular aid approaches to 'good governance'. However, as the cargo-cult copying approaches to industrialisation failed, so may simple adoption of supposed 'good governance' until all elements which contribute to such systems are in place. These include widespread effective education, adherence to common values including environmental values, freedom of information and debate, and active participation of concerned citizens in the political process, all reminiscent of *Mangalasutta* teachings.¹⁵²² Self-sufficiency embraces all of these factors across the whole society.

Self Sufficiency

¹⁵¹⁷ Sakharin, Rapee (1998)

¹⁵¹⁸ Sakharin, Rapee (1997)

¹⁵¹⁹ Wichiarajote, Puntape (1998)

¹⁵²⁰ Wasi, Prawase (1998)

¹⁵²¹ *Digha Nikaya* Volume 3:85

¹⁵²² Chandra-ngarm, Saeng (1998)

Among the unique aspects of Thai agriculture, culture has a specific role. The distinctive historical, cultural, and political aspects of Thai agriculture include such aspects as; the legal system, patronage based relationships, assimilative social character, and reliance on born leadership. The legal structure for Thailand, in such areas as land ownership for example, has drawn heavily from the West although it has lacked the supporting education, administration, and legal structures.¹⁵²³ The Thai patronage system has and continues to assist transference of knowledge of rural development in Thailand¹⁵²⁴ although it can impede civil servant effectiveness. The flexibility of Thai society has created an envied stability while absorbing different cultures into an evolving national identity, which is now faced with channelling the influence of Chinese Thai wealth into a unique democratic form of government for Thailand while meeting wide social objectives.

Flexibility is coupled with a high expectation of leadership from those in authority. Common persons continue to view the King as the ultimate authority, notwithstanding constitutional limitations to the power of the Monarchy. In fact, the leadership of His Majesty the King continues to be a major force in sensible development and amelioration of circumstances surrounding crises. Societal trust in leadership from others in authority, or those accorded status from higher levels of university education, has been less well rewarded.

Such special Thai characteristics lead to outcomes unforeseen by foreign observers, such the rapid adoption of the self-sufficiency ethic by politicians previously opposed to the approach,¹⁵²⁵ except as a means of risk minimisation with crop diversification.¹⁵²⁶ Self sufficiency is a bold initiative which would be difficult to introduce in the absence of a such a respected leader, and offers hope for some traditional values residual in rural Thailand¹⁵²⁷ to be reinstilled more broadly as its becomes more difficult to promote the Thai identity as having one cultural base or ethnic uniformity.^{1528,1529} As in times of crisis when familiar beliefs¹⁵³⁰ embodied in everyday Thai Buddhism¹⁵³¹ have resurfaced and moderated behaviour, including that of migrants,¹⁵³² so the authoritative and religious associations of self sufficiency should enhance its application in Thailand.

Self sufficiency in all aspects of Thai life draws on Thai Buddhism and common sense in advocating frugality, thrift, self awareness, and lay precepts which were forgotten by many through the 1980s and 1990s. Nevertheless they have been consistently advocated by His Majesty the King.¹⁵³³ Redoubled efforts to communicate the essence of self

¹⁵²³ Wijeyewardene, G. (1967)

¹⁵²⁴ Silcock, T.H. (1970)

¹⁵²⁵ Pongpaichit, Pasuk. (1999)

¹⁵²⁶ Siamwalla, Ammar. et al (no date)

¹⁵²⁷ Nartsupha, Chattip and Satyawadhna, Cholthira (1998)

¹⁵²⁸ Evans, G. (1997)

¹⁵²⁹ Wyatt, D.K. (1982)

¹⁵³⁰ Keyes, C.F. (1977)

¹⁵³¹ Terwiel, B.J. (1976)

¹⁵³² Tobias, S.F. (1977)

¹⁵³³ Board of the Royal Projects (1999)

sufficiency in the wake of the economic crisis has raised general awareness, although perhaps only as lip-service across sectors of the urban elite including the civil service.¹⁵³⁴ The concept is now important to a sensible view of Thailand's agricultural sector, and is intended to apply to all walks of life.¹⁵³⁵

Application of the approach to the rural sector has been codified in recommendations which aim to produce sufficient food for a farm family on-farm, and to use limited resources, particularly water in an equitable and frugal manner. The system would use minimal external inputs and operate within the ecosystem of the present day. Farm land would be allocated, for example, 30:30:30:10 to: on-farm water conservation for irrigation, integrated poultry production, aquatic plant production and aquaculture; wet rice production; cash and other crops including perennial trees; and housing, composting and backyard production. Indicative rather than prescriptive, the approach provides a starting point within an overriding theme of sustaining a family without reliance on external assistance and without requiring credit based links to a distant commercial chain. It further promotes cooperative action within a community for self improvement in such areas as collective bargaining, sharing of capital items, and negotiation with outside parties, including government officials and commercial interests.¹⁵³⁶

Recognising the existence of two agricultures in Thailand, self-sufficient and commercial, is but one outcome of the approach which links to earlier recommendations of the King that community participation in reforestation is essential in populated areas, and similar thoughts on communal pasture management.¹⁵³⁷ It further embodies overt recognition of agriculture as a social support system which has been undervalued since the 1960s. The opportunity for a post-crisis reconsideration of values, together with exceptional respect for the King, suggest that it is timely to consider significant changes to Thai rural development. However, while the approach would redress urban-rural disparities, urban middle class feelings of impoverishment from the crisis recall pre-crisis insularities which can easily undermine the intent of broader social equity.¹⁵³⁸

