

**1990 TDRI Year-End Conference on
Industrializing Thailand and Its Impact on the Environment**

**Urbanization and Environment:
Managing the Conflict**

The 1990 TDRI Year-End Conference

***INDUSTRIALIZING THAILAND AND
ITS IMPACT ON THE ENVIRONMENT***

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Research Report No. 6

**Urbanization and Environment:
Managing the Conflict**

**Banasopit Mekvichai
David Foster
Sopon Chomchan
Phanu Kritiporn**

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List of Researchers in the Project

Industrializing Thailand and Its Impact on the Environment

Policy research is a team effort. The names of researchers mobilized to undertake the various studies in preparation for the 1990 TDRI Year-End Conference and their respective topics of responsibility are listed below:

Project Director: Dr. Dhira Phantumvanit
Project Advisor: Dr. Theodore Panayotou

Theme: Natural Resources for the Future

Synthesis Paper #1: Natural Resources for a Sustainable Future: Spreading the Benefits

Researchers: Dr. Dhira Phantumvanit
 Dr. Theodore Panayotou

Research Report #1: Land and Forest: Projecting Demand and Managing Encroachment

Researchers: Dr. Theodore Panayotou
 Dr. Chartchai Parasuk

Research Associate: Khun Chiraphan Kulthubsak

Research Report #2: Deforestation and Poverty: Can Commercial and Social Forestry Break the Vicious Circle?

Researchers: Dr. Sopin Tongpan
 Dr. Theodore Panayotou
 Khun Songpol Jetanavanich
 Khun Ketty Faichampa
 Dr. Charlie Mehl

Research Report #3: Water Shortages: Managing Demand to Expand Supply

Researchers: Dr. Sacha Sethaputra
 Dr. Theodore Panayotou
 Dr. Vute Wangwacharakul

Research Associate: Khun Nittayaporn Ratanachompoo

Theme: Mineral Resources Development and Its Environmental Implications

Synthesis Paper #2: Mining, Environment and Sustainable Land Use: Meeting the Challenge

Researchers: Dr. Theodore Panayotou
Dr. Quanchai Leepowpanth
Dr. Duangjai Intarapavich

Research Report #4: Mineral Resource Development: Making the Best of a Limited Resource

Researchers: Dr. Duangjai Intarapavich
Dr. Quanchai Leepowpanth
Dr. Theodore Panayotou
Dr. Sunt Rachadawong

Research Associate: Khun Panitta Na Nakorn

Theme: Industrializing Thailand and the Impact on Its Environment

Synthesis Paper #3: Industrialization and Environmental Quality: Paying the Price

Researchers: Dr. Dhira Phantumvanit
Dr. Theodore Panayotou

Research Report #5: The Greening of Thai Industry: Producing More and Polluting Less

Researchers: Khun Phanu Kritiporn
Dr. Theodore Panayotou
Khun Kerkpong Champrateep

Research Associate: Khun Amornwan Resanond

Research Report #6: Urbanization and Environment: Managing the Conflict

Researchers: Dr. Banasopit Mekvichai
Mr. David Foster
Khun Sopon Chomchan
Khun Phanu Kritiporn

Research Associate: Khun Maysaya Chanawan

Research Report #7: Energy and Environment: Choosing the Right Mix

Researchers: Dr. Tienchai Chongpeerapien
Khun Somthawin Sungsuwan
Khun Phanu Kritiporn
Khun Suree Buranasajja
Resource Management Associates
(Dr. Wesley Foell, Dr. Mark Hanson,
Mr. Robert Lopez)

Research Associates: Khun Pramote Cheowchaiporn
Khun Wannit Arpechatakorn
Khun Watcharee Santisukpisan

Research Associates: Khun Surassawadee Tanprasat
Khun Surachai Chayawatanakijja

Other Researcher:	Khun Piyanoot Siwabut
Editors:	Ms. Christine Van Roosen Ms. Claudia Winkelman Ms. Nancy Conklin
Secretaries:	Khun Chuchitt Sombunthawong Khun Kwancheevit Pinyakul Khun Rungrat Phurekanokrat Khun Songsiri Suwanjinda Khun Warunee Pariyamekin Khun Haranya Tanaree

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Introduction

At the same time that rapid urban growth is making a major contribution to the economy of Thailand, that same growth is placing a major burden on the physical, environmental, and social infrastructure. Air and water pollution are growing rapidly and the traffic congestion in the Bangkok Metropolitan Region is among the worst in the world. The demand for water in the rapidly growing suburban areas far exceeds the available municipal supply and the resultant groundwater pumping has led to serious ground subsidence. Even the visual amenities of the pastoral landscape threaten to be replaced by a polluted agglomeration of factories and dense housing while critical environmental areas are threatened with extinction.

As part of its ongoing research efforts in environmental quality management, TDRI has undertaken a study to analyze current land use patterns in suburban provinces surrounding Bangkok and make recommendations regarding future policies and strategies for land use planning. The provinces in this suburban ring (Samut Prakan, Pathum Thani, Nonthaburi, Samut Sakhon, and Nakhon Pathom) are the most rapidly growing in Thailand, and potentially among the most important. Each year they receive the largest share of new investment and produce the largest portion of new jobs.

While free market systems have made a major contribution to the Thai economy, it is now evident that total reliance on unbridled private interests will provide neither adequate protection for the environment, nor adequate infrastructure for the community. In the absence of effective government policy, there are insufficient market incentives to assure that the private sector will provide adequate investment in roads, drainage, water supply, or pollution controls. Under the current structure, benefits from land development fall largely to private landowners while the costs (both the financial costs of providing infrastructure and the social and environmental costs of failing to provide adequate infrastructure) fall largely on the public. While it is probably too late to do much advance land use planning for Bangkok itself, the suburban provinces still offer an opportunity to guide development in such a manner that Thailand can obtain the desired mix of economic activities and environmental quality. Major policy issues include the following:

1. Given the history of Thailand's development, as well as that of most developed countries, is it realistic to expect that land can (or should) be reserved for agricultural use where significantly higher economic and employment benefits can be obtained through allowing its conversion to other uses under appropriate supervision?
2. To what extent does the current absence of environmental controls, betterment levies, and effective property taxes constitute a subsidy to irresponsible industries and developers and a penalty to responsible ones?
3. Are land use controls necessary, and if so what forms should they take?
4. Are there appropriate mechanisms such as transferable development rights or development impact fees, which can supplement zoning in order to make it a more equitable and effective tool for guiding development?

The study seeks to analyze current land use patterns, to examine the above mentioned issues, and to provide an overview of emerging policy options for land use planning in the rapidly urbanizing fringe around Bangkok.

Chapter 1

Urbanization in Thailand

THE TRANSITION TOWARD A MORE URBANIZED SOCIETY AND ENVIRONMENTAL CONCERNS

Given recent patterns of national and world urbanization and the government's efforts to implement its urban development policy, the trend of urbanization in Thailand in the near future can be envisioned roughly as follows:

- There will be a spectacular increase in the population growth rate for most urban communities in the country, especially those of the target cities. Within 15 to 25 years, about half the total population of the Kingdom will reside in urban areas (Table 1.1). This will follow the worldwide trend of urban growth rates expected by the United Nations (Department of International Economic and Social Affairs 1988: 176).
- With the increasing trend in urban populations, the associated urban activities in any sector will also increase. These range from extracting and primary production activities, processing, distribution of goods, provision and distribution of services, human development, recreation and public service activities, and residential activities.

Creating the conditions for urban development has often meant interference with the natural environment and, in many cases, outright destruction of part of that environment. The construction and expansion of urban areas has involved innumerable intrusions upon the environment, some of which have been beneficial to nature but many of which have proved detrimental. The concern should be not how to prevent urbanization from infringing upon the natural environment, but rather how urbanization can enhance the total environment. There can be environmentally sound urbanization, within which man can live decently and in ways which will enhance the beauty and harmony of the environment. An environmentally sound process must deal not only with pollution, but also with physical and mental health, the conservation of resources including

Table 1.1 Population, Urban Population, and Percent of Urban Population, 1990-2010

REGION	YEAR	URBAN POPULATION	TOTAL POPULATION	%URB
NORTHEAST	1990	3,462,687	19,320,685	17.92
NORTH	1990	2,567,044	10,803,754	23.76
5 PROVINCES	1990	1,519,072	2,808,318	54.09
SOUTH	1990	1,512,818	7,488,096	20.20
EAST	1990	1,171,086	3,490,838	33.55
WEST	1990	948,716	3,253,667	29.16
CENTRAL	1990	770,392	2,754,853	27.96
NORTHEAST	1992	3,779,155	19,784,124	19.10
NORTH	1992	2,747,318	11,023,241	24.92
5 PROVINCES	1992	1,672,863	2,964,136	56.44
SOUTH	1992	1,650,781	7,788,343	21.20
EAST	1992	1,281,205	3,622,672	35.37
WEST	1992	1,007,310	3,323,940	30.30
CENTRAL	1992	821,281	2,811,707	29.21
NORTHEAST	1996	4,511,746	20,728,087	21.77
NORTH	1996	3,147,438	11,457,931	27.47
5 PROVINCES	1996	2,029,205	3,301,804	61.46
SOUTH	1996	1,967,136	8,407,207	23.40
EAST	1996	1,536,045	3,900,387	39.38
WEST	1996	1,136,226	3,467,455	32.77
CENTRAL	1996	934,121	2,927,045	31.91
NORTHEAST	2010	7,728,156	23,516,189	32.86
NORTH	2010	4,714,466	12,575,276	37.49
5 PROVINCES	2010	3,468,612	4,575,150	75.81
SOUTH	2010	3,340,630	10,414,899	32.08
EAST	2010	2,617,262	4,871,044	53.73
WEST	2010	1,643,015	3,917,612	41.94
CENTRAL	2010	1,377,213	3,270,331	42.11

Source: Thailand Development Research Institute (1990)

aesthetically interesting and pleasing vistas, the transportation of people, the communication of ideas, and a host of other social, cultural, economic, and political issues.

Congestion, traffic jams, air pollution, noise nuisance, uncollected waste, water pollution, and lack of recreational areas and green space, are among the environmental issues that are magnified in urban areas. Conditions in the cities, particularly Bangkok, are subject to close scrutiny by the public, the media, opinion leaders, and decision makers in all sectors of society, as they frequently encounter these forms of environmental degradation. Although very significant efforts have been undertaken by the government to ameliorate environmental degradation, most urban areas are rapidly expanding, both in population and in area. Many urban areas are now inundated with successive waves of in-migration and natural population increases. There are, of course, limits to the number of people that urban areas can support. What is apparent is that these limits have been stretched many times over.

Difficulties arise in attempts to ameliorate urban conditions in Thailand due to the speed of urban growth and the shortage of available resources, including financial resources. Further contributing factors, though less apparent, operate with much greater force and are less amenable to solutions due to these shortages of resources. For instance, experience has shown that the provision of more and better urban expressways provides by itself no more than a temporary alleviation of traffic congestion and does not solve traffic problems in the long run as the number of vehicles increases. Water supply and sewage projects appear to be fighting a losing battle, the backlog is growing faster than it can be cleared. Soaring land prices make urban projects increasingly expensive. Comprehensive urban plans have tended to be unrealistic in terms of resources and capacity for implementation, and they tend to be out of date by the time they are completed. Urban administration is woefully lacking in its capacity to deal with these problems, responsibilities are highly fragmented, and there is a general lack of enforcement of regulations and controls.

The urban environmental problems are legion, but so are the opportunities, especially for prevention. Since we can expect a doubling of the urban population in the near future, it is clear that adequate political incentive must exist to force growth of the city to be ecologically sound, not cancerous and unsustainable. City building and management requires management of the human environment, which entails economic,

technological, and environmental management. There is no nation that can afford not to integrate environmental concerns with urban planning and management efforts.

SPATIAL DEVELOPMENT

According to the Urban Development Coordination Division of the National Economic and Social Development Board (NESDB), the country is divided into 7 regions for planning purposes: the Bangkok Metropolitan Region (BMR), the Central, the Eastern, the Western, the Northern, the Northeastern, and the Southern Regions (Figure 1.1).

In these regions, 18 cities are considered major urban centers. Twelve cities designated as regional growth centers are in the six regions outside the BMR. The other six cities deemed regional growth centers are all in the BMR.

Most cities in Thailand grew from old settlements to become administrative, trade, and industrial centers of local, subregional, regional, national, and international levels. In general, the urban centers in each region have had different historical patterns of development.

For example, Chiang Mai, the largest urban center in the Northern Region and the third largest city in Thailand following Bangkok, was once the capital of an autonomous principality that was a tributary of the Central Siamese Kingdom before 1868 (Vichit-Vadakan and Nakata 1976, 6). Other contemporary urban centers in the north, such as Lampang and Chiang Rai, also used to be centers of autonomous tributary principalities, or were major "frontier" or peripheral cities of the Siamese Kingdoms in Ayutthaya and Ratanakosin. Sukhothai has a unique history, being first the royal capital during what is considered the initial period of the Siamese state (1238-1349), then later becoming a principal "frontier" city of the Ayutthaya Kingdom.¹ Nakhon Sawan, in the lower part of the Northern Region, has been for centuries the major transportation link between the Chao Phraya Plain and the Northern Region. It sits on the confluence of the major rivers from the north that form the Chao Phraya, the major means of transportation until a few decades ago. More recently it has remained a major trade center as a transportation link in the country's rail and highway networks.

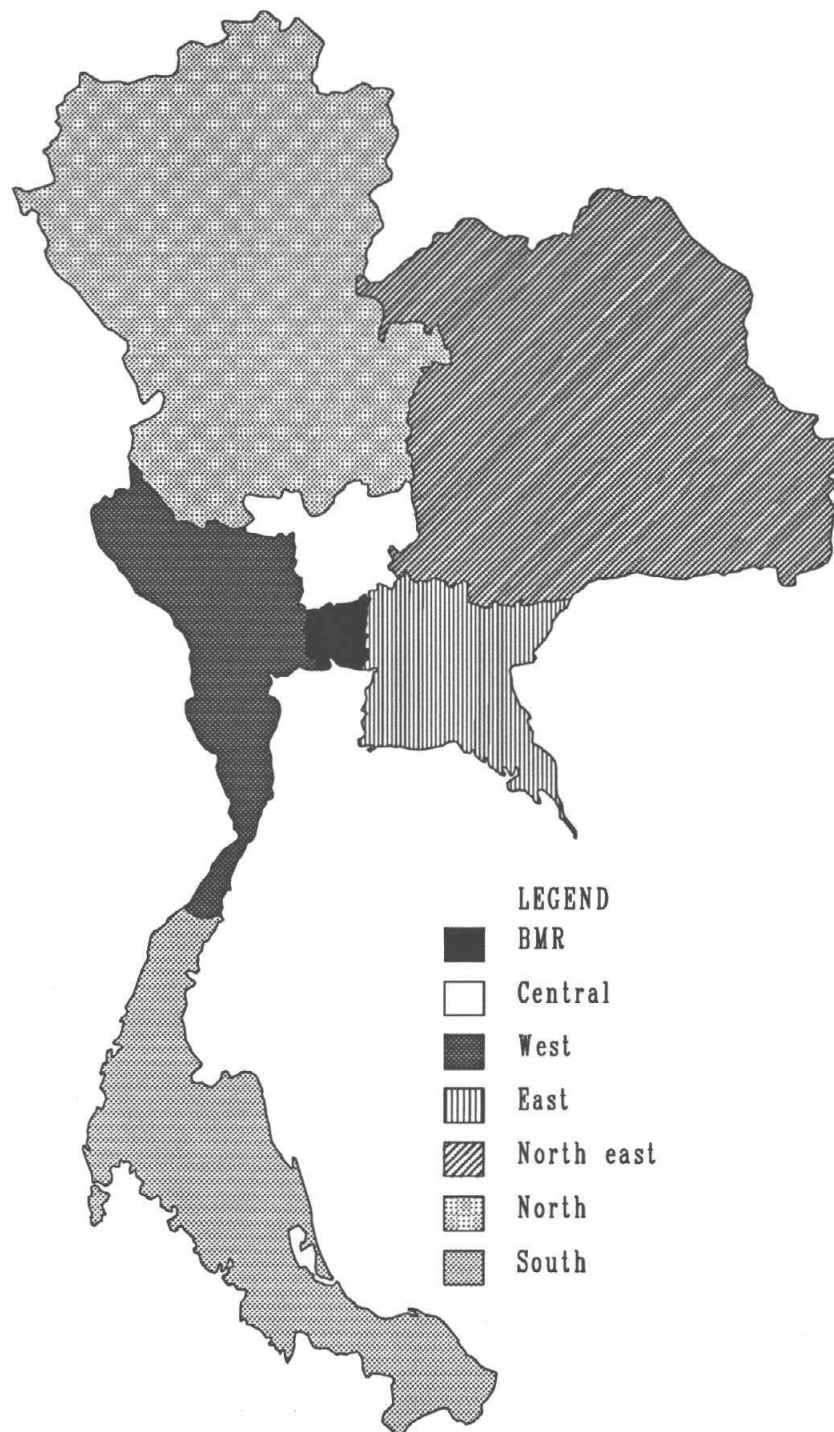


Figure 1.1 Planning Regions of Thailand

Nakhon Ratchasima, or Khorat, is the largest city in the Northeastern Region and the second largest city in the country. It was built in the late seventeenth century as a fortified city to protect the eastern frontier of the Siamese Kingdom and control the major bullock-cart trails linking the Chao Phraya Plain with the Khorat Plateau (Intha Kanok 1977). In addition to its important role as a transportation and trade center, Nakhon Ratchasima was also the site of an United States Air Force Base during the Vietnam War. The United States Military presence throughout most of the 1960s contributed to rapid economic development—mainly in the service sector and in physical infrastructure—and rapid growth of the Nakhon Ratchasima urban area. Two of the other three major urban centers in the northeast, Udon Thani and Ubon Ratchathani, have long been important trade centers. Udon Thani was the site of another United States Air Force Base during the Vietnam War and like Khorat, experienced considerable economic and physical growth during that period. Khon Kaen, the first designated urban growth center for the region in the 1960s, developed primarily because of its role as the regional administrative center and as the site of Khon Kaen University, the Northeastern regional university (Kranich 1974, 33-34).