Self-sufficiency for the small farmer may be seen in a global context as a means of easing the burden assigned by participation in a complex commercial industry without adequate knowledge or protection. Leo Tolstoy described the broad issue in personal terms as ... 'being carried on the peasant's back while choking the peasant, and yet assuring himself and others of his concern to ease the lot of the peasant by whatever means, except getting off the peasant's back'. Transcending the materialistic developmental approach seems impossible; thus a practical solution seems to be the accepting two types of Thai citizens, the urban and the rural, or, those consumers forming part of the global elite and the self-sufficient. However, the self-sufficient are, by definition, no longer existing to subsidise the lifestyle of the elite, which includes the middle classes. If the poverty is considered as the absence of an ability to work in a creative and productive manner to look after

¹⁵³⁴ Tandhanan, Mallika et al. (2000)

¹⁵³⁵ Adulyadet, Bhumipon (1997)

¹⁵³⁶ Board of the Royal Projects (1999)

¹⁵³⁷ Adulyadej, Bhumibol. (1997)

¹⁵³⁸ Phongpaichit, Pasuk. (1999)

one's self and one's family, allowing a self-sufficient farmer to live in peace while enjoying social services similar to others in the society may represent true development in Thailand. It would also facilitate consideration of environmental care as part of a life-style approach to agriculture.

Summary

Key points pertinent to Thai agriculture arising from this discussion related to social, cultural and environmental matters may be summarised as:

- Environmental management in Thailand is inseparable from global food demand and development thought which respectively require an efficient and responsible Thai agriculture in an environment which it has significantly changed, mainly through rising commercial demands which emerged in Ayutthaya, increased with Rama IV's modernisation, and assumed national importance in recent decades.
- Through a period of rapid population increase, poor farmers have been forced into more sensitive areas while urban values shifted with Western influences which falsely assumed that all essential underpinnings of economic development existed, resulting in environmental decline and social inequity.
- The recent economic crisis and religious philosophers have stimulated a rise in environmental concern which, notwithstanding purist religious views, has led to a popular eco-Buddhism which promotes environmentally and socially sensitive alternatives to commercial agricultural practices, one of which is a broadly based and uniquely Thai approach to self-sufficiency for small-holder farmers.

Chapter 15

Whither Thai Agriculture?

Thai agriculture has created a culture and a nation. In an era in which agricultural production is universally under-valued in social terms, the continuing export strength of Thai agriculture alone is insufficient to ensure its secure future. Its future shape is now likely to be determined by global pressures on environmental management and domestic social pressures, as much as are financial matters. These trends are already evident.

This chapter takes a future perspective by considering the evolution of Thai agriculture, Thailand's current position, policy outcomes, and the effects of the recent Asian financial crisis. By comparing these perspectives, some challenges now facing the sector are introduced as the conclusion of the story of Thai agriculture to date.

From Past to Present

This section draws from each of the preceding chapters to present an integrated overview of Thai agriculture, from its various origins to recent commercial, social, and environmental outcomes.

From shared origins with wider Asian agriculture as hunters and gatherers were gradually dominated by migrating wet rice agriculturists, agro-cities, and then State-religious Empires prospered while they managed rice production well. More than a millennium ago, the Tai ethnic group migrated from China with wet glutinous rice technologies, aspects of which proved sustainable into the twentieth century. Integration of Tai and Mon-Khmer systems enhanced water control, and produced a complex blend of religious associations, including an agriculturists' view of the natural environment requiring change to suit man, and fearsome in its natural state. Rice culture determined community organisation and government administrative structures within an embracing and pragmatic culture, which was easily able to produce a surplus.

With the political consolidation at Ayutthaya, which laid foundation for today's nation, the Central Plain was gradually developed and a relationship between rice agriculture and the security of the Kingdom became established. Expansionary war spoils, in the form of labour, enhanced the role of rice as an exportable and taxable commodity of small-holder producers who responded to market forces and relaxed labour laws. Chinese and European domination of export markets led them into agribusiness, for the beginning of what would become a major production and processing economy. Agriculture expanded, fuelling population increase until accessible land was expended and agricultural prices fell, although output increases continued with intensification of production with concomitant environmental concern. Agribusiness and government cooperation expanded the sector further while assuming that small-holders could continue to be taxed while isolated from the profits of the nation. In this state, Thailand emerged as a major

agricultural exporter, receipts from which funded national development and crisis recovery, as its production base became less understood by decision-makers.

Diversification of the economy necessarily reduced the relative contribution of agriculture to GDP, which caused its other benefits of employment, crisis resilience, self-sufficiency, rural social support, and cultural custody, to be undervalued. National planning approaches came with irrevocable reliance on the global economy and widespread adoption of green revolution technologies, with Thailand being able to increase production at a lower environmental cost than most other countries. However, environmental and social costs are indicated by extreme forest destruction, which originated with foreign then illegal local logging, to an extent that the principle viable hope for reforestation is now tied to community involvement.

Organisations supporting Thai agriculture include government and agribusiness. From embryonic institutions at Sukhothai, Ayutthaya evolved agricultural taxation and dispute resolution systems, which emerged as today's departmental structures. Constrained by culture, institutions have produced outputs beneficial yet below potential in research, education, and technology transfer, with a bias toward commercial agriculture funded by credit. Agribusiness similarly emerged from Ayutthaya through colonial and, in particular, Chinese traders who worked with the Crown for economic expansion. After World War II, government also entered agribusiness with variable outcomes, and private agribusiness expanded rapidly with agricultural production from the 1960s, with government assistance, including contract small-holder schemes aimed at lifting all producers into a commercial system.