The urban centers of the Southern Region developed as trade centers on both the east coast (Gulf of Siam) and the west coast (Indian Ocean). Several centers, most notably Nakhon Si Thammarat, were originally capitals of tributary principalities to the Siamese Kingdom. Hat Yai emerged as an important transportation and trade center after the construction of the southern railway. It rapidly grew to become the commercial center of the region, while the earlier city of Songkhla less than 30 kilometers away on the east coast serves as the administrative center of the region. The major west coast city, Phuket, developed rapidly in recent decades as a major international resort center, having earlier been a trade center for a major tin-producing area.

The main cities of the Eastern Region, Chon Buri and Rayong, developed as seaports and trade centers. The Chon Buri area was also the site of an United States Air Force Base, which contributed significantly to its infrastructure development. It is the commercial and industrial center of the Eastern Region, with most of the Eastern Seaboard development along the Chon Buri coast.

The cities of the Western Region resemble major provincial centers throughout the country. They developed largely as local administrative and trade centers. In recent years, both Petchaburi and Ratchaburi have grown as subregional trade centers for

agricultural export goods, while Kanchanaburi has become the center of a major national resort area.

The cities of the Central Region (excluding the BMR) emerged historically as administrative centers of the Siamese Kingdom. Ayutthaya was the capital of the Kingdom for over 400 years. Although destroyed in the mid-eighteenth century, it has since become a regional trade and administrative center. Saraburi's location as trade link between the Central Plain and Nakhon Ratchasima contributed to its urban development. Nearly all the cities of the Central Region are located along rivers and canals, the major means of transportation in the Chao Phraya River valley before this century.

The most dominant city of Thailand is of course Bangkok, a classic example of a primary city. Bangkok has been the national and international urban center of the country since 1782, the year it was established as the royal capital of the Siamese Kingdom. It is the administrative, military, commercial, and industrial center, linking Thailand with the rest of the world and even serving as the administrative and trade link among the different regions of the country. Its growth in recent years has been virtually uncontrollable, intensifying the usual urban problems of large cities throughout the world; traffic congestion, uncontrolled land use, slums, housing, and water and air pollution. The other cities of the BMR have grown in recent years because of their proximity to Bangkok.

Geographically, almost all the urban centers in Thailand are located in appropriate locations in terms of site selection for urban land use. Most share similar site characteristics.

- Topographically they are located on level land. In hilly or mountainous areas, they are located in valleys.
- They have a readily available water supply for agriculture and for household consumption.
- They are surrounded by fertile agricultural land to support the local consumption needs of the cities when Thailand was largely a subsistence economy. In recent years, the cities serve as trade centers for the surrounding export-oriented agricultural production.
- They have easy access to major transportation, whether rivers and canals in the Central Region, the seacoast in the south and east, or trails and roads in the northeast.

In addition, many of the cities dating from earlier centuries have good land use plans because they were originally designed and built as fortified towns. They were built in a block design, with the blocks of space fully utilized.

Unfortunately, the development of these urban centers, most notably the Bangkok Metropolitan Area (BMA), Chiang Mai, Khorat, and Ayutthaya, has been distorted from their old designs without plans or guidelines for expansion. This distorted growth is evident even among the smaller urban areas that were first established as walled cities. The growth of other cities that were not fortified follows the more recent development of Bangkok, Chiang Mai, etc., but without the benefit of an original "core" block of well designed and laid out urban land use.

At present, it is clear that the pattern of urban development in Thailand occurs along the transportation networks. In cities, both large and small, land along the road is fully utilized to a depth of 10 to 200 meters from the road. The land farther in remains unused, leaving pockets of empty land in between the road networks. The land becomes utilized only after roads are built through or access roads built into these pockets of empty land. This type of ribbon development can be seen both in the big cities like the BMA, Chiang Mai, and Nakhon Ratchasima, and in small provincial cities like Nongkhai, Mukdahan, and Ranong.

The unplanned and virtually uncontrolled development of Thailand's urban areas creates many problems in managing the cities. Many of the problems in urban environmental management, including control of industrial pollution, wastewater, and air pollution from traffic, are intensified in Thailand's cities because of their unplanned, unorganized growth in recent decades.

SIZE OF THE CITIES

The size of cities in Thailand varies greatly in terms of area and population. The order of cities in terms of their size and population does not fall into a neat hierarchical pattern, as is found with cities in many other countries of the world.

As mentioned above, the BMA dominates urban Thailand. The area of the city is about 1,560 square kilometers covering the entire Bangkok province on both sides of the Chao Phraya River. Its population in 1988 was estimated between 5.7 - 7.5 million, 11 percent to 14 percent of the total population of the country, and 27 to 36 times larger than the second most populous city, Nakhon Ratchasima.² The urban areas of the second and

third largest cities take up less than 0.50 percent of their provincial areas, with Nakhon Ratchasima covering 37.5 square kilometers and Chiang Mai covering only 40.12 square kilometers. The official population inside their city limits is about 208,000 for Nakhon Ratchasima and only about 165,000 for Chiang Mai.³

THE URBAN ECONOMY

In general, provinces with urban centers in all regions except the BMR had a major share of their Gross Provincial Product (GPP) in agriculture in both 1982 and 1987 (Table 1.2). It is interesting to note that in nearly all these provinces the GPP share in the service sector of the economy increased by about 1 percent to 3 percent. The share of manufacturing in the Gross Regional Product (GRP) increased in all the regions except the east and south. However, the change in share of manufacturing in the GPP of many of the provinces being analyzed in the west, north, and northeast, declined during this period, even when the regional share increased slightly.

The proportion of the GPP share in each sector can be divided into 6 general patterns:

1. Those having manufacturing and trade as the leading sectors. These are the BMA, Samut Prakan, Samut Sakhon, Pathum Thani, Saraburi, and Chon Buri.
2. Those with manufacturing as the leading sector and agriculture as the other main sector. In 1987, Tak fit in this category.
3. Those with agriculture as the primary sector, and manufacturing and trade as the other main sectors. These are Nakhon Pathom, Ayutthaya, Ratchaburi, Kanchanaburi, Nakhon Ratchasima, and Khon Kaen.
4. Those having service and manufacturing as the leading sectors. The provinces in this category include Phuket and Nonthaburi.
5. Those with agriculture and services as the main sectors. Chiang Mai falls in this category.
6. Those with agriculture and trade as the leading sectors. All the rest fall in this group.

The patterns described above show a change in the traditional pattern of the economy, from a rural economy to a more urban-oriented economy based on the manufacturing, trade, and service sectors. However, the traditional economic pattern, with agriculture and trade as the leading sectors, still dominates many of the provinces, where the areas remain mainly rural and the majority of the population still earns its livelihood from agriculture and related activities. The patterns mentioned above also somewhat reflect the decentralization policy of the previous national development plan.

Despite that, it is evident that nearly all non-agricultural economic activities as well as recent economic expansion remains concentrated in the BMR, especially in the BMA. When looking at the proportion of Gross Domestic Product (GDP) divided among all the regions, and the proportions of the sectors accounted for by the selected provinces, one can see that the proportion of the total GDP in the BMR has actually increased by over 4 percent between 1982 and 1987 to nearly half the GDP (Table 1.3), while the proportion of the GDP accounted for by all the other regions and the selected provinces generally decreased. The proportion of the BMR's share of all the major sectors of the GDP except services increased in this period. Manufacturing and trade increased the most, with the BMR in 1987 accounting for nearly 77 percent of all the country's manufacturing sector (a 3 percent increase from 1982), and over 55 percent of the country's trade sector (a 9 percent increase in the 5 years). Despite the slight decline in the BMR's share of the nation's service sector, the region still accounts for 51 percent of the total GDP.

Table 1.2 Proportion of Major GDP Sectors, by Region and Selected Provinces,
Derived from 1972 Prices, for 1982 and 1987

Unit: Percent

REGION Province	Proportion of Agriculture		Proportion of Manufacturing		Proportion of Trade		Proportion of Services		Proportion of Total G.D.P.	
	1982	1987	1982	1987	1982	1987	1982	1987	1982	1987
WHOLE KINGDOM	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
BANGKOK METROPOLITAN REGION	8.32	8.61	73.57	76.80	46.10	55.64	51.85	51.29	44.36	48.55
Bangkok Metropolitan Area	3.40	3.37	57.58	58.78	39.41	47.25	47.90	47.06	36.73	39.69
Samut Prakan	0.97	1.25	10.18	10.46	3.61	4.54	1.15	1.21	3.71	4.27
Samut Sakhon	0.84	0.90	0.78	0.16	0.85	1.19	0.39	0.41	0.70	1.00
Pathum Thani	1.10	0.91	3.59	4.34	1.36	1.78	0.60	0.67	1.56	1.84
Nonthaburi	0.40	0.55	0.65	0.83	0.31	0.37	0.85	1.01	0.64	0.78
Nakhon Pathom	1.61	1.65	0.81	0.83	0.55	0.53	0.95	0.95	1.02	0.98
CENTRAL	6.21	5.43	3.37	3.36	4.44	3.49	3.52	3.28	4.80	4.26
Phra Nakhon Sri Ayutthaya	1.04	0.99	0.85	0.76	0.96	0.72	0.78	0.72	0.95	0.82
Saraburi	1.09	1.01	1.89	2.10	1.58	1.48	0.77	0.74	1.59	1.60
EAST	9.23	9.18	7.25	6.24	8.20	7.88	8.22	8.10	7.34	7.23
Chon Buri	1.97	2.03	5.88	4.51	4.07	4.20	5.11	5.12	3.43	3.36
Chachoengsao	2.00	2.03	0.17	0.39	0.98	0.91	0.69	0.64	0.96	1.05
Rayong	1.78	1.67	0.73	0.71	1.28	1.29	0.55	0.54	0.97	1.02
WEST	10.39	9.36	3.24	2.72	6.16	4.61	3.76	3.61	6.22	5.25
Ratchaburi	1.65	1.29	0.83	0.92	1.19	0.87	0.97	0.92	1.39	1.17
Kanchanaburi	2.52	2.48	1.42	0.99	1.80	1.27	0.77	0.73	1.85	1.52
Petchaburi	1.02	1.06	0.28	0.16	0.63	0.47	0.50	0.45	0.67	0.58
NORTH	23.83	23.03	4.09	3.79	11.01	8.58	11.57	11.50	12.72	11.72
Chiang Mai	2.93	3.04	0.78	0.84	1.63	1.41	2.92	3.00	2.09	2.01
Chiang Rai	2.60	2.74	0.35	0.15	1.08	0.76	0.86	0.89	1.18	1.03
Nakhon Sawan	2.52	2.42	0.60	0.66	1.18	1.04	1.07	1.02	1.33	1.28
Phitsanulok	1.55	1.49	0.32	0.15	0.76	0.52	0.80	0.76	0.90	0.78
Tak	0.79	0.60	0.12	0.46	0.52	0.40	0.34	0.37	0.45	0.58
NORTHEAST	25.96	26.10	5.69	5.02	13.10	10.30	12.61	13.57	14.71	13.61
Nakhon Ratchasima	4.35	3.75	1.62	1.27	2.42	1.58	1.76	1.85	2.57	2.15
Khon Kaen	2.09	2.00	1.10	1.00	1.42	1.22	1.56	1.85	1.64	1.53
Udon Thani	2.25	2.07	0.67	1.00	1.24	0.83	1.26	1.29	1.43	1.19
Ubon Ratchathani	1.56	2.23	0.45	0.35	0.92	0.92	1.07	1.23	1.15	1.24
SOUTH	16.06	18.28	2.78	2.08	10.99	9.49	8.48	8.64	9.86	9.38
Surat Thani	1.99	2.18	1.10	1.27	1.19	1.20	0.82	0.84	1.15	1.19
Songkhla (Hat Yai)	2.15	2.28	0.46	0.34	1.97	1.71	1.57	1.65	1.61	1.60
Nakhon Si Thammarat	2.19	2.45	0.47	0.33	1.23	1.19	1.30	1.45	1.34	1.36
Phuket	0.25	0.28	0.69	0.31	0.63	0.39	0.69	0.71	0.57	0.49

Source: National Economic and Social Development Board

**Table 1.2 (continued) Percent of Major Sector Contributions to G.D.P., G.R.R., and G.P.P.,
Derived from 1972 prices, for 1982 and 1987**

Unit: Percent

REGION Province	Proportion of Agriculture		Proportion of Manufacturing		Proportion of Trade		Proportion of Services		Proportion of Total G.D.P.	
	1982	1987	1982	1987	1982	1987	1982	1987	1982	1987
WHOLE KINGDOM	20.24	17.23	21.37	22.72	16.45	16.74	13.27	14.21	71.33	70.35
BANGKOK METROPOLITAN REGION	3.80	3.07	35.45	35.94	17.09	19.19	15.51	15.01	71.85	73.21
Bangkok Metropolitan Area	1.87	1.47	33.50	33.65	17.65	19.93	17.30	16.84	70.32	71.89
Samut Prakan	5.30	5.06	58.65	55.66	16.01	17.81	4.12	4.01	84.08	82.54
Samut Sakhon	24.38	15.53	23.65	35.48	20.04	19.55	7.45	5.81	75.52	76.37
Pathum Thani	14.28	8.52	49.27	53.50	14.40	16.16	5.10	5.12	83.05	83.30
Nonthaburi	12.53	12.12	21.50	24.11	8.04	8.03	17.49	18.37	59.56	62.63
Nakhon Pathom	32.15	29.12	16.99	19.34	3.88	9.10	12.46	13.75	70.49	71.31
CENTRAL	26.17	22.02	14.99	17.91	15.22	13.73	9.73	10.93	66.11	64.59
Phra Nakhon Sri Ayutthaya	22.26	20.09	19.04	21.28	16.61	14.71	10.91	12.59	68.82	69.50
Saraburi	13.87	10.97	25.44	29.98	16.32	15.55	6.43	6.61	62.06	63.11
EAST	25.47	21.96	21.12	19.62	18.38	18.26	14.85	15.93	79.82	75.77
Chon Buri	11.41	10.45	36.00	30.42	19.16	20.91	19.43	21.60	86.00	83.38
Chachoengsao	42.06	33.45	3.79	8.45	16.81	14.44	9.58	8.66	72.24	65.00
Rayong	36.87	28.22	15.97	16.49	21.55	21.10	7.43	7.49	81.82	73.30
WEST	33.80	30.81	11.14	1.78	16.29	14.72	8.02	9.77	69.25	67.08
Ratchaburi	24.06	19.08	12.78	17.86	14.13	12.41	9.22	11.17	60.19	60.52
Kanchanaburi	27.56	28.15	16.32	14.80	15.95	13.99	5.50	6.73	65.33	63.73
Petchaburi	30.80	31.57	8.87	6.17	15.56	13.62	9.92	11.05	65.15	62.41
NORTH	37.93	33.96	6.88	7.34	14.24	12.25	12.07	13.94	71.12	67.43
Chiang Mai	28.43	26.14	8.00	9.50	12.85	11.77	18.58	21.17	67.87	68.58
Chiang Rai	44.66	45.80	6.26	3.21	15.15	12.35	9.73	12.29	75.80	73.65
Nakhon Sawan	38.52	32.71	9.66	11.66	14.61	13.65	10.70	11.37	73.49	69.39
Phitsanulok	34.88	33.06	7.47	4.37	13.87	11.29	11.84	13.92	68.06	62.64
Tak	35.85	17.83	5.94	18.12	19.19	11.63	10.02	8.93	71.00	56.51
NORTHEAST	35.73	33.17	8.27	8.37	14.65	12.67	11.37	14.17	70.02	68.38
Nakhon Ratchasima	34.27	30.12	13.43	13.42	15.47	12.29	9.09	12.21	72.26	68.04
Khon Kaen	25.81	22.57	14.30	14.81	14.26	13.26	12.59	17.11	66.96	67.75
Udon Thani	31.30	30.08	10.01	6.76	14.26	11.62	11.68	15.41	67.85	63.87
Ubon Ratchathani	27.58	30.98	8.53	8.15	13.24	12.44	12.41	13.99	61.76	65.56
SOUTH	32.93	33.69	6.03	5.04	18.34	16.94	11.41	13.09	68.77	68.76
Surat Thani	35.16	31.64	3.93	7.54	17.10	16.82	9.50	10.03	65.69	66.03
Songkhla (Hat Yai)	27.02	24.57	6.09	4.84	20.19	17.83	12.93	14.64	66.23	61.88
Nakhon Si Thammarat	33.08	31.07	7.57	5.46	15.16	14.60	12.85	15.08	68.66	66.21
Phuket	8.83	10.63	25.73	15.32	17.99	14.10	16.08	21.82	68.63	61.87

Source: National Economic and Social Development Board

SUMMARY

In summary, there are five main issues of urbanization in Thailand that should be noted. First, despite the difference in size of population between the BMA, the largest city of the country, and the four or five next largest cities, the pattern of spatial expansion of the cities is similar. Ribbon development outside the boundaries of the city (i.e., the municipality boundary) is the main pattern occurring for industrial, trade, and service activities. The continuation of this pattern of development should be anticipated for the near future.