However, small-holders continued to underpin the economy by producing exported surpluses while supporting their 70 percent of the population from family farms which were much more than a phase toward industrial agriculture. Their intensive integrated production systems allow high quality outputs and efficient use of waste products, which still have not been adequately valued. Encouragingly, agriculture is now increasingly viewed as a social rather than a financial sector in planning, and linked to rising poverty, environmental, and cultural loss concerns. Seeking a balance between this perspective and Thailand's inseparability from global food demand and development politics has now highlighted the need to rectify past omissions in such areas as social equity, environmental management, enforceable legal structures, wider education, and religious and cultural values.

The fertile and well watered land which diverse ethnic groups developed to become one of the world's few major agricultural exporters, now leads the world in rice, rubber, canned pineapple, and black tiger prawn production and export, and is the region's largest exporter of chicken. Feeding more the four times its own population from an agriculture less intensive than that of most of its neighbours, Thailand has real potential to reduce poverty among marginal farmers while enhancing export earnings from agriculture; both rely on strengthening of education, research, legal, and social equity programs. These may be addressed in the wake of the recent Asian financial crisis, which has coincided with a rise in popular religious and secular proposals for

environmentally and socially sensitive alternatives for small-holder farmers coexisting with commercial agriculture. Nevertheless, hopes of rapid industrialisation continue to be seen by some planners as the basis for addressing these diverse social issues.

Current Position

Thailand ranks as a lower-middle income country with its neighbours the Philippines and Papua New Guinea, and other such countries as, South Africa, Sri Lanka, Kasakstan, Iran, Egypt, and Guyana. It differs from upper-middle income countries such as South Korea and Malaysia, low-income countries such as Indonesia and Vietnam, and high-income non-OECD countries such as Singapore and Taiwan.¹⁵³⁹ It also differs in the generation of its wealth from agriculture which has made it dominant in world rice export, and production and export of black tiger prawns, canned pineapple, and rubber,¹⁵⁴⁰ and a significant exporter and/or producer of cassava, maize, sugar, oil palm, chicken meat, and beans, with unrealised potential in other crops, livestock, and fisheries.

General comparisons mask Thailand's leading agricultural role; consider for example, Thailand's rankings, such as thirty-second among pig meat producers, seventeenth for chicken meat,¹⁵⁴¹ and producing something less than four percent of the global rice.¹⁵⁴² Such comparisons naturally favour nations with larger land areas, and may be better expressed as production per unit area or population, or even on the basis of the standard of living allowed from wealth derived mainly from agriculture. Thailand's standard of living, which approaches the world average¹⁵⁴³ on a price parity basis, owes much to its natural resource base,¹⁵⁴⁴ and its development of agriculture as abundant descriptive displays attest.¹⁵⁴⁵

The first national Plan is sometimes suggested to have begun the change from traditional self-sufficient agriculture to modern methods.¹⁵⁴⁶ In fact, foreign involvement at this time probably spurred economic development, part of which was national planning, rather than the Plans themselves generating economic growth. Similarly, traditional farming did not disappear, but rather continues in some areas as a form of eco-farming, while in others, commercial methods have been practiced for decades to the extent of technology available. Thus recent determinations that integrated farming can be more profitable than mono-culture¹⁵⁴⁷ and can underpin new developments such as integrated chemical-free production of fruits, vegetables, and spices,¹⁵⁴⁸ and milk,¹⁵⁴⁹ might be considered a maturing of the analyses which allows alternatives to be integrated with development

¹⁵³⁹ World Bank (1999)

¹⁵⁴⁰ FAO (1999)

¹⁵⁴¹ FAO (1999)

¹⁵⁴² FAO (1999)

¹⁵⁴³ World Bank (1999)

¹⁵⁴⁴ Arbhabhirama, Anat, Phantumvanit, Dhira, Elkington, D. and Ingkasuwan, P. (1987)

¹⁵⁴⁵ OAE (1992)

¹⁵⁴⁶ Puntasen, Apichai and Preedasak, Pardorn (1998)

¹⁵⁴⁷ Watanabe, K. (1994)

¹⁵⁴⁸ Puntasen, Apichai and Preedasak, Pardorn (1998)

¹⁵⁴⁹ Chantalakhina, Charan (1999)

proposals. Proposals now accommodate trends in social needs and global markets, among other factors. Such growing awareness of the social and economic benefits of small-holder integrated agriculture, and continued low prices for agricultural commodities, portend significant and immanent changes in Thai agriculture.¹⁵⁵⁰

Thailand, in common with other less developed nations, has traditionally taxed agriculture to an extent equivalent to 25 percent of production,¹⁵⁵¹ although outflows may have been less than in some Latin American and African countries.¹⁵⁵² Income, asset, and access disparities between rural and urban areas, some highlighted since the 1997 financial crisis, may not have been factored into these analyses. The current situation is a product of both history and policy outcomes, which in many cases have differed from intentions.

Policy Outcomes

Through the 1950s and 1960s, industry and agricultural policy were sublimated to a transcending political need for stability. Industrial development relied on aid and continued income for agricultural products, although the approach proved unsustainable. The emergence of an urban middle class, with an expectation of continued prosperity which was ultimately not met, led to political turmoil in 1973; one outcome was industrial policies which considered the well-being of urban centres in terms of employment creation, supply of goods, and infrastructural development.¹⁵⁵³ Such investment consolidated the traditional post-1932 revolution elite as the military, civil service, and aristocracy,¹⁵⁵⁴ with the middle class aspiring to associate with these ranks.

Yet agriculture remained the most international business of Thailand. Notwithstanding global over-supply of agricultural commodities, which may well continue post-GATT, Thailand's advantages in export agriculture have so far outweighed limitations placed on it through inadequate research and enabling legislative environments, and development Plans to the 1990s continued to rely on agriculture's profits and social savings to fund national development. However, financial success increased the gap between poor and commercial farmers in the absence of adequate social support programs.¹⁵⁵⁵

Even before the 1997 crisis, the total agriculture sector represented more than 50 percent of the economy,¹⁵⁵⁶ with a high net positive trade balance which contrasted strongly with that for non-agricultural trade,¹⁵⁵⁷ within natural resource related exports, agriculture represented some 90 percent.¹⁵⁵⁸ However, recording the contribution as only some 11 percent of GDP, led to further under-emphasis in financial, and especially social

¹⁵⁵⁰ Puntasen, Apichai and Preedasak, Pardorn (1998)

¹⁵⁵¹ Fulginiti, L.E. and Perrin R.K. (1993)

¹⁵⁵² Yamada, J. (1998)

¹⁵⁵³ Phogpaichit, Pasuk. (1978)

¹⁵⁵⁴ Meesok, Oeg Astra., Tinakorn, Pranee., and Vaddhanaphuti, Chayan. (1989)

¹⁵⁵⁵ Siamwalla, Ammar., Setboonsarng, Suthad., and Patmasiriwat, Direk. (1989)

¹⁵⁵⁶ Trébuil, G. (1995)

¹⁵⁵⁷ OAE (1998)

¹⁵⁵⁸ Arbhahirama, Anat, Phantumvanit, Dhira, Elkington, D. and Ingkasuwan, P. (1987)

terms,¹⁵⁵⁹ and produced the issues which have now brought Thai agriculture to a cross-roads.¹⁵⁶⁰

Past policies which aimed to benefit all citizens through general wealth creation, falsely assumed that Thailand could rapidly industrialise. Currently Thailand has a GNP per capita approximately seven percent of that of the USA (19 percent on a Purchasing Power Parity basis) and, 5.5 percent of that of Switzerland (18 percent on PPP basis)¹⁵⁶¹ and a disparity of income of 46 percent on the GINI scale where zero represents equality across the whole population. Swiss or USA GNPs may not be an espoused aim of Thailand, but those of Singapore and the Republic of Korea have been; yet, Singapore's per capita GNP exceeded that of the USA in 1998, and Thailand's GNP per capita was less than 30 percent of that of the Republic of Korea. As 'increasing the cake' economics is balanced with social equity,¹⁵⁶² aspirations to wealth from widespread industrialisation can be viewed in terms of relative influence to control trans-national access to human and natural resources, and markets.¹⁵⁶³ Such realities favour Thailand's rising consideration of mixed commercial and self sufficient agriculture.

The developmental imbalance, emanating from a desire to achieve an industrialised status,¹⁵⁶⁴ eventually highlighted the need for increased inputs¹⁵⁶⁵ into agriculture, including research and environmental regulation, as well as rural poverty.¹⁵⁶⁶ While it may be argued that more has been invested in agriculture than received from taxes,¹⁵⁶⁷ and even that the rice tax unwittingly stimulated crop diversification,¹⁵⁶⁸ the continuous increases in agricultural efficiency essential to maintenance of some income equity in an industrialising economy, have not eventuated. High potential returns to research have been shown,¹⁵⁶⁹ yet not realised. Education, which enhances the ability to adopt new technologies, has similarly lagged in rural areas.

Policy lags led to Thai rice producers subsidising consumers, even beyond Thailand,¹⁵⁷⁰ to Thai consumers subsidising sugar and sugar cane producers,¹⁵⁷¹ and even to an assumption that rural access to social services need not be of the same level as in urban levels. The impact of agriculture on the environment, initially through conversion of forest to paddy fields, then later through expansion of upland cropping, continued with the economic marginalisation of poorer farmers who were forced into unsustainable agricultural practices.¹⁵⁷² By viewing agriculture primarily as an export income generator

¹⁵⁵⁹ ADB (1998)

¹⁵⁶⁰ Siamwalla, Ammar. et al (No date)

¹⁵⁶¹ World Bank (1999)

¹⁵⁶² Camadessus, M. (2000)

¹⁵⁶³ Sivarakasa, Sulak (1990)

¹⁵⁶⁴ Krongkaew, Medhi. (1989)

¹⁵⁶⁵ NESDB (1983)

¹⁵⁶⁶ Krongkaew, Medhi. (1986)

¹⁵⁶⁷ Meesok, Oeg Astra., Tinakorn, Pranee., and Vaddhanaphuti, Chayan. (1989)

¹⁵⁶⁸ Setboonsarng, Suthad. and Evenson, R.E. (1991)

¹⁵⁶⁹ Setboonsarng, Suthad. and Evenson, R.E. (1991)

¹⁵⁷⁰ Kunstadter, P. (1989)

¹⁵⁷¹ Arbhabhirama, Anat. et al (1987)

¹⁵⁷² Tingsabadh, Charit. (1989)

in conjunction with agribusiness, environmental impacts and poverty were subordinated. Policy orientations which considered agriculture a sunset industry further reduced interest in sustainable agricultural practices, leading to potentially large social and environmental recovery costs.¹⁵⁷³

Reliance on rapid economic growth to reduce poverty failed to reach the poorest areas. Government welfare programs were, according to the World Bank, limited, uncoordinated and, in many cases, ineffective. Accordingly, improved administration of resource allocations to poverty areas, and fewer and better managed and funded programs were recommended.¹⁵⁷⁴ Social sustainability requires welfare systems as well as cultural identity, improved social mobility, and the creation of institutions able to efficiently administer government programs.¹⁵⁷⁵ These may now be considered in the light of a range of experiences previously considered to be beyond the purview of government.