Second, without effective control measures and an effective control mechanism, this uncontrolled ribbon development will cause further problems for managing the cities, especially the management of the cities' environments.

Third, the changing patterns of the economy in different provinces have implications for the urgent need of appropriate land use planning in the cities, so that the urban centers of the provinces can be prepared to function well and support the changing economy.

Fourth, as the emphasis of the country's economy remains on export promotion, and the BMA is still the center of transactions with the only major ports (both sea and air) to export goods out of the country, an agglomeration of the manufacturing, trade, and service sectors in the BMR cannot be avoided.

Finally, a decline in the GPP share of agriculture in the selected province, and an increase in the service and manufacturing sectors is evident. However, the increase of GPP in manufacturing is not prominent in all areas, except in the BMR and in provinces along the periphery of the BMR, such as Saraburi, Ayutthaya, Ratchaburi, Chachoengsao, and Rayong.

Thus, the policy to decentralize industry has not proven successful and needs to be reconsidered and revised. In addition, to alleviate problems that occur with industrial-related activities in the major cities, especially those in the BMR, effective policies to decentralize industrial development and policies to improve the urban environment need to be pursued in the near future.

Endnotes

- 1 For more information about the types and systems of Thai cities, see "The System of Urban Places of Thailand" in Larry Sternstein 1976. Thailand: The Environment of Modernization. Sydney:McGraw Hill Book Company.
- 2 The discrepancy in Bangkok's population is due to differences in counting, reporting, and estimating the number of residents. The lower estimate of 5.7 million comes from the official registration records of the Ministry of Interior. There are of course many residents—both temporary and permanent migrants to the city—who are not officially registered in Bangkok, but remain "resident" in their "homes" throughout the country. The higher population estimates for the city, based on demographic trends since the last national census in 1980, are more likely correct, since these include the many students, temporary migrants, permanent residents, and foreigners living in Bangkok who are not registered in the city.
3. The actual urban areas and populations of the two cities are somewhat larger, because official government statistics are limited to the area and registered population within the administrative municipal units. Urban growth in both cities has expanded beyond the municipal boundaries. The populations for the municipalities and their "suburbs" would therefore be higher than the reported figures. In addition, these cities attract many temporary migrants, students, etc., from their surrounding regions. As in the case of Bangkok, these people are not officially registered as residents, and so they are not reported in the cities' population. Also please refer to Appendix 1.1 for registered municipal and provincial population.

Chapter 2

Expansion of the Bangkok Metropolis

SPATIAL DEVELOPMENT

The urban economy of Bangkok has undergone a major expansion following the socioeconomic developments of the 1960s. Urban infrastructure was planned and constructed as a base for development. Roads quickly connected Bangkok with every major city and became the overwhelming choice of transportation within Bangkok. The importance of water transportation in Bangkok consequently declined with the growth of road-based transport (Pongsatat 1982).

Drawn by these road networks, the rapidly urbanizing Bangkok Metropolitan Region (BMR) sprawled out along the main roads radiating from the city of Bangkok such as Petchaburi, Sukhumvit, Pahonyotin, and Petch Kasem. The network of roads provided easy access to the relatively inexpensive land on the outskirts of the city, particularly along the major highways. As this land was plentiful and there was no serious attempt to recoup the cost of the road network through increased taxes on land adjacent to the highway, it became attractive to developers obviously. The growing demand for factory and housing sites quickly bid up the price of this land above the price which could be supported by agriculture, and farms were rapidly displaced.

At the same time that major road networks facilitated access to land along the highways, the haphazard development of small soils together with the pre-existing khlongs and patchwork of small land holdings, left other parcels almost inaccessible and undeveloped. Sprawling urbanization imposes major additional costs, in providing city services. The costs of constructing and maintaining roads, water, sewer, power, and phone lines all increase with distance, with little if any increase in benefit. Similarly, the costs of monitoring and enforcing environmental regulations also generally increase with distance.

This growth pattern of uneven development is further exacerbated by property tax and state enterprise land policies. Low property tax rates remove one potentially valuable incentive for land development, allowing landowners to sit on idle land imposing additional burdens on their neighbors while paying little of the cost. Similarly, policies which enable state enterprises to keep land idle, but not to sell it, remove the pressure of "opportunity cost" which could otherwise induce owners to either develop or sell idle land located near the city center.

Figures 2.1 and 2.2 illustrates the dominant growth pattern, with urbanization spreading out along the major arterial highways while neglecting less readily accessible parcels.

This uneven growth pattern also increases the incidence of adverse environmental impacts. Not only does environmental infrastructure become more expensive and thereby less available, but linear development increases commuting and transport distances thus increasing fuel consumption and automotive pollutants. Furthermore, as the potential for urban/rural environmental conflicts is largely dependent on the nature and extent of the boundary areas which separate them, the more urban sprawl, the greater the potential for environmental conflict.

For example, while the two regions have devoted equal areas to urban/industrial activities, the compact area has only one-third the urban perimeter boundary, and roughly one-third the number of locations where urban and rural land uses will come into conflict. Similarly, in the extreme case where urban and industrial land uses are not just dispersed along the highway but spread in tiny pockets across the landscape, the number of urban/rural boundary areas becomes almost infinite, and so does the opportunity for conflict.

Even in countries with a strong tradition of planning and enforcement of stringent environmental controls, sprawling development presents major problems. In countries without those traditions and the requisite infrastructure, urban sprawl may be a recipe for disaster.

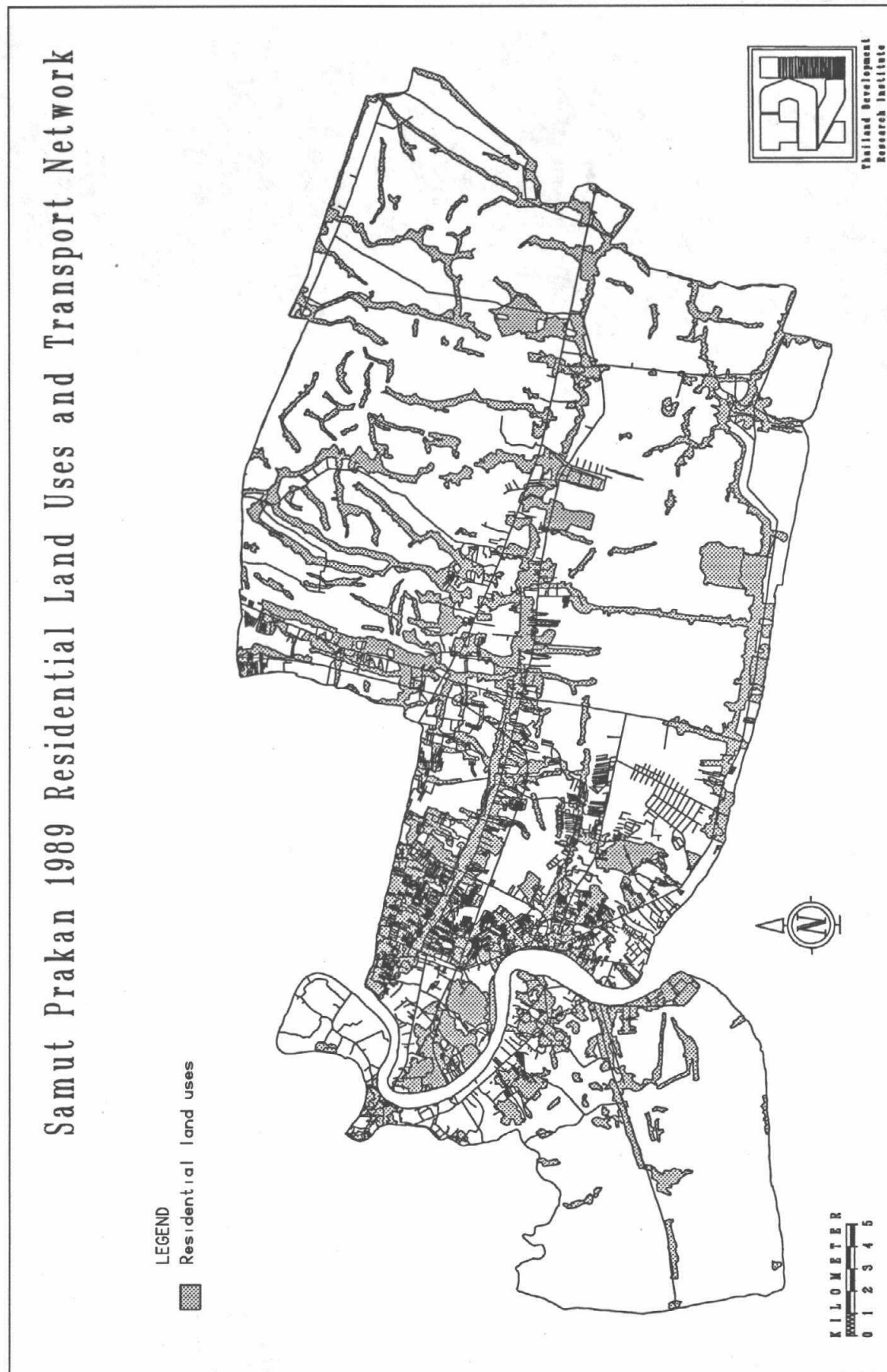


Figure 2.1 Samut Prakan Residential VS Infrastructure

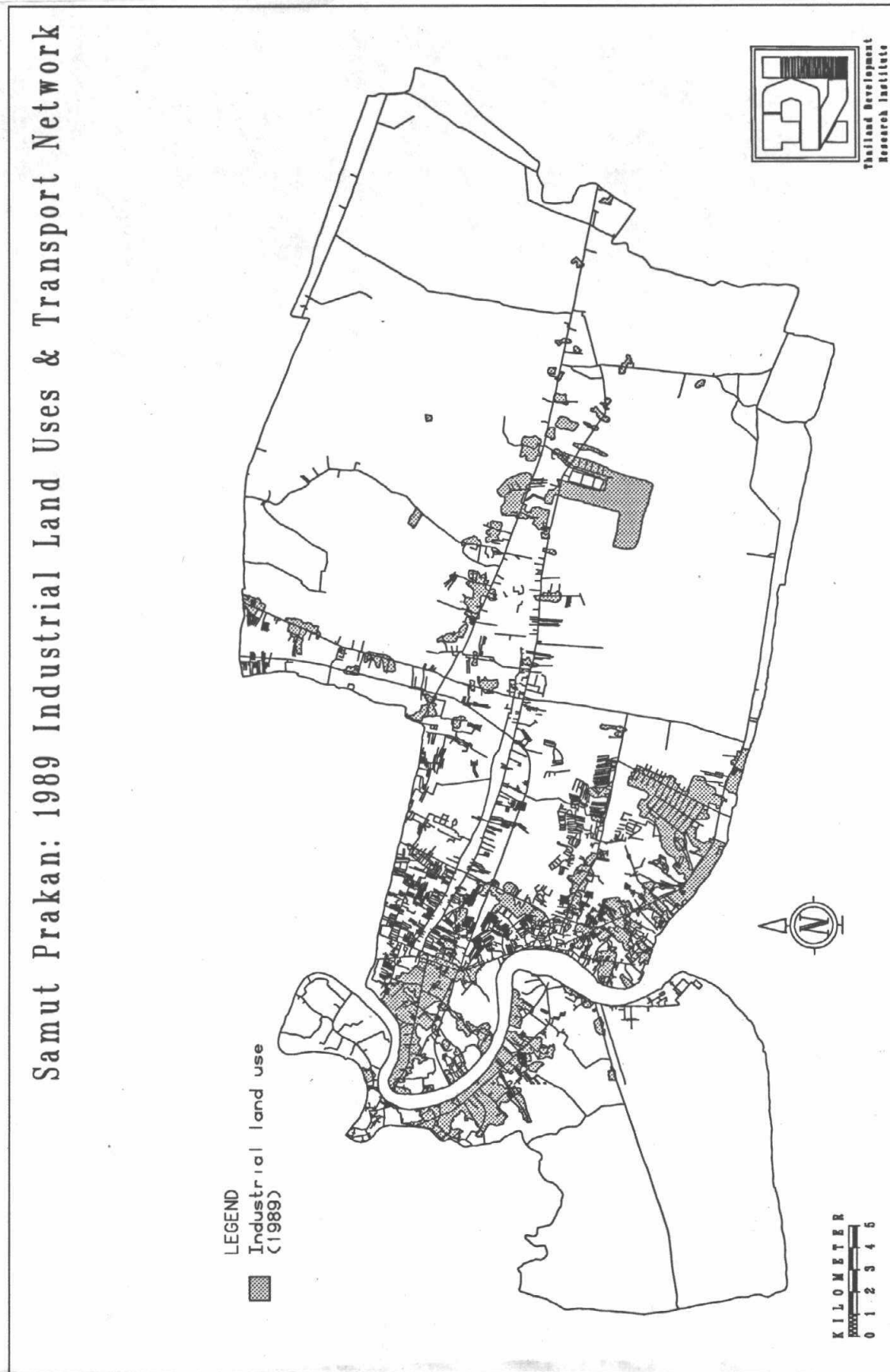


Figure 2.2 Samut Prakan's Industrial VS Infrastructure

The transformation of the economy from an agricultural to an industrial base during the past 30 years has also contributed to changes in the urban form. Demand for more land to facilitate urban activities in the housing, commercial, industrial, and service industries has dramatically increased. The built-up area of Bangkok has now expanded into the former suburbs including Nonthaburi, Pathum Thani, Samut Prakan, Samut Sakhon, and Nakhon Pathom. Thus, former agricultural lands in these provinces have been encroached up on since the early 1960s and have now become suburbs of Bangkok.

The built-up area of the city expanded from 96 square kilometers in 1958 to 184 square kilometers in 1971, and continued to expand to 344 square kilometers in 1980 and 855 square kilometers in 1984 (DTCP 1984; Chanond 1987). Thus the built-up area nearly doubled each decade during the 1960s and 1970s, and then more than doubled during the first half of the 1980s (Figure 2.3).

The details of changing land use in the BMR can be briefly summarized as follows:

- Nonthaburi: The major orchard of Bangkok and of the country, has now become a residential area for the BMR.
- Pathum Thani: The major rice production area has now become a residential and industrial area for the BMR.
- Samut Prakan: The major rice fields and fish farms have become residential, industrial, and golf course areas.
- Samut Sakhon: the major orchards and saltwater fish farms have become industrial areas.
- Nakhon Pathom: The major orchard, poultry, and meat production areas have slowly transformed into residential areas.

POPULATION PROFILE

Along with the spatial changes during this time period, population in the BMR has also changed dramatically. The population of the BMR has increased at a rate much higher than that of the country as a whole, and the urbanizing suburban fringe has been the most rapidly growing of all. While the country's annual growth rate of population was 2.68 percent, the growth rate in the BMR was 3.24 percent (CUSRI 1986, 6). At the same time it is reported that one-quarter (24.78 percent) of the registered population in the BMR are migrants to this region (CUSRI 1986, 7). When looking at changes in the BMR itself, the population in the fringe areas of Bangkok, especially in Nonthaburi, Samut

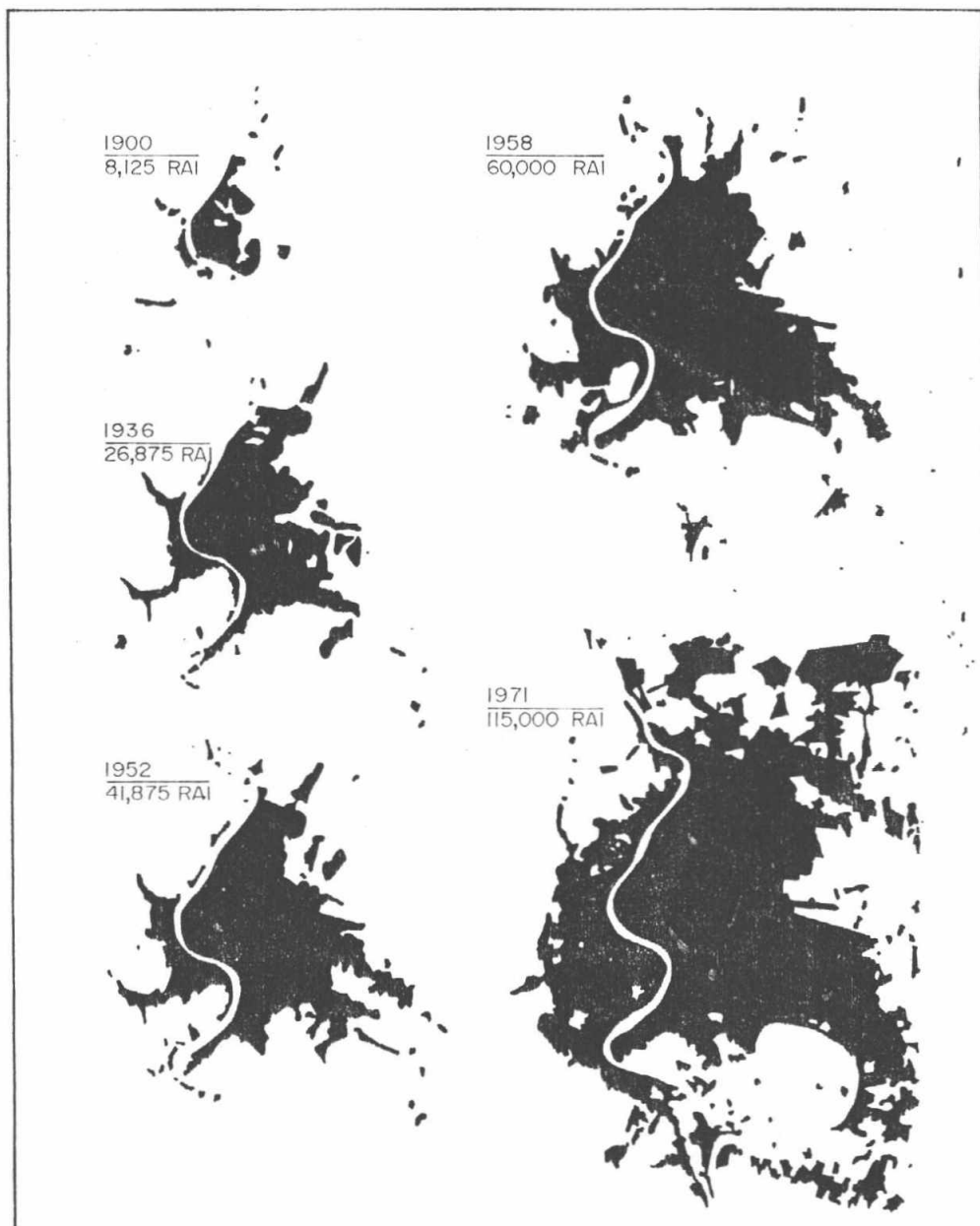


Figure 2.3 Expansion of Bangkok 1900 - 1971

Source 1) DTCP, Report on the First Revision of the Plan for the Metropolitan Area, Bangkok 1971
2) BMA, Basic Planning Information, Bangkok 1972

Prakan, and Patum Thani has increased at a much faster rate than population in Bangkok from 1986 to 1989. Overall, the rate of growth in the urban fringe areas during past 10 years has been about 2 percent higher than the rate in Bangkok. Furthermore, it is expected that during the years 1991 to 2001 the population in the BMR will increase at a rate of 2.3 percent per year and Nonthaburi and Pathum Thani will increase at 3.4 percent and 3.5 percent, respectively, compared to a rate of only 1.4 percent for the rest of the country (Population Working Group) (Table 2.1).

When looking at the economic activities of these provinces, reference should be made to the section on urban economics. There it is shown that the specialization of each of the provinces is as follows:

1. Bangkok Metropolitan Area (BMA), Samut Prakan, Samut Sakhon, and Pathum Thani have manufacturing and trade as their leading sectors.
2. Agriculture is the primary sector in Nakhon Pathom, the manufacturing and trade sectors are also significant.
3. Nonthaburi's leading sectors are service and manufacturing.

More over, economic and demographic trends have become evident which are expected to continue to have a major impact on urban development in Thailand.

1. Industry will play an increasingly important role in the country's development.
2. While the BMR produced 45 percent of the country's total GPP from 1982 to 1987, it produced 73 percent to 77 percent of the country's manufacturing sector GPP during the same period.
3. It is projected that over the next 20 years, the economy will grow as shown in Table 2.2, and that the BMR will continue to be the major economic production area of the country.
4. The population in the BMR is expected to increase approximately 2.5 percent per year, in contrast to the country's growth rate of 1.6 percent per year, over the next 20 years.

Given the history of the spatial expansion of Bangkok and the trends as noted above, it should be expected that expansion of Bangkok's urban fringe will continue to be a dominant factor. Moreover, the suburban fringe areas in Nonthaburi, Pathum Thani, Samut Prakan, Samut Sakhon, and Nakhon Pathom, which have been heavily affected by the urbanization of Bangkok since the early 1960s, will continue to be the growth centers of the BMR during the next two decades.

Table 2.1 Population and Rate of Increase

Province	Population (Thousands)			Rate of Increase (%)
	1986	1991	2001	1991-2001
BMA	5,713	6,477	7,850	2.1
Nakhon Pathom	614	672	796	1.7
Nonthaburi	473	556	782	3.4
Pathum Thani	406	478	681	3.5
Samut Prakan	625	739	1,002	3.2
Samut Sakhon	294	331	430	2.6
Total BMR	8,125	9,253	11,541	2.3
Total Country	52,654	57,196	65,138	1.4

Source: Population Working Group

Table 2.2 Growth Rate of GDP, 1991-2010

Unit: Constant 1972 Prices

Year	GDP Growth	Growth Agriculture	Growth Industry	Growth Services
1991	10.00	1.40	11.50	11.40
1992	10.10	2.40	11.40	11.30
1993	9.60	2.80	10.70	10.60
1994	9.20	2.90	10.10	9.90
1995	8.60	2.90	9.50	9.30
1996	8.10	2.90	8.80	8.60
1997	7.50	2.90	8.20	7.90
1998	6.90	2.90	7.50	7.20
1999	6.50	2.90	7.00	6.70
2000	6.20	3.00	6.80	6.30
2001	6.00	3.00	6.60	6.10
2002	6.00	3.00	6.60	6.00
2003	6.00	3.00	6.70	6.00
2004	6.10	3.00	6.80	6.00
2005	6.10	3.00	7.00	6.00
2006	6.20	3.00	7.10	6.00
2007	6.30	3.00	7.30	6.00
2008	6.40	3.00	7.40	6.10
2009	6.50	3.00	7.50	6.20
2010	6.60	3.00	7.70	6.30
Average	7.25	2.84	8.11	7.50

Growth Rate of GDP, 1991-2010

Unit: Constant 1972 Prices

Year	GDP Growth	Growth Agriculture	Growth Industry	Growth Services
1991	10.10	2.40	11.40	11.30
1993	9.60	2.80	10.70	10.60
1994	9.20	2.90	10.10	9.90
1995	8.60	2.90	9.50	9.30
1996	8.10	2.90	8.80	8.60
Average	9.13	2.76	10.12	9.95

THE CURRENT STATUS OF DEVELOPMENT

A survey conducted by the Department of Land Development (DLD) found that land in all provinces of the BMR, except the BMA itself, is still predominantly under agricultural use (Figure 2.4-2.8 and Table 2.3).

In the BMA, much of the agricultural land in Bangkok, Min Buri, Nong Chog, Lad Krabang, Bang Kapi, Phra Kanong, Bang Khunthien, and Bangkok has changed to residential, industrial, golf course, and other urban uses. Within the 'green belt' of the Min Buri and Nong Chog areas, the agricultural land has been transformed into residential areas and golf courses. While in areas outside the 'green belt', such as Lad Krabang, land has already been converted to industrial buildings and housing projects. In Bang Kapi and Prakanong, a variety of housing projects have emerged. This residential area expands up to the boundary of Samut Prakan Province. In Bang Khunthien, Talingchan, and Bang Bon, the orchards have been converted into shophouses.

The expansion of the city follows the roads in almost every direction. The wider the road and the more intersections provided, the more built-up the adjacent land has become. Mixed land use and ribbon development are the predominant land use patterns in the BMA, the BMR, and the other urban areas of the country.

The patterns of land use in the urban fringes of the BMR are shown in Tables 2.4, 2.5, and 2.6.

Table 2.3 The Area of the Bangkok Metropolitan Region

Province	Area	
	Rai	km2
Bangkok	978,263.00	1,565.22
Pathum Thani	953,660.00	1,525.86
Nonthaburi	388,939.00	622.30
Samut Prakan	627,557.00	1,004.09
Samut Sakhon	545,216.00	872.35
Nakhon Pathom	1,355,204.00	2,168.33
Total	4,848,839.00	7,758.15

Source: Military Mapping Department (1978)