Rural development can benefit from pilot experiences in environmental and social areas, using such techniques as electronic media,¹⁵⁷⁶ revival of social institutions like water user groups,¹⁵⁷⁷ and appropriate technologies.¹⁵⁷⁸ The critical importance of agriculture is recognised in small yet powerful components of Thai society¹⁵⁷⁹ which understand its high levels of social and production efficiency,¹⁵⁸⁰ and need for efficient resource laws¹⁵⁸¹ to reorient decision making. The existing situation of, for example, open access to water,¹⁵⁸² and its allocation on administrative or technical rather than economic or social principles,¹⁵⁸³ has supported investment in dams,¹⁵⁸⁴ including renewed consideration of the Mekong Pa Mong Dam, to increase returns from agriculture.¹⁵⁸⁵ The need for specific natural resource management policies has been clear since the 1970s¹⁵⁸⁶ when legislation was proposed for the National Environmental Quality Act (1975), although its effective use has been minimal.¹⁵⁸⁷ Perhaps foreign environmental and social concerns attached to trade and market conditions¹⁵⁸⁸ will catalyse such change, as seems to be the case with forest destruction.¹⁵⁸⁹ Certainly, Thai intellectual and foreign influence since the 1997 Asian financial crisis has highlighted such issues.

¹⁵⁷³ Kaosaard, Mingsarn and Rerkesem, Benjawan (1999)

¹⁵⁷⁴ World Bank (1999)

¹⁵⁷⁵ Serageldin, I. (1996)

¹⁵⁷⁶ TDRI (1987)

¹⁵⁷⁷ Attwater, R. (1998)

¹⁵⁷⁸ Kaosaard, Mingsarn and Mrekesem, Benjawan (1999)

¹⁵⁷⁹ Chanthalakakhana, Charana and Sakulaman, Phakaphan. (1999)

¹⁵⁸⁰ TDRI (1992)

¹⁵⁸¹ Siamwalla, Ammar, Setboonsarng, Suthad. And Patamasiriwat, Direk (1987)

¹⁵⁸² Christensen, S.R. and Boon-long, Areeya (1994)

¹⁵⁸³ Kaosaard, Mingsarn and Kositrat, Nisakorn (1993)

¹⁵⁸⁴ Hirsch, P. (1998)

¹⁵⁸⁵ Mekong Secretariat (1978)

¹⁵⁸⁶ TDRI (1986)

¹⁵⁸⁷ Charoenpanij, Sriracha (1989)

¹⁵⁸⁸ Falvey, L. (2000)

¹⁵⁸⁹ Sadoff, C.W. (1992)

The context for the future of Thai agriculture is determined by trends of the past. While the 1997 crisis had specific impacts, these probably have little effect on long term price trends of agricultural products, shifts from trade barriers to quality assured specifications, and continued development of other sectors, with consequent reduction of the proportional importance of agriculture. Within Thailand, trends identified in the current decade¹⁵⁹⁰ remain important, including:

- increasing capital intensity in agricultural production
- increasing migration to cities of poorer farmers
- increased political polarisation between city and rural areas.

With these outcomes, despite other policy intentions, alternative approaches, including self-sufficient agriculture and rural social programs, are receiving some credence among the widespread financial plans emanating from the Asian crisis.

The Asian Financial Crisis

The crisis provided an opportunity for more reflective decision making than had recently been evident; nevertheless, much analysis of agriculture in the post-crisis period related to its income production capacity. Currency depreciation was expected to favour agricultural exports following the crisis, but global market variations, impediments to rapid response through the early months of the crisis, and rising interest rates combined to limit benefits. Despite Thailand's pre-eminence in rice and rubber export, declining prices outweighed increases in export volume of these products, resulting in reduced export income in 1998. However, notwithstanding adverse climatic and market circumstances, agricultural production rose by 2.5 percent in 1998 compared to falls of 7.5 percent for manufacturing, 22 percent for construction, and 7.1 percent for the services sector.¹⁵⁹¹ Agriculture already has slipped from the confidence-building rhetoric of 2000.¹⁵⁹²

The renewed if temporary interest in agriculture¹⁵⁹³ was clearly related to its export income¹⁵⁹⁴ through which it mitigated the full effect of the first year post-crisis while international support was being garnered. As Thailand's slipped to become the ninth largest global debtor, and the one with the highest proportion (38 percent) of short term debt,¹⁵⁹⁵ recent objections to foreign assistance were reconsidered and official external assistance in 1998¹⁵⁹⁶ rose to \$10.4 billion. At the same time, rural communities absorbed unwanted labour from cities, in turn displacing employed women.¹⁵⁹⁷ The disparities which caused the problems of the rural sector although foreseen,¹⁵⁹⁸ remained unheeded until wider consideration of the crisis stimulated concern about social and political issues surrounding agriculture.

¹⁵⁹⁰ Ieosriwong, Nithi. (1993)

¹⁵⁹¹ Warr, P. (1999)

¹⁵⁹² Leekpai, Chuan. (2000)

¹⁵⁹³ Pongpaichit, Pasuk. (1999)

¹⁵⁹⁴ Poapongsakorn, Nipon (1999)

¹⁵⁹⁵ World Bank (1999)

¹⁵⁹⁶ ADB (1998)

¹⁵⁹⁷ Siamwalla, Ammar (1999)

¹⁵⁹⁸ Akrasanee, Narongchai., Dapice, D. and Flatters, F. (no date)

The crisis largely undid past gains in reducing rural poverty. Stabilising and restructuring of the economy has now shifted to the three objectives of; restoring economic growth through structural reforms, ensuring that poorer segments of the society are insulated from effects of the crisis and recovery, and encouraging reinvestment of international capital. While the World Bank predicts that recovery will take longer than that of the Mexican and Argentine crises of 1994, official optimism aims to mobilise the international community to allocate aid and investment resources.¹⁵⁹⁹ However, the tentative and conditional language which continues to dominate research documents, suggests that Thailand and Indonesia are in great depression similar to USA and Germany¹⁶⁰⁰ in the 1930s.