Figure 2.4 Samut Prakan Land use 1989

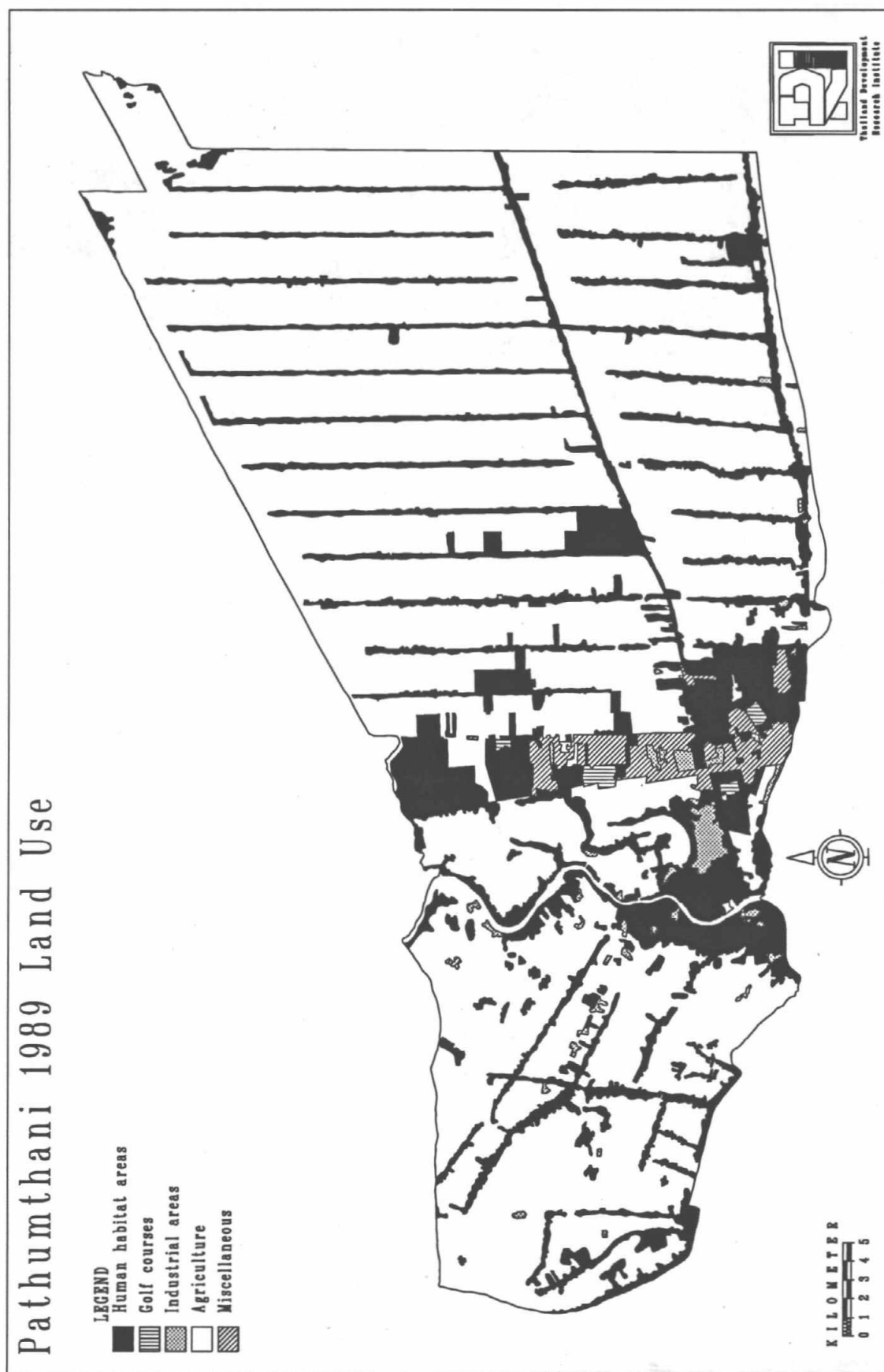


Figure 2.5 Patum Thani Land Use 1989



Figure 2.6 Nonthaburi Land Use 1989

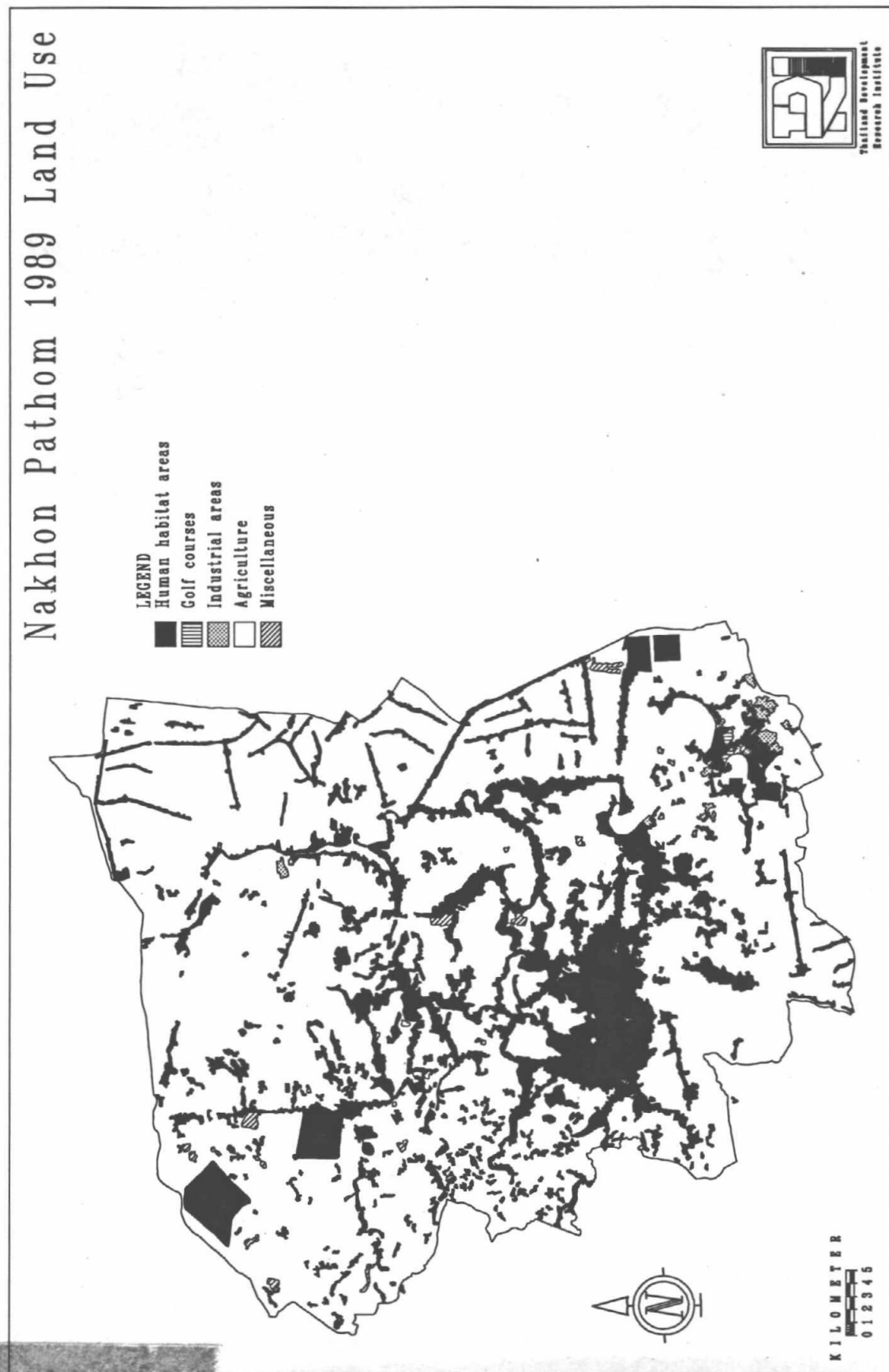
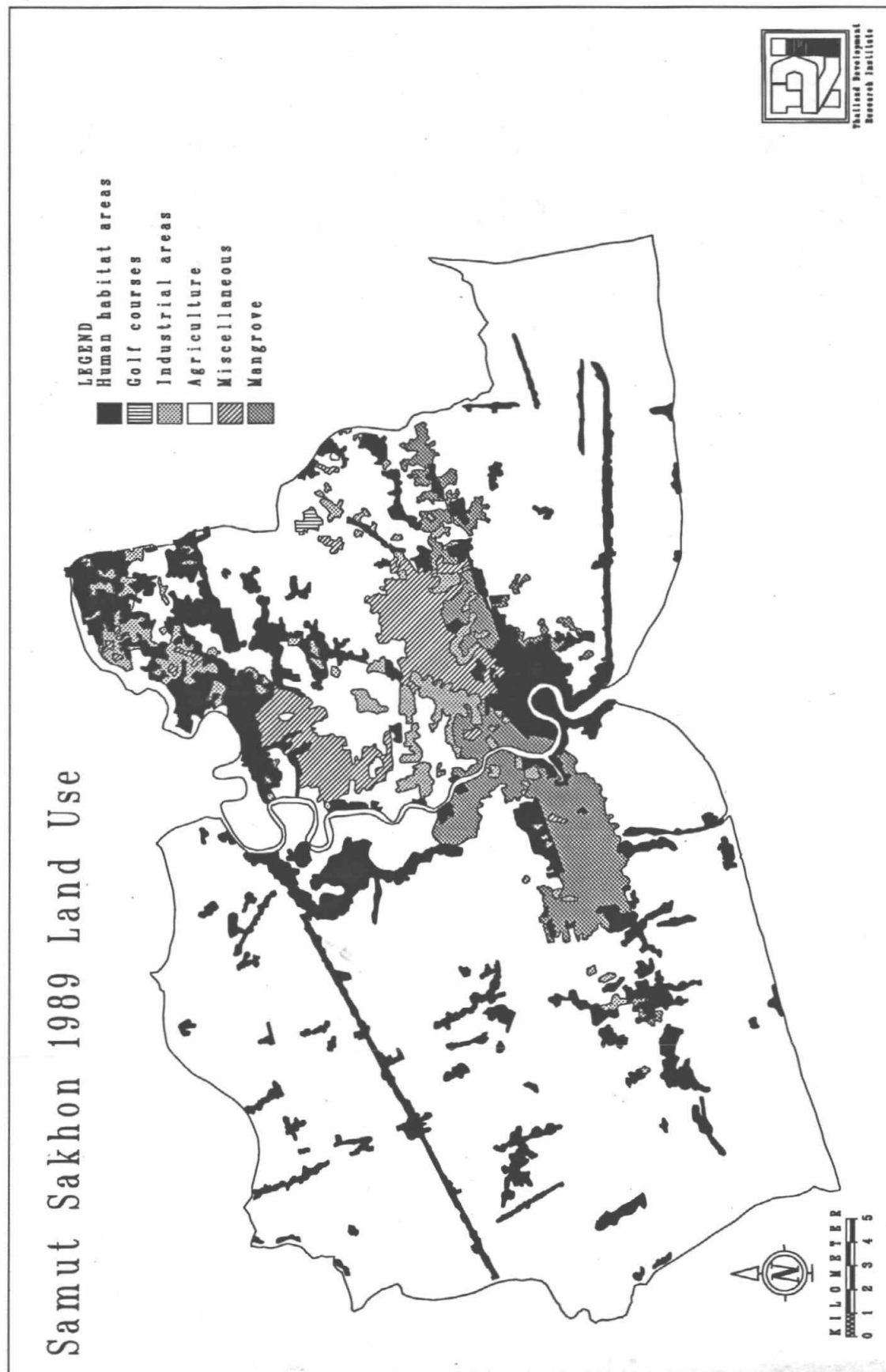


Figure 2.7 Nakhon Pathom Land Use 1989



3 Samut Sakhon Land Use 1989

Table 2.4 Major Land Use in the Urban Fringe of the BMR, 1989

Province	Agricultural	Industrial	Residential	Total Land
Nonthaburi	273,151	3,426	90,406	388,939
Pathum Thani	747,730	16,266	144,825	953,660
Samut Prakan	433,049	46,940	93,482	627,557
Samut Sakhon	403,898	14,083	71,788	545,216
Nakhon Pathom	1,049,501	7,403	247,688	1,355,204
Total	2,907,329	88,118	648,189	3,870,576

Source: Department of Land Development

Table 2.5 Share of Land Use in the Urban Fringe of the BMR, 1989 (by province)

Province	Agricultural	Industrial	Residential	Total Land
Nonthaburi	70.23	0.88	23.24	100.00
Patum Thani	78.41	1.71	15.19	100.00
Samut Prakan	69.01	7.48	14.90	100.00
Samut Sakhon	74.08	2.58	13.17	100.00
Nakhon Pathom	77.44	0.55	18.28	100.00
Total	75.11	2.28	16.75	100.00

Table 2.6 Share of Land Use in the Urban Fringe of the BMR, 1989 (by Province)

Province	Agricultural	Industrial	Residential	Total Land
Nonthaburi	9.40	3.89	13.95	10.05
Pathum Thani	25.72	18.46	22.34	24.64
Samut Prakan	14.90	53.27	14.42	16.21
Samut Sakhon	13.89	15.98	11.08	14.09
Nakhon Pathom	36.10	8.40	38.21	35.01
Total	100.00	100.00	100.00	100.00

Predominance of Agricultural Land

According to the DLD survey, approximately 75 percent of total land in the urban fringe is still under agriculture. The major agricultural uses are paddies, orchards, and vegetables. Agricultural land remaining in the urban fringe is located as follows:

- Amphoe Klong Luang, Lad Lum Kao, Tanyaburi, and Muang in Pathum Thani
- Amphoe Sainoi, Bang Buathong, Bang Kruay, and Bang Yai in Nonthaburi
- Northeastern and southern parts of Samut Prakan
- Amphoe Ban Paew and Kratukmban in Samut Sakhon
- Amphoe Band Lane, Nakhon Chaisri, Sampran, Sontum, Muang, and Kampang San in Nakhon Pathom

Emerging Subdivided Orchards

Since 1984, a new form of land subdivision has emerged. The original purpose was to convert rice paddies into small orchards. Further developments included infrastructure such as roads and electricity, recreational facilities, housing, and gardening services. This type of subdivision can be found in the following areas:

- Amphoe Klong Luang, Tanyaburi, Lad Lum Kao, and Muang in Pathum Thani
- Amphoe Sainoi in Nonthaburi

It is expected that these subdivided orchards will be further developed into residential areas once other infrastructure is provided and urban facilities become accessible.

Rapidly Expanding Housing Projects

The metropolitan residential areas expand from the center of the cities in every direction. The types of projects are diversified ranging from low density single houses and row houses to high-rise buildings. These housing projects developed shoulder to shoulder with industrial development.

The report of the Housing Policy Committee of the National Economic and Social Development Board (NESDB) found there was an 18.6 percent increase in housing units in the BMR during 1989. This was the third major annual increase in the number of houses since 1987 (NESDB 1989). Along with this increase, there have been shifts in the structure and pattern of housing from single family houses to row houses. In 1989 the most rapidly expanding type of new housing was the condominium. These high-rise

residential units increased 9 percent in 1989 in response to increasing demand from every income group, including low-income groups (NESDB).

There were 10,133 units of new housing registered in Samut Prakan, 5,184 units in Nonthaburi, and 1,452 units in Pathum Thani in 1989. The composition of housing in the BMR consists of 51 percent single family houses, 39 percent row houses, 9 percent apartments and condominiums, and 1 percent duplexes (NESDB).

In 1989, requests in the BMR accounted for more than half of all the subdivision permits requested by the private sector. Fifty-six percent of the country's new permits were in the BMA, 17 percent in Nonthaburi, 9 percent in Pathum Thani, 8 percent in Samut Prakan, and 9 percent in the other provinces. Spatially, 41 percent of the area requested in the BMR is located in Samut Prakan, and 9 percent in Nonthaburi. Approximately 50 percent of the requested subdivision permits, the largest single portion, were requests to build townhouses.

The patterns of housing development in the areas described can be summarized as follows:

1. Land subdivision in the BMR is primarily for low-rise residential developments within 25 kilometers of the center (Hua Lampong). The development concentrates on the left bank of the Chao Phraya River, especially in Nonthaburi, and follows the major roads. Townhouse projects and higher priced single houses are more available closer to the center and in the more accessible locations.
2. High-rise housing projects are found in similar locations. The more luxurious condominiums are located in the inner city and on the waterfront, while the low-income condominiums are located in the suburbs and nearby industrial areas as follows:
 - Northeast of the BMA in Min Buri
 - North of the BMA along Changwattana Road, in Rangsit Pathum Thani
 - West of the BMA on Charan Sanitwong Road, Suksawat Road, and Petch Kasem Road as far as Samut Sakhon Province
 - Southeast of the BMA in Amphoe Muang, Samut Prakan, and Phra Pradang, on Sukhumvit Road, Teparak Road, and Bangna-Trad Road (NESDB).

Sprawling Heterogeneous Industrial Development

In a pattern similar to that of housing development, industrial development is drawn to locations which are in close proximity to markets and labor supply, and adequately provided with infrastructure especially roads and water supply. Industries,

both those registered and non-registered with the Department of Industrial Works (DIW), are therefore concentrated in the BMR. There are three major patterns of industrial development. These include (1) The traditional factory--a single factory with supporting activity area; (2) the industrial estate; and (3) the industrial condominium or "flatted factory". The last category is the most recent development in small manufacturing which needs to be close to the major markets and transportation networks despite the high land prices often associated with these locations. High land prices are, of course, the major constraint for development of low-rise factories.

The existing locations of industrial development in the urban fringe are as follows:

1. Industrial development in Pathum Thani is concentrated along Vipawadee Road from the Rangsit intersection to the northern part of the province. It is also extends west to the railroad tracks, to the east along the Chao Phraya River, the Rangsit - Nakhon Nayok Road, and the Patumthani - Lad Lum Kao Road.
2. In Nonthaburi, single factories are located along the river, Changwattana Road, and in the outer areas such as in Amphoe Sainoi where land prices are lower than in the more densely populated areas. Industrial condominiums are primarily planned for locations along Changwattana Road.

Golf Courses: A New Form of Land Development

Golf courses are a new form of real estate development in Thailand. This development is combined with housing complexes to serve the recreational interests of high-income groups. The major factors needed for such development are (1) large parcels of land; (2) sufficient water supply; and (3) proximity to adequate transportation routes for potential customers.

As a result of these factors the BMR has become the prime location for golf course development, resulting in the conversion of agricultural land into golf courses. Some courses are as large as 3,000 to 4,000 rai (Prachachart Turakit 1990). Major sites of this type in the urban fringe include Rangsit and Lamlugga in Pathum Thani, Bangna-Trad Road in Samut Prakan, Pudhamonton Road in Nakhon Pathom, and Ekachai Road in Samut Sakhon.

These developments are intermixed and sprawl along major roads in the form of ribbon development. Environmental problems occur as a result of such urban development. These environmental impact issues will be discussed later in Chapter 5.

SUMMARY

As a result of these and previously discussed trends, it appears inevitable that more agricultural land, especially land which is relatively accessible to the urban center, will be demanded by the market for conversion to urban activities such as housing and manufacturing. Given these pressures, the economic importance of the urban fringe areas, and the prospect of conflict over competing land uses, it is crucial that appropriate land use policies be developed to provide for efficient use of resources while minimizing the likelihood of adverse impacts. Chapters 5 and 6 further examine the causes of this transformation, and the potential alternatives which might mitigate their impacts.

Chapter 3

Conversion of Agricultural Land

Although approximately 75 percent of land in the BMR is still used for agricultural purposes, the rapid conversion of agricultural land for urban development has become an increasing cause of concern. Accustomed to observing only slow gradual conversion rates of 1 to 2 percent per year, the rapid conversion in recent years has raised a number of important issues:

1. How significant is the conversion of agricultural land?
2. What are the primary causes of land conversion?
3. What are the consequences of the conversion?
4. What can and should be done about the land conversion?

VANISHING AGRICULTURAL LAND?

A survey conducted by the Department of Land Development (DLD) indicates that the long-term trend has been fairly gradual. Over the past 18 years the survey reveals that the average annual conversion rate in the BMR urban fringe was roughly 1 percent. Only in Nonthaburi was the percentage higher, about 1.57 percent annually (Table 3.1). However, with recent increases in the growth rate of the economy and the population, dramatically higher annual conversion rates have been seen in recent years. The provinces observed were Nonthaburi, Pathum Thani, and Samut Prakan where population growth rates in the past two years were much higher than in the rest of the region (Table 2.1). In these three provinces, the conversion rates were also higher; 7.21 percent per year in Nonthaburi, 5.92 percent in Pathum Thani, and 2.56 percent in Samut Prakan (Tables 3.1 and 3.2).

Table 3.1 Annual Change of Agricultural Land in the BMR

Province	1 1971 (Rai)	1989 (Rai)	Annual Change (%)
Nontaburi	380,630	273,151	1.57
Patum Tani	891,876	747,730	0.92
Samut Prakan	492,413	433,049	0.67
Samut Sakhon	423,938	403,898	0.26
Nakhon Pathom	1,260,710	1,049,501	0.93

Recent Changes	1987 (Rai)	1989 (Rai)	Annual Change (%)
Nontaburi	319,152	273,151	7.21
Patum Thani	848,278	747,730	5.92
Samut Prakan	456,417	433,049	2.56

Source: Department of Land Development

Table 3.2 The BMR's Agricultural Area, Selected Years

Province	a 1971	a 1980	a 1982	a 1987	b 1989
Bangkok	540,804.0	533,284.0	-	525,359.0	-
Pathum Thani	897,876.0	884,490.0	-	848,278.0	747,730.0
Nonthaburi	380,630.0	340,234.0	-	319,152.0	273,151.0
Samut Prakan	492,413.0	475,986.0	459,986.0	456,417.0	433,049.0
Samut Sakhon	423,937.0	-	385,955.0	-	403,898.0
Nakhon Pathom	126,710.0	-	-	-	1,049,501.0

Note:

a: Translation from aerial photograph

b: Translation from satellite photograph, August, 1989

c: Agricultural area increased because mangrove forest was decreased from 69,693 rai (1982) to 25,845 rai (1989) and mangrove forest changed to agricultural areas (Shrimp farm).

Sources: Department of Land Development

Analysis of the aggregate trends is somewhat complicated by the different forms under which land use data are made available. Notwithstanding the general trends noted above, when looking at the composition of changes in agricultural land use using available agricultural statistics (Agricultural Statistics Division, Agricultural Economic Office), total agricultural land in the BMR, including the BMA, has increased 8.77 percent from 1981 to 1988, and 16.14 percent from 1986 to 1988. With the exception of the BMA, Pathum Thani, and Samut Sakhon the total agricultural land of every province has actually increased. A discrepancy arises here between the data obtained from the survey showing a reduction of agricultural land, and the data from the Agricultural Statistics Division which show an increase in agricultural land.

Regardless of the discrepancy noted above, when we look to the composition of the aggregate changes, we see that land under paddy, field crops, vegetables, and flowers in the BMR decreased between 6 percent and 15 percent from 1986 to 1988. Paddy land in every province except Nonthaburi and Samut Sakhon decreased during this period. Field crops, vegetables and flowers, and unclassified land categories also decreased. Meanwhile, grass land, idle land, other land and unclassified lands increased (Table 3.3).