A fall in domestic consumption of 11 percent caused GDP to contract by 9.4 percent in 1998, with consequent reductions in private investment by almost 50 percent. Essential government budgetary cuts of 18 percent in the first half of 1998 exacerbated economic contraction, until a possibly stable position of 12 to 24 percent reductions in real wages.¹⁶⁰¹ The unemployed population, including the seasonally inactive labour force, increased to more than 11 percent of the total labour force during 1998, while poverty incidence in rural areas increased to 13 percent of the population.¹⁶⁰² Gaining investor confidence in such circumstances has been deemed a priority. Also important is domestic confidence and understanding, which recent surveys suggest is low; for example, a Suan Dusit Poll suggest that 69% of civil servants consider the economy continues to decline in the second quarter of 2000, and only five percent consider that the disparity between rich and poor has increased. At the same time, a Bangkok University survey indicated that only five percent of the general public consider that the existing bureaucratic system is efficient.¹⁶⁰³

Potential for further profits from agriculture exist through the expected recovery period, although government approaches do not reflect innovation. For example, plans to extend credit to small-holders and cooperatives entail risks which have been detailed earlier. In social terms, the impact of the crisis appears in poverty statistics of the Northeast and the South where poverty respectively increased by 3.4 percentage points to 22.7, and by 4.2 points to 15.6. Labour availability in rural areas increased as rural migrants to the city returned unemployed to farms entering a drought period in 1998,¹⁶⁰⁴ combining to exacerbated environmental impacts, which paralleled those resulting from private sector efforts to reduce debt through short term profit making.¹⁶⁰⁵

The crisis exposed inadequacies of the Thai development model. Growth dependant on foreign capital and technology was proven unsustainable.¹⁶⁰⁶ Industrialisation was

¹⁵⁹⁹ World Bank (1998)

¹⁶⁰⁰ World Bank (1999)

¹⁶⁰¹ World Bank (1999)

¹⁶⁰² RTG (1999)

¹⁶⁰³ Nation (2000)

¹⁶⁰⁴ Warr, P. (1999)

¹⁶⁰⁵ Dauvargne, D. (1999) .

¹⁶⁰⁶ Leekpai, Chuan (1999)

revealed to have been only cheap labour-based assembly lines which used simple technology and thus masked the weakness of the essential role of education and research for an industrialised economy. Investment attracted for reasons other than cheap labour, except for logical expansion of agribusiness, included large scale speculation which tested the regulatory power of government and the culture itself, as it fuelled the highest global economic growth rates of the era. Now more realistically viewed, international business considers Thailand to be possibly a generation behind the education, training, and science of its peer neighbours (Table 15.1).¹⁶⁰⁷

Table 15.1 Competitiveness Indicators of Selected Asian Countries, 1999¹⁶⁰⁸

Indicator	Unit ^a	Thailand	Singapore	Malaysia	Philippines
Years of Schooling	Bus perc'n	4.0	6.0	5.2	5.5
Primary Enrolments	%	73	94	91	100
Secondary Enrolments	%	57	72	62	79
Maths and Science Education	Bus perc'n	4.3	6.5	5.0	3.9
Staff Training	Bus perc'n	4.0	5.5	4.9	4.9
Management Education	Bus perc'n	4.9	5.5	4.8	5.9
Total Quality Management	Bus perc'n	3.8	5.4	4.5	4.5
Scientists and Engineers	Bus perc'n	4.3	5.6	4.6	4.6
Technology Transfer from	Bus perc'n	4.9	6.2	5.8	5.4
Foreign Investment					

^aBus perc'n = Business Perceptions ranked on a scale of 1 to 7

World Bank loans to Thailand in response to the crisis are based on:

- restoring competitiveness through corporate restructuring, financial sector strengthening, and fiscal stimulus
- strengthening public sector governance through capacity building in private expenditure management, administrative reform, and privatisation
- sharing growth through support for the unemployed and the vulnerable, empowerment of local communities, and financing of social programs.

Once again, such foreign forces appear to determine the direction of the Thai economy.

Recovery from the crisis dominates much current analysis and planning. Reliance on generic Asian remedies,¹⁶⁰⁹ which ignore different economic structures between countries, can easily distract from Thailand's specific needs, which include support for rights of rural education and self actualisation through land and other reforms.¹⁶¹⁰ Trade policy similarly has special needs where the majority of the population is supported by agriculture, where it remains the major part of the economy, and embodies much of the cultural values of the society. As the major regional agricultural exporter, Thailand continues to advocate fair and tariff-free market access, elimination of domestic subsidies, and rare and judicious use of export subsidies, while seeking minor concessions in the tariffication of rice. Yet farmers are expected to continue to be the

¹⁶⁰⁷ Brimble, P. (1999)

¹⁶⁰⁸ Brimble, P. (1999)

¹⁶⁰⁹ Stiglitz, J. (1999)

¹⁶¹⁰ Putzel, J. (1999)

most disadvantaged groups from such WTO agreements.¹⁶¹¹ Small-holder agriculture including social issues will be the determinant of success in this decade, rather than national income from agricultural exports. The latter may require little input by government as the expected rise in demand for agricultural products should provide windfall profits to Thailand through its regional advantage as a reliable supplier of primary and processed products which can be further enhanced through improved competitive ability.¹⁶¹² Gaining foreign investor's confidence is part of economic approach being pursued.