CAUSES OF CONVERSION OF AGRICULTURAL LAND

The causes of conversion from agricultural land use to industrial or residential land use are not entirely all that different from the factors which influence the conversion of land from one crop to another. For example, paddy and field crops, which have experienced the most rapid conversion, have also recently had comparatively low rates of return compared to fruit and tree crops. The introduction of dairy cattle in Ratchaburi also explains the growing demand for grassland area in Nakhon Pathom. Moreover, the increased demand for shrimp farms in Samut Sakhon and Samut Prakan resulted in decreases of other agricultural land use there (Table 3.4). A other example is that idle lands which are not currently used for either urban or industrial development locations are often reported as used for agriculture, especially fruit and tree crops, in order to avoid higher taxes charged on land that is left idle. It is clear that farmers, when given a choice, do respond to economic incentives and gradually convert their land to the use which appears to promise them the greatest return. Whether that return is greatest from alternative crops or alternative land uses, overtime land in a free market is converted to the use providing the greatest potential return.

Table 3.3 Agricultural Land Use, Selected Years

Year	Total Land	Total Agri. Land	Average Farm Size	Number of Farms	Housing Area	Paddy Land	Under Field Crops	Fruit & Oth. Tree Crops	Vegs. & Flowers	Grass Land	Idle Land	Other Land	Unclassified Land
1981	4,848,841	3,004,221	23.93	125,518	82,807	2,163,463	296,165	300,394	59,188	200	1,637	100,367	1,844,620
1984	4,848,841	2,878,968	24.09	119,517	84,536	2,048,228	302,515	303,250	74,979	3,934	3,934	44,199	1,969,873
1986	4,848,841	2,813,379	23.60	119,224	96,144	1,899,669	239,843	409,775	90,940	3,385	3,385	51,093	2,035,462
1988	4,848,841	3,267,544	26.75	122,168	90,635	1,779,513	184,726	478,136	76,523	422,301	422,301	211,805	1,581,297
%Change 1981-88		8.77	11.75	-2.67	9.45	-17.75	-37.63	-59.17	29.29	211,050.50	1,360.29	111.03	-14.28
%Change 1984-88		13.50	11.03	2.22	3.45	-13.12	-38.94	57.67	2.06	10,634.65	66.85	379.21	-19.73
%Change 1986-88		16.14	13.34	2.47	-5.73	-6.33	-22.98	16.68	-15.85	12,375.66	6.10	314.55	-0.2231

Note: BMR Provinces include Bangkok, Pathum Thani, Nonthaburi, Nakhon Pathom, Samut Prakan, Samut Sakhon

Source: Agricultural Economics Office of Agricultural Statistics Division,

Table 3.4 The Composition of Changes in Agricultural Land Use, Selected Years

Province: Bangkok Metropolis

Year	Total Land	Forest Land	Total Agri. Land	Average Farm Size	Number of Farms	Housing Area	Paddy Land	Under Field Crops	Fruit & Oth. Tree Crops	Vegs. & Flowers	Grass Land	Idle Land	Other Land	Unclassified Land
1981	978,263	0	443,000	20.33	21,786	11,599	400,278	722	21,445	8,080	0	0	876	535,263
1984	978,263	0	394,913	20.79	18,995	11,959	327,388	1,065	32,790	17,460	0	3,345	906	583,350
1986	978,263	0	388,456	20.96	18,531	14,591	280,231	1,468	48,812	27,743	115	11,646	3,850	589,807
1988	978,263	0	364,974	20.66	17,667	11,917	239,838	0	60,588	19,819	7,376	1,684	23,752	613,289
%Change 1981-88		0.00	-17.61	1.59	-18.91	2.74	-40.08	-100.00	182.53	145.28	Inf.	Inf.	2611.42	14.58
%Change 1984-88		0.00	-7.58	-0.63	-6.99	-0.35	-26.74	-100.00	84.78	13.51	Inf.	-49.66	2521.63	5.13
%Change 1986-88		0.00	-6.04	-1.45	-4.66	-18.33	-14.41	-100.00	24.13	-28.56	6313.91	-85.54	516.94	3.98

Table 3.4 (Con.)

Province: Nakhon Pathom

Agricultural Land Use, Selected Years

Year	Total Land	Forest Land	Total Agri. Land	Average Farm Size	Number of Farms	Housing Area	Paddy Land	Under Field Crops	Fruit & Oth. Tree Crops	Vegs. & Flowers	Grass Land	Idle Land	Other Land	Unclassified Land
1981	1,355,204	0	1,004,642	22.35	44,954	34,965	559,800	289,238	64,264	25,796	0	0	30,579	350,562
1984	1,355,204	0	961,704	22.76	42,254	37,236	520,589	296,075	66,658	30,678	3,934	3,721	2,813	393,500
1986	1,355,204	0	950,429	22.34	42,537	38,856	531,215	233,733	86,576	38,820	3,270	5,003	12,966	404,775
1988	1,355,204	0	1,217,943	29.31	41,552	42,503	477,408	181,035	105,727	26,710	366,831	6,580	11,149	137,261
%Change 1981-88		0.00	21.23	31.16	-7.57	21.56	-14.72	-37.41	64.52	3.54	Inf.	Inf.	-63.54	-60.85
%Change 1984-88		0.00	26.64	28.78	-1.66	14.14	-8.29	-38.86	58.61	-12.93	9224.63	76.83	296.34	-65.12
%Change 1986-88		0.00	28.15	31.18	-2.32	9.39	-10.13	-22.54	22.12	-31.20	11118.07	31.52	-14.01	-66.09

Table 3.4 (Con.)

Province: Nonthaburi

Agricultural Land Use, Selected Years

Year	Total Land	Forest Land	Total Agri. Land	Average Farm Size	Number of Farms	Housing Area	Paddy Land	Under Field Crops	Fruit & Oth. Tree Crops	Vegs. & Flowers	Grass Land	Idle Land	Other Land	Unclass- ified Land
1981	388,939	0	211,069	15.13	13,952	6,138	151,997	0	46,521	2,424	0	0	3,989	177,870
1984	388,939	0	209,972	16.13	13,014	6,371	154,050	0	44,801	1,770	0	1,530	1,450	178,967
1986	388,939	0	205,945	14.92	13,805	7,247	161,174	1,414	30,297	2,639	0	2,150	1,024	182,994
1988	388,939	0	281,352	17.97	15,660	4,767	204,952	0	52,922	8,810	7,206	1,821	874	107,587
%Change 1981-88		0.00	33.30	18.76	12.24	-22.34	34.84	0.00	13.76	263.45	Inf.	Inf.	-78.09	-39.51
%Change 1984-88		0.00	34.00	11.35	20.33	-25.18	33.04	0.00	18.13	397.74	Inf.	19.02	-39.72	-39.88
%Change 1986-88		0.00	36.62	20.43	13.44	-34.22	27.16	-100.00	74.68	233.84	Inf.	-15.30	-14.65	-41.21

Table 3.4 (Con.)

Province: Samut Sakhon

Agricultural Land Use, Selected Years

Year	Total Land	Forest Land	Total Agri. Land	Average Farm Size	Number of Farms	Housing Area	Paddy Land	Under Field Crops	Fruit & Oth. Tree Crops	Vegs. & Flowers	Grass Land	Idle Land	Other Land	Unclassified Land
1981	545,217	0	273,891	24.73	11,075	7,280	144,684	4,417	79,415	10,741	119	0	27,235	271,326
1984	545,217	0	213,492	19.91	10,724	6,668	126,454	4,229	60,318	10,698	0	108	5,017	331,725
1986	545,217	0	201,875	17.21	11,733	7,390	109,262	2,548	65,569	11,973	0	905	4,228	343,342
1988	545,217	0	249,315	19.01	13,113	7,934	125,817	0	54,669	14,176	9,414	10,629	26,676	295,902
%Change 1981-88		0.00	-8.97	-23.12	18.40	8.98	-13.04	-100.00	-31.16	31.98	7810.92	Inf.	-2.05	9.06
%Change 1984-88		0.00	16.78	-4.50	22.28	18.99	-0.50	-100.00	-9.37	32.51	Inf.	9741.67	431.71	-10.80
%Change 1986-88		0.00	23.50	10.50	11.76	7.36	15.15	-100.00	-16.62	18.40	Inf.	1074.48	530.94	-13.82

Table 3.4 (Con.)

Province: Samut Prakan

Agricultural Land Use, Selected Years

Year	Total Land	Forest Land	Total Agri. Land	Average Farm Size	Number of Farms	Housing Area	Paddy Land	Under Field Crops	Fruit & Oth. Tree Crops	Vegs. & Flowers	Grass Land	Idle Land	Other Land	Unclassified Land
1981	627,558	0	279,618	21.19	13,193	8,919	207,620	0	47,046	356	0	0	15,677	347,940
1984	627,558	0	315,298	22.13	14,250	10,794	226,396	0	51,119	2,257	0	215	24,517	312,260
1986	627,558	0	301,623	23.81	12,670	9,778	214,380	0	54,178	1,610	0	393	21,284	325,935
1988	627,558	0	437,245	31.09	14,063	9,072	209,959	0	63,043	1,051	14,630	342	139,148	190,313
%Change 1981-88		0.00	56.37	46.70	6.59	1.72	1.13	0.00	34.00	195.22	Inf.	Inf.	787.59	-45.30
%Change 1984-88		0.00	38.68	40.52	-1.31	-15.95	-7.26	0.00	23.33	-53.43	Inf.	59.07	467.56	-39.05
%Change 1986-88		0.00	44.96	30.60	10.99	-7.22	-2.06	0.00	16.36	-34.72	Inf.	-12.98	553.77	-41.61

Table 3.4 (Con.)

Province: Pathum Thani

Agricultural Land Use, Selected Years

Year	Total Land	Forest Land	Total Agri. Land	Average Farm Size	Number of Farms	Housing Area	Paddy Land	Under Field Crops	Fruit & Oth. Tree Crops	Vegs. & Flowers	Grass Land	Idle Land	Other Land	Unclassified Land
1981	953,660	0	792,001	38.53	20,558	13,906	699,084	1,788	41,703	11,791	81	1,637	22,011	161,659
1984	953,660	0	783,589	38.64	20,280	14,508	693,351	1,146	47,564	12,116	0	5,408	9,496	170,071
1986	953,660	0	765,051	38.35	19,948	18,282	603,407	690	124,343	8,155	0	2,433	7,741	188,609
1988	953,660	0	716,715	35.63	20,113	14,442	521,539	3,691	141,187	5,957	16,844	2,849	10,206	236,945
%Change 1981-88		0.00	-9.51	-7.50	-2.16	3.85	-25.40	106.43	238.55	-49.48	20695.06	74.04	-53.63	46.57
%Change 1984-88		0.00	-8.53	-7.77	-0.82	-0.45	-24.78	222.08	196.84	-50.83	Inf.	-47.32	7.48	39.32
%Change 1986-88		0.00	-6.32	-7.09	0.83	-21.00	-13.57	434.93	13.55	-26.95	Inf.	17.10	31.84	25.63

Source: Agricultural Statistics Division, Office of Agricultural Economics

While most of the reasons for conversion of agricultural land are related to economics, we find that they can be usefully divided into the following three categories:

1. Destruction of agricultural productivity as a result of inadequate environmental controls
2. Waste of agricultural land through land use and tax policies which subsidize inefficient use
3. Conversion of agricultural land as a result of competing land and labor demands for alternative uses, as reflected in rising wages and land prices

Inadequate Environmental Controls

The destruction of agricultural land through failure to provide adequate environmental controls is perhaps the most visible the three causes. Uncontrolled automobiles and factories as well as untreated waste from shrimp farms reduce potential productivity of the remaining agricultural lands in Samut Prakan and other suburban provinces. As productivity declines and the desirability of these former pastoral locations is reduced, the disparity between potential returns from farming and sale for development loom even greater. While the exact level of impact is not known, studies in the United States, and Western Europe have repeatedly shown that air and water pollution are harmful not only to human health but to fruit trees, field crops, and livestock.

Not only does pollution reduce the agricultural productivity of land but it also directly impacts the safety and desirability of the crops for human consumption. Data collected during 1984 to 1986 by the Food Control Division of the Thailand Food and Drug Administration (Ministry of Health) reveal that food marketed in the BMR had particularly high levels of contamination for lead, arsenic, cadmium, and mercury. Ultimately this contamination will affect the health of these products and the economic viability of the agricultural lands that produce them.

While there is no precise estimate on the quantity of agricultural land that is lost through inadequate environmental protection, it is obvious that failure to require reasonable environmental controls acts primarily as a subsidy to urban and industrial uses and as a penalty to agricultural uses. Given the desire to preserve agricultural land, it will be important to assure that all new and existing pollution sources are required to limit their pollution discharges, particularly where they threaten to adversely impact adjacent land and especially where those sources are already subsidized through Board of Investment (BOI) privileges.

Inefficient Land Use and Property Tax Policies

Just as failure to control industrial pollutants subsidizes industrial land uses at the expense of agriculture, inefficient land use and tax policies act to encourage urban sprawl at the expense of agriculture. Ultimately, efficient use of agricultural land will require efficient use of urban land as well. When urban land use is sprawling and inefficient it becomes "land intensive" and consumes excessive quantities of agricultural land. Three factors contributing to inefficient urban sprawl are most readily apparent:

1. Low or non-existent property taxes
2. Absence of development fees or special assessments to cover the cost of publicly provided infrastructure
3. Restrictive rules which limit the use and/or sale of state owned properties

Reports by the World Bank (Thailand 1988) confirm that the property tax rate in Thailand is only half that in Korea and less than one-tenth the rate found in Japan and Singapore. In addition to the low reported rates for property taxation, recent studies by the Land Institute Foundation of Thailand reveal that for the randomly selected districts analyzed in the Bangkok Metropolitan Authority, less than half the taxes assessed were ever actually collected.

Low property taxes not only subsidize the landowner but they enable landowners to tie up parcels of land unproductively, at relatively low cost to themselves, while forcing the government and their neighbors to assume additional costs of extending infrastructure to pay for urban sprawl.

In addition to property taxes, many countries are increasingly relying on development impact fees to shift the burden of infrastructure development costs on to the developer and landowner (the primary beneficiaries) and away from the general public. This system, however, does not yet exist in Thailand. When fees and property taxes are inadequate to cover the cost of providing public infrastructure, that cost ultimately must be made up from other public revenues. This means that as roads and other infrastructure are provided into previously undeveloped land, the landowners receive substantial benefit through the appreciation of their properties but pay little or none of the cost. Ultimately, under these circumstances, the owners of these parcels of land near a highway are subsidized at the expense of those who have relatively limited access to roads or other services. At the same time that development occurs rapidly along major highways consuming high quality agricultural land, low taxes and poorly developed road networks leave substantial "blind pockets" of land near the urban centers undeveloped. Under

these circumstances, sprawling ribbon development becomes more attractive to the developer despite the fact that it consumes more agricultural land and costs more for the government to provide the infrastructure.

The third factor which restricts efficient development and promotes urban sprawl involves restrictions on the sale or use of government and state enterprise land. When any organization is restricted in the use or sale of its property, it incurs little opportunity cost when that property is left idle. A private owner cannot afford to let land remain under-utilized for too long because he realizes that each day such use or sale is postponed results in foregone income. A state enterprise that is forbidden to sell land, by contrast, experiences no such opportunity cost for letting land sit idle. In addition, as a government agency normally receives no compensation when its land is taken for expansion of a road or other public facility, it has little incentive to cooperate and every incentive to obstinately hang on to its land. Both these aspects act to frustrate the orderly development of urban land and ultimately lead to excessive consumption of agricultural land. Ironically, through its current tax and land use policies, a government that purports to want to preserve agricultural land is subsidizing precisely the kind of sprawling urban development that is most likely to result in the excessive consumption of agricultural land.

Competition for Land and Labor for Alternative Uses

Of all the causes of land conversion from agricultural to urban and industrial uses, increased competition for land in an expanding economy is the least avoidable. At the same time however, *If policy makers can be assured that the competition is fair (i.e., that all factor costs are fairly priced)*, then it is not clear that the government should seek to prevent either such competition or the resulting land conversion. Furthermore, we find no evidence of any country that has successfully limited land conversion without creating serious inflationary pressure on land prices for other uses. Japan, for example, has artificially preserved agricultural land but in so doing it has inflated its rice prices to seven times the world market price and inflated the cost of residential housing to the highest in the world.

The factors leading to the growing competition for land, and the resultant pressure for land conversion, are all closely linked to growth in the economy and to each other. They include at least the following:

- Expansion of the urban and industrial economy

- Rising land prices
- Rising wages

Rising Demand for Land to Support: Urban and Industrial Development

The growing competition for land is a direct consequence of the expanding economy's search for additional land at reasonably low prices. As the inner city has become more crowded with new migrants and new industries, the industrial, residential, and commercial sectors have continued to expand at an annual rate far above national averages and even ahead of other rapidly expanding economies in the Pacific Rim. After a recession during 1983 to 1986, the Thai economy recovered rapidly and has experienced a very high growth rate during the past few years. The BMR, as the center of economic activities, set the pace and has kept expanding economically and spatially since 1987. With the expansion of the economy and the pressures of land scarcity in the inner city, suburbanization became the urban development pattern in the past two years. As shown in Chapter 2, population in the urban fringes of the BMR experienced higher population increases than the BMA. Housing projects, department stores, and manufactures rapidly located in the urban fringes.

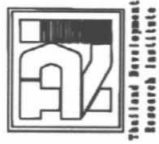
Moreover, it is expected that urban population in the BMR will continue to increase in the next two decades, and that the economy will grow at 7.25% annually at the same time. The industrial sector will also perform as a leading sector (Table 2.2). The current urban development can be divided into two patterns spatially:

1. Horizontal suburbanization
2. Vertical development of the inner city

As a result, demand for land in the suburbs of the BMR has increased rapidly and will continue to increase in the future.

Incentive to Sell : High Land Prices

As the competition for land has led to increased land prices, an increasingly powerful incentive to sell has obviously been created. Based on recent studies by the Land Institute of Thailand and PADCO the lowest land price in the housing projects in these 5 provinces has now reached 2 million baht per rai (Figure 3.1). This price is far higher than the income potentially derived from agricultural products produced in the area (Table 3.5). Even a conservatively high estimate of the price for agricultural land is no greater than 60,000 baht per rai. As a result, from a landowner's point of view, selling



BMR 1990 Land Prices



Figure 3.1 BMR 1990 Land Price

Table 3.5 Average Annual Agricultural Productivity (at Constant 1972 Price)

Unit : 1,000 Baht/Rai

Province	1982	1983	1984	1985	1986
Bangkok	5.425	5.770	5.512	7.164	6.583
Samut Prakan	2.011	2.005	2.360	2.901	3.214
Samut Sakhon	2.406	2.700	2.658	2.448	3.515
Nakhon Pathom	1.166	1.199	1.284	1.381	1.332
Nonthaburi	1.297	1.532	2.075	2.024	2.111
Pathum Thani	0.936	0.898	0.822	0.830	0.866

Source: Agricultural Statistics Division, Office of Agricultural Economics (1989)

the land is much more economically attractive than renting out for agriculture or farming by oneself.

Incentive for Tenant Farmers to Leave Low Wage Farming

Just as the landowner experiences increasing competition and higher prices for his land, the tenant farmer can be expected to become increasingly aware of the growing disparity between his wages and those available to industrial and service workers. A substantial portion of the farmers in the BMR are not the landowners. As shown in Table 3.6, about 48% of the farmers in the BMR provinces rent their land in 1986. As a result, the social attachment to the land could not be expected to be as great. They farm the land out of the necessity to earn a subsistence income to support their families. They cannot develop the land for other uses as they are not the owners. Naturally, if they found a better job opportunity that outweighed the cost of changing their lifestyles, they would not hesitate to leave the farms. In addition, as the BMR experiences expanding urbanization and industrialization, more job opportunities are made available. As a result, the farmers find that becoming a wage laborer in the industrial and service sectors is often financially more attractive. The income received in these industries is usually higher than income derived from farming. Looking at wages earned by farming, the average annual agricultural income is about 15,000 baht per year (50 baht per day x 25 days per month x 12 months per year = 15,000 baht per year). This wage is much lower than annual the wage derived from the service and industrial sectors. That is, in comparison to the lowest wage rate in the BMR, the worker would receive 95 baht per day x 25 days per month x 12 months per year = 27,000 baht per year (almost double even for the lowest skilled worker).

For the reasons listed above, in those areas with rapidly expanding economies and a highly competitive demand for land, the process of converting land from agricultural use to urban and industrial uses is largely unavoidable and can be expected to continue long into the future. The pattern of conversion, however, can be directed so as to minimize urban sprawl, unnecessary agricultural conversion, and adverse environmental impacts. Effective land use policies and environmental controls should allow development to occur in such a manner that the man-made environment can harmonize with the natural environment and the conversion, where possible, will consume the least amount of high quality agricultural land.

Table 3.6 Farm Holding Land, 1982

Province	Total Land (Rai)	%	Owner (Rai)	%	Rented (Rai)	%
Bangkok	978,263	100	122,769	29	285,378	68
Samut Prakan	627,558	100	67,381	21	255,015	79
Samut Sakhon	545,217	100	164,235	70	70,506	30
Nakhon Pathom	1,355,204	100	638,763	69	284,043	31
Nonthaburi	388,939	100	66,437	32	129,745	63
Pathum Thani	953,660	100	195,473	25	562,229	71

Farm Holding Land, 1984

Province	Total Land (Rai)	%	Owner (Rai)	%	Rented (Rai)	%
Bangkok	978,263	100	107,736	27	282,353	71
Samut Prakan	627,558	100	73,333	23	231,411	73
Samut Sakhon	545,217	100	149,689	70	54,349	25
Nakhon Pathom	1,355,204	100	710,676	74	233,993	24
Nonthaburi	388,939	100	64,961	31	126,792	60
Pathum Thani	953,660	100	207,000	26	563,388	72

Farm Holding Land, 1986

Province	Total Land (Rai)	%	Owner (Rai)	%	Rented (Rai)	%
Bangkok	978,263	100	126,546	33	254,987	66
Samut Prakan	627,558	100	61,302	20	219,526	73
Samut Sakhon	545,217	100	116,490	58	69,328	34
Nakhon Pathom	1,355,204	100	607,407	64	290,569	31
Nonthaburi	388,939	100	157,719	77	44,834	22
Pathum Thani	953,660	100	285,532	37	472,362	62

Source: Agriculture Statistics Division, Office of Agricultural Economics (1989)

ENVIRONMENTAL CONSEQUENCES ASSOCIATED WITH LAND CONVERSION

As the conversion of agricultural land to urban land occurs in response to market forces, without any controls or guidelines, three major environmental concerns should be addressed:

- Loss of high quality agricultural land
- Conflicting land uses
- Direct pollution and indirect pollution

LOSS OF HIGH QUALITY AGRICULTURAL LAND

First, there will inevitably be a loss of good agricultural land wherever fertile soil is converted into building sites. Ironically, almost all of the soil series found in the BMR are extremely well suited for agriculture. The soils here are rated as most suitable or second ranked suitable for producing paddy, fruits, and vegetables. These soil series are presented in Table 3.7. Without land use controls or guidelines, lands with these soil series are converted to other uses such as industry. Misuse of the soil suitability (use of good agricultural land for non-agricultural uses) occurs in every province of the area studied. One example of the misuse of prime agricultural soil is in Samut Prakan. The soil series here—Bangkok series—is one of the best suited for growing rice. It occupies approximately 257,430 rai of the province. Most of the area covered by this soil series appears to already have been converted to use for residences, aquaculture, factories or golf courses (Table 3.8).

Important as it is to avoid unnecessary consumption of good quality agricultural land, it should also be recognized that the agricultural productivity of a parcel of land is only one measure of its intrinsic worth. Just as soil series, climate, water supply, and drainage help to establish the value of land for agriculture; location, the availability of infrastructure, drainage, and proximity to markets, supplies, and labor all help to establish the value of land as a potential building site. Where the competing demands for land differ by orders of magnitude, as they do in the urbanizing fringe around Bangkok, it is neither realistic nor economically efficient to totally restrict even prime agricultural land to that one exclusive use.

[illegible]

Table 3.7 (Con.)

No.	Soil Suitability	Very well suited				Well suited				Moderately suited				Poorly suited			
	Soil	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
23	Rangsit, very acid phase (Rs-a)									*					*	*	*
24	Thanyaburi (Tan)					*									*	*	*
25	Sena (Se)					*									*	*	*
26	Ongkharak (Ok)									*	*				*	*	*
27	Don Muang (Dm)									*	*				*	*	*
28	Undifferentiated Ridge acid Soils (Nc)						*	*	*					*			
29	Bang Pa-in	*								*						*	
30	Ratchaburi, mildly alkaline variant (Rb-al)	*													*	*	*
31	Sing Buri (Sin)					*									*	*	*
32	Sing Buri, acid substratum variant (Sin-a)					*									*	*	*
33	Tha Muang/Chainat calcareous variant association (Tm/Cn-ca)			*		*						*				*	
34	Kamphaeng Saen (Ks)		*	*	*									*			
35	Saraburi (Sb)	*													*	*	*
36	Saraburi, acid substratum variant (Sb-b)	*													*	*	*
37	Saraburi, marine substratum variant (Sb-m)	*													*	*	*
38	Nakorn Pathom (Np)					*					*					*	*
39	Kamphaeng Saen/Nakorn Patho (Ks/Np)		*	*		*	*					*				*	

Note: 1 = Paddy
 2 = Cash Crops
 3 = Tree Crops
 4 = Vegetables

Source: Department of Land Development

Table 3.8 The Agricultural Topsoil in Samut Prakan

Major Land Use	Area (Rai)	Percent
Agricultural	90,306	35
Habitat area	70,878	28
Aquaculture	65,542	25
Factory	16,047	6
Misc (unused)	12,299	5
Golf course	2,358	1
Total	257,430	100

Note: From the above it is obvious that most (65%) of the area covered by Bangkok soil is being misused.

Environmental Problems Associated With Unplanned Conversion

A second issue concerns environmental problems associated with unplanned conversion. Although there are obvious economic advantages to land conversion, there are also less obvious but still serious environmental disadvantages, especially in the mixed use of natural and man-made environments. Unintentionally mixed land use may result in environmental problems such as conflicts in resource uses, and both direct and indirect pollution.

Conflict in Resource Uses

One major resource required for almost every activity is water¹. Consequently, where water is scarce, conflicts over water supply are increasingly common. In Samut Prakan, for example, a major area of highly mixed land uses, demand for water is very high for agriculture, aquaculture, industry, and golf courses. In the BMR, searching for underground water has been the solution for most developers. Unfortunately, this practice increasingly leads to land subsidence or contamination of the underground aquifers. Land development sometimes exceeds the environment's natural carrying capacity and the supply of available resources. Therefore, it may become necessary for economic as well as environmental reasons to suspend some activities or to control resource allocation.

Topsoil is another resource worthy of mention here. The BMR is a lowland region, with an elevation only 1-2 meters above sea level. When converting these lowlands to urban and industrial activities, the most common procedure was to fill the land for better drainage and to avoid flooding. In so doing, topsoil from unused agricultural fields is transported from the suburban areas to fill these development projects. According to the survey, the sites where topsoil was dug were in Min Buri (BMA), Sainoi (Nonthaburi), Samkok (Patum Thani), and Muang (Samut Sakhon—near Ekachai Golf Course). As a result, good topsoil which had taken years to accumulate appropriately for agricultural production, was lost due to urban and industrial development. Ironically, this "mining" of topsoil occurred despite the fact that some of the areas "mined" were supposedly restricted to agricultural uses precisely in order to take advantage of their highly productive soils².

Direct Pollution

The major land use pattern found as a result of unplanned land use is a mixed pattern. Samut Prakan is an example where industry is prominent, and factories and houses are interspersed among agricultural fields. As a result, pollution from domestic and industrial areas impacts agricultural productivity directly. As described above,

pollution from unplanned and uncontrolled development can significantly impact agricultural productivity and the safety of the products.

In addition, our GIS study showed that existing irrigation canals designed for agricultural purposes have been adversely affected by human habitation and aquaculture. Another related problem is the pollution associated with traffic resulting from commuting to these areas of expanding activity³.

PRESERVING AGRICULTURAL LAND

Despite the environmental problems discussed above and the desire to make efficient use of the best quality agricultural lands, it will not be feasible to restrict large quantities of agricultural land from being converted to other uses. Land in close proximity to the BMA is already too much in demand for alternative uses.

Constraints on Large Scale Land Preservation

High demand for residential, commercial, and industrial land has already driven the average land price in the fringe areas of the BMA well above that justified by the expected return from agriculture. To forcibly restrict conversion of this land would not only confiscate more than three-quarters of the value of the property from the current landowners in the affected zones but would also substantially increase the cost of housing in the BMR. Recent studies conducted by PADCO and LIF reveal that the price of land is the single most rapidly increasing factor in the cost of new housing in the BMR. For these reasons and because of the difficulties of enforcement, we do not believe that agricultural zoning is a feasible or desirable option for protecting the environment of the BMR.

One theoretical alternative to zoning would be for the government to purchase the best agricultural land and hold it for that use. This option, however appears no more feasible than zoning. As we can see in the proposed zoning plan recently issued by DTCP, the urban fringes around the BMA are already engaged in many development projects. Appeals for agricultural zoning in these provinces, especially in Samut Prakan, have made the headlines of the newspapers. Thus, when considering different strategies to attain preservation, we must focus on the financial feasibility of enforcing such zoning.

If, for example, the median market land price in Samut Prakan were only one million baht per rai (instead of the more common estimate of two million), the government would have to set aside 13 billion baht for this province alone in order to

acquire the 13,000 rai of currently undeveloped agricultural land occupied by the soil most suitable for rice growing—the Bangkok Series. If the government were then to forever restrict this land to agricultural uses, as envisioned under this scheme, the land would then be worth no more than 60,000 baht per rai. This action to preserve the best agricultural land in one province alone would result in a net loss to the government of more than 12 billion baht⁴.

Even if, as is sometimes suggested, 10 percent of the agricultural zone could still be legally converted to other uses, this would still amount to a loss of over 10 billion baht for one province. It is interesting to note that the net loss to Thailand from restricting this valuable land resource to a less competitive use would be precisely the same whether the land was obtained through confiscatory zoning or through outright purchase. In either case the economic value of the land would be reduced for as long as the conversion prohibition was in effect.

For these reasons, we strongly believe that land preservation programs in the BMR should focus not on large-scale zoning of agricultural lands, but on programs closely tailored to preserve highly sensitive areas and on policies which make more efficient use of urban lands.

Preserving Environmentally Fragile Areas:

While it is not financially feasible to purchase large quantities of agricultural land to prevent conversion, there may well be certain limited locations that are environmentally fragile and worthy of protection. These could include certain mangrove areas, water recharge areas, wildlife sanctuaries, natural springs, waterfalls, or other scenic areas. Most of these areas are currently public lands or occupied by the government such as the navy and the army. However, to assure that there are no attempts to have titles issued for private ownership, it is suggested that most of these areas should be promptly protected as environmental protected zones. In order to speed up the planning process these zones should be implemented as soon as possible through a ministerial regulation.

Implementing the Building Construction Control Acts of 1979

Developing guidelines for efficient urban development for the entire area of the BMR is strongly recommended. However, because zoning enforcement is such a long process that it cannot keep pace with the rapid expansion of the city, it is suggested that the current building control laws and regulations should be enforced in all areas of the suburban provinces, particularly in the urban fringe.

the current building control laws and regulations should be enforced in all areas of the suburban provinces, particularly in the urban fringe.

Moreover, the guidelines for urban development for rapidly growing cities, such as regional growth cities and new economically active cities like frontier cities, should be enforced terms of zoning for the whole growth area.

SUMMARY

Agricultural land is being lost in the rapidly growing suburban areas around Bangkok for three major reasons:

1. Decreasing agricultural productivity as a result of conflicting land uses and inadequate environmental controls.
2. Waste of agricultural land through land use and tax policies which subsidize inefficient use.
3. Conversion of agricultural land as a result of competing demands for alternative uses, as reflected in rising land prices.

The first two problems can be effectively addressed, with both economic and social benefits. The third factor, loss of agricultural land due to competing demands for alternative uses, can only be curtailed at great financial and possibly social cost as well. For these reasons, Thailand should focus primarily not on exclusionary Zoning, but on the development and implementation of sound environmental and land use policies. Possible measures which could be used to mitigate the adverse impacts without destroying the opportunity for continued economic growth are discussed in Chapter 6.

Endnotes

- 1 Concerning water resource issue, please refer to "Water Use Conflicts and Their Policy Implications."
- 2 As of today, there is a draft of a Ministerial regulation restricting excavation of topsoil in the BMA.
- 3 Please refer to Chapter 5's : section on Pollution Trends for a discussion about environmental quality in the BMR.
- 4 $13,000 \text{ rai} \times (1,000,000 - 60,000) \text{ baht/rai} = 12,220,000,000 \text{ baht}$.