The Challenge

The forces on Thai agriculture now are global in the forms of market pressures and foreign influence associated with economic stabilisation. The overall environment for the significant change which will affect agriculture is created by a new Constitution approved in late 1997, which aims to reduce corruption, and to improve public expenditure management and service delivery. Among other reforms, it also provides for universal access to education through grade 12, and the involvement of the private sector in educational delivery.¹⁶¹³

Thailand's comparative advantages in agriculture are difficult to determine at present,¹⁶¹⁴ as wage rates, availability of capital, adaptability of technologies, and confidence of producers adjust to post-crisis norms. Trends suggest that horticultural and livestock products will be of importance, while traditional crops, particularly rice, will continue to decline.¹⁶¹⁵ Further uncertainties exist about environmental and social policies,¹⁶¹⁶ outcomes of domestic and regional competition for water,¹⁶¹⁷ returns from flood irrigated agriculture, and the reliability of water catchments.¹⁶¹⁸ These might only be reduced by lower production costs¹⁶¹⁹ associated, not only with yield increases,¹⁶²⁰ but with increased quality,¹⁶²¹ and development of new processed products.

Such opportunities accrue to commercial agriculture which increasingly must accommodate consumer preferences, such as pesticide-free food, biologically safe products, and assurances that products are produced in a responsible manner.¹⁶²² Demand for higher priced food items by richer urban enclaves in China or India may also suit Thailand, more so if the food security policies of those countries fail.¹⁶²³ However,

¹⁶¹¹ Malhotra, K. (1999)

¹⁶¹² BTI (1999)

¹⁶¹³ World Bank (1999)

¹⁶¹⁴ Siamwalla, Ammar (1992)

¹⁶¹⁵ Poapongsakorn, Nipon (1995)

¹⁶¹⁶ Siamwalla, Ammar, (1999)

¹⁶¹⁷ Setaputra, Sacha, Panayotou, T. and Wangwacharakul, Vute (1990)

¹⁶¹⁸ Van Beek, S. (1995)

¹⁶¹⁹ World Bank (1986)

¹⁶²⁰ Evans, L.T. (1998)

¹⁶²¹ Isvilanonda, Somporn and Poapongsakorn, Nipon. (1995)

¹⁶²² Erath, H. (1999)

¹⁶²³ Yifu Lin, Justin (1998)

there is no panacea in linking market reform and credit-based intensive agriculture to development.¹⁶²⁴ Self-sufficient farmers seeking to sell a small surplus may not readily benefit from such innovations as the WTO 20 percent reduction in subsidies on agricultural products in more developed countries, even though it should open markets to commercial Thai agriculture. WTO reductions in import duties of around 24 percent, on the other hand, would certainly challenge subsidised Thai agricultural commodities, particularly soy beans and sugar.¹⁶²⁵

Official development assistance, which has often introduced Western concepts of equity to development, is presently poised to again support Thai agriculture. Receipts in 1990 of 0.9 percent of GNP contrast with immediate pre-crisis (1997) receipts of 0.4 percent, reflecting a declining donor influence in the economy. Since 1997, foreign assistance projects can be viewed as indicators of policy directions, with influence extending beyond financial contributions from conditional loans accepted by government in the absence of other funds. For agriculture, projects will focus on, in the case of the Asian Development Bank¹⁶²⁶ for example; further increases in productivity, enhanced export competitiveness, and improved sector governance and management. Specific activities include improvements to watershed and soil management, land utilisation, access by the poor to credit, farmer driven research and extension, and reduced government procurement and subsidy. The assumption that credit can assist poor farmers continues to pervade most such plans, thereby indicating continued tacit orientation to national wealth creation as the central poverty alleviation policy. Current external assistance to the agricultural sector includes a range of small projects, including many of significance in the NGO Sector (Table 15.2).¹⁶²⁷ Separate poverty reduction policies remain an imperative.

Table 15.2 Grants (G) and Loans (L) to Agriculture (currencies in millions)¹⁶²⁸

Source and Type	Subject of Project	Amount
Production and Environment		
European Union G	Fruit and Vegetable Production in the Northeast	EU B283; RTG B180
European Union G	Pilot Rubber Tree Cultivation in the Northeast	EU B19; RTG B6
European Union G	Development of Silk Production in the Northeast	EU B362; RTG B3
Japan, JICA G	Dairy Farming Development in the Central Region	na
Denmark G	Management of the Western Forest Complex	DK 14.8
Denmark G	Sustainable Agricultural Development	DK 25.4
Germany G	Regulatory and Policy Reform for Pesticides	B67
Japan, JICA G	Reafforestation and Extension in the Northeast	na
Japan, JICA/OECF L	Integrated Development of Land Reform Areas	Y3,617
World Bank, Australia L	Land Titling Project Phase III	\$25.3
Canada G	Natural Resources and Environmental Management	Can \$8.9; RTG B81
European Union G	Decision Support for Coastal Area Management	EU 0.385
European Union G	Community Participation in Mangrove Management	EU 0.902
European Union G	Natural Resource Management, Mae Chan	EU 0.216

¹⁶²⁴ Zeller, M. and Sharma, M. (1998)

¹⁶²⁵ Itharatanna, Kajonwan (1999)

¹⁶²⁶ ADB (1999)

¹⁶²⁷ ADB (1999)

¹⁶²⁸ ADB (1999)

European Union G	Phu Khieo Wildlife Sanctuary	EU 6.0 (indicative)
World Bank L	Natural Resources Management	\$200 (indicative)
Quality Improvement, Processing and Marketing		
Japan, JICA G	Chiang Mai University Plant	na
Japan, JICA G	Research on Quality of Fisheries Products	na
Japan, JICA G	Research on Forestry and Agricultural Plant Materials	na
USA, Japan, Australia, Denmark G	Support to the National Center for Genetic Engineering and Biotechnology	na
Rural Credit		
Germany G	Linking Self-Help groups to Banking Services	DM 7
Japan, OECF L	BAAC Credit for Rural Development	Y12,300
Japan, OECF L	Agricultural Credit for Job Creation	Y18,360
European Union G	Social Support Project	E15
European Union G	Northeast Poor Farmers Scheme	B343
ADB L	Rural Enterprise Credit Project	\$200
ADB L	Small Farmers Credit Project	\$50
Institutional and Agricultural Support Service Strengthening		
Australia G	Agricultural Research and Development Support	Small Grants
France G	Cotton, Rubber, and Peri-Urban Vegetable	na
FAO, UNDP, UNIDO G	Agricultural Resource Management Program	Local
Japan, JICA G	Land and Water Conservation Center	na
Japan, JICA G	National Institute of Animal Health Project Phase 2	na
Japan, JICA G	Technical Assistance to MOAC	na
CGIAR G	Basic and applied research, development and training	na
Agricultural Infrastructure and Water Resource Development		
European Union G	Northeast Water Management Improvement	EU B870; RTG B518
EU, Belgium. G	On-Farm Development, Huai Mong Irrigation	EU B166; RTG B300
Rural Development and Social Projects Related to Agriculture		
Canada G	Assistance to Local Development Foundation	C\$8.1
Canada G	Regional Rural Development Programs	na
UNDP G	Sustainable Poverty Alleviation	\$6.8
UNDP G	Thai-United Nations Collaborative Action Plan	\$0.25
Germany G	Community-based Integrated Rural Development	DM 8.8
World Bank L	Social Investment Program	\$120

Improved general education is perhaps of greatest benefit to natural resource management, as it enables adoption of appropriate technologies with a concomitant decrease in pressure to open new lands.¹⁶²⁹ Recommendations in science and technology now include social considerations, not just as a field of imported ideas, but as one to:¹⁶³⁰

- create new types of employment without eliminating old ones
- reduce job tedium rather than make workers machinery components
- increase personal and national income evenly across industrial and agricultural sectors
- increase productivity and economic diversity without incurring greater pollution
- improve infrastructure without increasing urban congestion or rural disintegration
- acknowledge increased global integration without loss of Thai identity.

¹⁶²⁹ TDRI (1998)

¹⁶³⁰ Yuthavong, Yongyuth and Wojcik, A.M. (1997)

The beginnings of policies, which encourage self-sufficiency as a choice within an improved rural social service provision, and for enhanced natural resource management, may be contained in such sentiments.

It seems likely that specific natural resource management plans¹⁶³¹ will evolve. In social terms, these may be linked to agro-ecological thought through practical self-sufficient agriculture, as a major component of balanced rural development which acknowledges the independence of Thai small-holder lifestyles. Experience to date favours such embracing development approaches, together with such lessons as:¹⁶³²

- agricultural policies should not be oriented to poverty alleviation
- technology development research should be encouraged and increased
- prices and markets of agricultural raw materials should not be manipulated
- extension to advanced agriculture should be privatised
- long-term loans should be provided to farmers in association with agribusiness
- tariffs should be reduced
- agricultural value adding industries should be promoted
- natural resource management should be enhanced
- farmers should participate in development planning
- export quality control and marketing should be improved
- government agencies should be reorganised to meet new priorities.

Such recommendations span commercial agriculture and agribusiness and provide potential benefits to the whole rural sector. However, near subsistence small-holders require a different approach. While it is implied that this can be delivered by separation of agricultural from poverty alleviation policies, the latter must acknowledge self-sufficiency which sells surplus production. Agriculture embraces social more than financial and technical sectors, while the majority of the Thai population are involved in it and earn little. As financial institutions such as development banks must take a financial perspective, even on social programs, government with their many unsolicited advisers, remains the obvious responsible voice for small-holders. With a highly educated public service and improved bureaucratic procedures, such a new role for government in agriculture and rural development appears feasible, although considering traditions, difficult.

¹⁶³¹ Arbhabhirama, Anat. et al (1987)

¹⁶³² Khaosaard, Mingsarn (1998)

The story of Thai agriculture is largely one of wet rice culture, which built cities with God-Emperors, long after first food gatherers. With glutinous rice, migrating Tai sustained yields based on the *muang fai*, founding a sound governance device for a civil State with surplus rice. Ayutthaya rose, secure and wealthy, while its rice was cared for and healthy; then foreign business emerged and grew, as Thai numbers and new lands ensued. Declining in a pure fiscal term, agriculture's real role remained firm for work, income, and social support, and from global force, an old resort. Imported plans allowed excesses, unredeemed by research successes, as roles changed to knowledge extension, in a package of credit expansion. Agribusiness then as State right arm, sought to convert the small to a large farm, losing the complete production system and social values of local wisdom.

Uniquely Thai, farming comprises, ancient irrigation contrivances, and governance based on water control, which support a primary export role. With agribusiness now multinational, foreign deals which mix need with the rational, and scope for increases from techniques known, Thailand seems set to reap what it has sown. As a leader in chicken meat and prawn, and feeding more than four times its own born, from less intense farming than neighbours', markets portend more reward for labours. Yet poverty, research, welfare, and schools, now shown as lacking along with law's rule, define culture and nature's demise, in a land yet to industrialise. Is it income or less poverty, or tradition informing policy, commercial or self-sufficiency? In fact it is all, with real equity. Sunthorn Phu's lament of bull powered mills, might today cause tears for buffalo killed, which is but part of lost social traditions that form the challenge for rural transitions.

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