Chapter 4

Increase of Small Industries in the Bangkok Metropolitan Region

MANUFACTURING: THE MAJOR ECONOMIC CONTRIBUTOR OF THE REGION

The manufacturing sector has become the dominant sector of the Thai economy. It has surpassed the agricultural sector in recent years, and has had the highest share of the GNP since 1981. The Bangkok Metropolitan Region (BMR), which captures the major part of the country's economy, accounts for about 75 percent of the manufacturing sector. According to a TDRI study in 1989, the BMR has the highest average rate of increase of GRP at 6.8 percent, compared with a national annual rate of increase of GNP of 5.8 percent. When looking at the manufacturing sector alone, the BMR again has the highest growth rate of value added in the country, about 7.2 percent for the BMR compared to a rate of 6.8 percent per year for the entire country, and much lower rates for the other regions. Nearly all non-agricultural economic activities are concentrated in the BMR, and the proportion of value added of the manufacturing sector in the GRP of the BMR during 1981-1987 was higher than in all other regions. It is clear that the rate of increase of the manufacturing sector for the entire country is driven mainly by the BMR. It is also clear that industrial activities remain concentrated, and have in fact increased in the BMR over the past decade, despite government policies during this period to decentralize industrial development.

Within the region itself, the Bangkok Metropolitan Area (BMA) has the highest share of the GDP for the manufacturing sector, with Samut Prakan ranked second and Pathum Thani third. However, the manufacturing sector is more important for the provincial economies of Samut Prakan and Pathum Thani than for the BMA, with the value added share of the manufacturing sector in the GPP of Samut Prakan

approximately 60 percent, that of Pathum Thani 50 percent, and that of the BMA about 35 percent during 1981-1987.

SIZE OF INDUSTRY IN THE BANGKOK METROPOLITAN REGION

According to the Ministry of Industry's (MOI) classification of the size of industry by the number of employees, most registered industries are small. Approximately 60 percent of all industries in the BMR in 1987 were household or small-sized industries. Less than 0.1 percent of the registered industries were classified as large (Table 4.1). Detailed data on the number and size of industries by the Thailand Standard industrial Classification for each province in the BMR are presented in Appendix 4.1. The J-curve distribution of industries by size found in the BMR is similar to that in the provinces outside the BMR and in the country as a whole (Thailand Development Research Institute 1989).

The size distribution of industries is quite different among most of the provinces that make up the urban fringe of the BMR. While Nonthaburi tends to follow the J-curve distribution, the other four fringe provinces of BMR tend to have a nearly equal proportions of household-sized and small-sized industries, and a greater than average proportion of medium-sized industries. A much higher proportion of the large industries in the BMR can be found in these four fringe provinces, especially in Samut Prakan which has nearly as many large industries as the BMA.

The differences among the BMR provinces in distribution of industries are likely due to several factors. Lower land prices and greater land availability are certainly among the more important considerations for locating medium and large industries in the provinces of the urban fringe. In addition, the availability of infrastructure in the newer industrial parks, as well as various laws, regulations, and ordinances restricting or controlling the establishment of new factories in certain areas are the major factors leading to the different distribution of factories by size in Bangkok and Nonthaburi compared to the other four provinces of the BMR.

Table 4.1 Proportion of Different Sized Factories in the BMR

Province	Number of Factories					Proportion				
	HH	Small	Medium	Large	Total	HH	Small	Medium	Large	Total
BMA	13966	6795	1088	79	21928	63.69	30.99	4.96	0.36	100.00
Nonthaburi	402	165	42	4	613	65.58	26.92	6.85	0.65	100.00
Pathum Thani	178	181	122	26	507	35.11	35.70	24.06	5.13	100.00
Samut Prakarn	948	923	560	65	2496	37.98	36.98	22.44	2.60	100.00
Samut Sakhon	305	213	138	6	662	46.07	32.18	20.85	0.91	100.00
Nakhon Pathom	249	196	83	12	540	46.11	36.30	15.37	2.22	100.00
BMR	16048	8473	2033	192	26746	60.00	31.68	7.60	0.72	100.00

Source: Department of Industrial Works, 1987

AREA SPECIALIZATION

Available statistics confirm that nearly all of Thailand's industrial activities have remained concentrated in the BMR, and especially in the BMA. With the exception of the food and tobacco industries, and non metals industries such as cement, more than half to nearly all the factories in all industrial categories are located in the BMR (Table 4.2 and Table 4.3).

Bangkok has a high rate of area specialization for many industries. More than 70 percent of all the nation's factories producing textiles, wearing apparel, leather goods and footwear, paper products and printing, rubber and plastic products, chemical products, basic metals, fabricated products, and electrical machinery are located in the BMR. These industries with high area specialization in the BMR are all export-oriented, with the exception of paper products and printing. Industries that are less concentrated in the BMR tend to be for both local consumption and export.

Nearly 55 percent of the country's registered factories are in the BMR, with roughly 44 percent in the BMA alone. Another 5.5 percent are in Samut Prakan, with 1.46 percent, 1.39 percent, 1.34 percent and 1.02 percent in Samut Sakhon, Nakhon Pathom, Nonthaburi, and Pathum Thani, respectively. Of all the provinces in the BMR, the BMA has the highest degree of specialization in nearly all the industries listed in the TSIC. Only the food, beverages, tobacco, and non metals (cement, gypsum, etc.) industries have less than 30 percent of their factories in the BMA (Table 4.2 and Table 4.3). Even in these cases, the proportion of factories in the BMA is much greater than elsewhere in the country, with the notable exception of the tobacco industry.

Samut Prakan, with the second largest share of total factories, has the second greatest concentration of industrial activity among the provinces of the BMR. The industrial specialization of Samut Prakan accounts for over 30 percent of the leather and footwear industry, nearly 25 percent of the basic metals industry, 18 percent of the textiles industry, and 14 percent of the chemical products industry. Other industries with a high degree of concentration in Samut Prakan, ranging from 7 percent to 9 percent of the country's registered factories, are electrical machinery, paper and paper products, rubber and plastics products, petroleum products, and fabricated products.

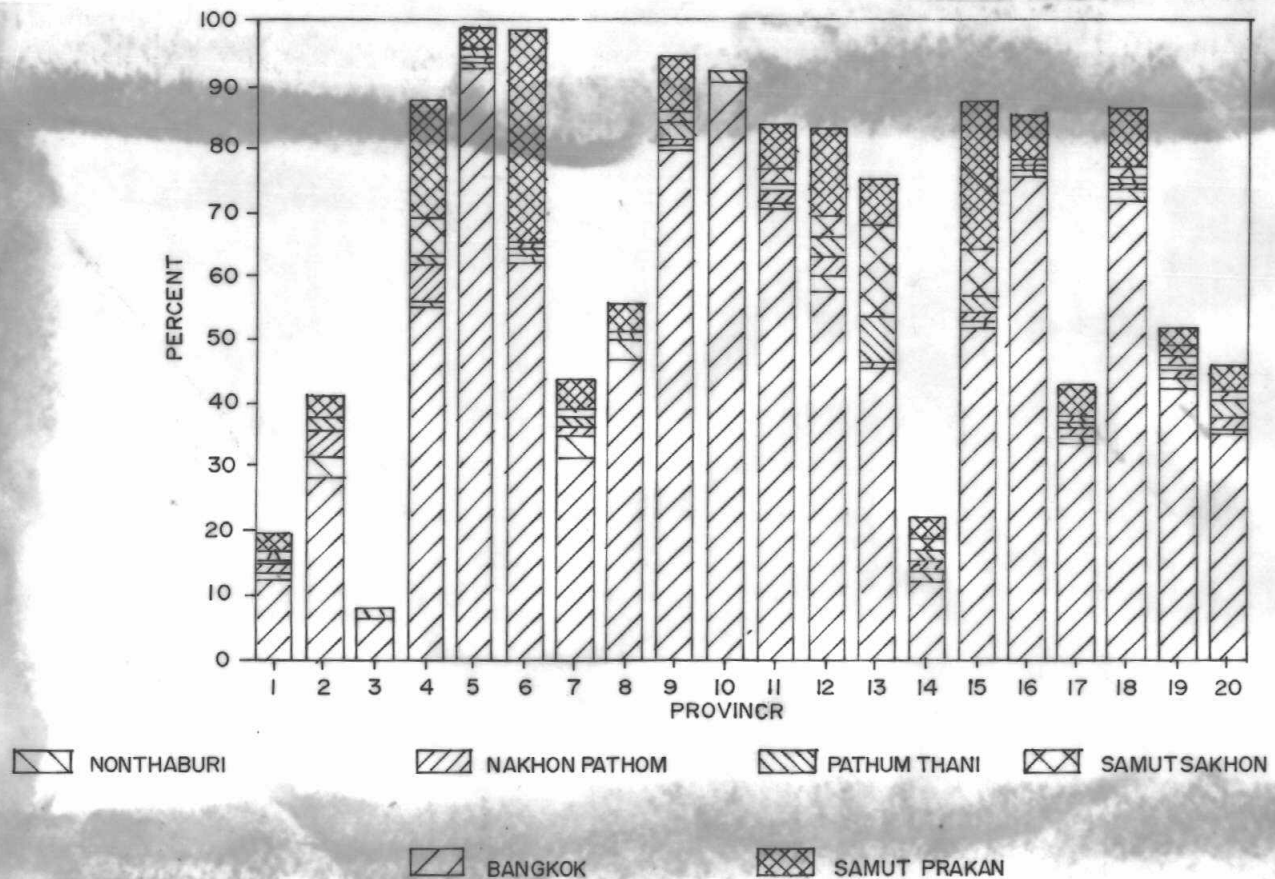
**Table 4.2 Average Distribution of Registered Factories Classified
by TSIC in Percentage of the Country Total, 1978-1989**

TSIC	BMR	BMA	Nonthaburi	Nakhon Pathom	Samut Prakan	Samut Sakhon	Patum Thani
311,312	19.72	12.97	0.93	1.32	2.62	1.31	1.58
313	41.11	28.68	3.19	4.52	2.75	0.36	1.60
314	8.04	6.95	0.00	0.00	0.47	0.00	0.62
321	87.91	55.68	0.79	5.96	18.30	5.57	1.61
322	98.79	93.45	0.99	0.57	2.52	0.39	0.87
323,324	98.69	62.64	0.80	0.21	33.23	0.85	0.96
331	43.92	31.61	3.68	1.31	4.43	1.35	1.54
332	56.04	47.91	2.47	0.63	3.68	0.50	0.85
341	95.12	80.64	0.80	1.18	8.20	1.65	2.64
342	92.25	90.36	0.45	0.21	0.89	0.21	0.12
356,356	84.32	71.09	0.96	2.08	7.11	2.23	0.85
351,352	83.66	58.34	2.39	2.91	13.62	3.35	3.05
353,354	77.33	46.86	1.36	0.75	6.58	14.14	7.63
361,2,9	22.83	13.20	1.55	1.60	3.20	1.82	1.46
371,372	87.87	53.03	0.65	1.60	23.08	7.08	2.44
381	85.77	76.50	1.03	0.46	6.57	0.82	0.39
382	43.37	34.31	1.18	1.11	4.64	1.10	1.02
383	86.82	72.69	1.69	0.75	9.17	1.47	1.05
384	53.26	43.76	1.33	1.74	4.47	1.32	0.63
385-91	45.86	35.41	0.72	1.62	3.81	1.23	3.07
TOTAL	54.51	43.96	1.34	1.39	5.52	1.46	1.02

Source: Department of Industrial Works, Ministry of Industry.

Table 4.3 Average Annual Growth Rate of the Number of Factories in the Urban Fringe

TSIC	Country	BMR	BMA	Nonthaburi	Nakhon Pathom	Samut Prakan	Samut Sakhon	Patum Thani
311,312	6.09	4.06	2.35	5.45	7.39	7.31	9.40	9.28
313	11.17	9.76	9.16	4.85	11.81	8.64	20.21	20.00
314	-0.64	-0.51	-2.26			0.00	0.00	
321	5.34	5.35	5.63	3.35	2.73	4.70	12.02	9.69
322	18.89	18.78	18.93	15.93	16.12	22.00	17.93	17.21
323,324	12.13	11.83	13.69	15.54	18.75	8.85	20.25	24.09
331	2.83	2.30	1.02	4.84	7.07	5.75	7.03	6.55
332	9.89	9.29	8.63	21.99	10.97	9.00	28.97	14.26
341	7.20	6.65	6.39	12.12	4.09	9.36	4.79	11.71
342	1.20	1.79	1.79	5.73	-9.85	3.96	15.15	-1.36
356,356	5.28	4.95	3.99	12.17	9.24	8.97	16.52	13.03
351,352	2.35	1.87	-0.16	9.51	7.58	5.77	9.32	7.67
353,354	3.98	2.61	-0.14	0.00	0.00	13.64	4.55	5.76
361,2,9	10.87	9.73	4.11	10.08	12.77	8.59	15.14	10.64
371,372	3.50	3.59	0.66	25.91	24.80	4.08	9.39	20.31
381	6.60	5.63	4.87	12.46	15.90	10.36	18.45	22.90
382	6.08	3.53	2.67	2.80	3.11	9.46	4.22	10.92
383	8.18	7.11	6.51	8.90	14.37	8.36	27.09	14.64
384	10.39	7.36	6.60	19.37	6.14	11.43	8.43	15.33
385-91	6.13	6.24	5.67	11.23	20.81	11.27	5.80	14.06
TOTAL	6.46	5.42	4.71	8.21	7.26	7.89	8.55	11.35



Note:

1 =	311,312	Food
2 =	313	Beverage
3 =	314	Tobacco
4 =	321	Textile
5 =	322	Wearing apparel
6 =	323,324	Leather & footwear
7 =	331	Wood & cork
8 =	332	Furniture & fixture
9 =	341	Paper & paper products
10 =	342	Printing, publishing
11 =	355,356	Rubber, plastic products
12 =	351,352	Chemical products
13 =	353,354	Petroleum products
14 =	361,-2,-9	Non-metallic
15 =	371,372	Basic metal
16 =	381	Fabricated products
17 =	382	Machinery & parts
18 =	383	Electrical machinery
19 =	384	Transport equipment
20 =	385-391	Other

Figure 4.1 Percentage Share of Factories

Samut Sakhon's industrial specialization is mainly in petroleum products (14 percent of the country's registered factories), basic metals (7 percent), and textiles (5 percent). Nakhon Pathom specializes in textiles (6 percent) and beverages (4 percent), while Nonthaburi specializes in wood and cork industries (4 percent) and beverages (3 percent), and Pathum Thani specializes in petroleum products (nearly 8 percent) and chemical products (3 percent).

CHANGES IN INDUSTRIAL LOCATION

When looking at the changes in location of most industries in recent years, it is clear that more industries are being established in the suburban provinces of the BMR than in the past, because these are now considered the prime locations for export-oriented industries. The rate of increase in the number of factories in the BMR was slightly lower than the national average, this was mainly due to the much lower rate of increase in the BMA. The increase in all of the suburban provinces of the BMR was greater than the national average. As of last year, the degree of the BMR's specialization in most industries remained exceedingly high, ranging from over 75 percent to as much as 98 percent of all registered factories in these industries. Figure 4.1 presents the percentage shares of factories in the BMR.

Changes in the share of factories located in the BMR provinces are varied. For some industries, the slight decline in concentration in the BMA was met with an increased share of factories in the other provinces of the BMR. This was evident for the chemical products, petroleum products, plastic and rubber products, non metals, basic metals, machinery and parts, and transport equipment industries. The proportion of registered factories in the BMA has remained fairly stable over the past ten years in the wearing apparel, paper and paper products, and printing industries.

The first group of industries mentioned above, those shifting away from the BMA to the suburban provinces of the BMR, are mainly industries for which raw materials are imported. They need to be located near ports, whether air and sea. In addition to these constraints, the industries face newer pressures from laws and regulations prohibiting environmentally sensitive industrial activities in high density urban areas, and high land prices in the BMA. The outer provinces of the BMR are therefore prime locations for these industries. They are near the ports in the BMA, yet away from high density urban areas and in areas where land is still relatively cheap.

The second group of industries, those which remain largely in the BMA with little shift to the suburban provinces, are either export-oriented industries like wearing apparel, or industries with a strong urban market and orientation, like paper and paper products or printing and publishing. Environmentally, these industries produce less hazardous pollution and wastes than the previous group of industries; thus they can remain located in higher density urban areas.

EXPECTED INDUSTRIAL SPECIALIZATION OF THE BMR

The national economy is expected to grow at a rate of 9.1 percent per year during the Seventh National Development Plan period (1992-1996). As in recent years much of the growth is expected to be fueled by the manufacturing sector, which is supposed to increase at a rate of 10.1 percent per year, and the service sector, expected to grow at slightly less than 10 percent per year, while the growth rate of the agricultural sector will remain a relatively low 2.78 percent per year (Table 2.2).

Over the longer run, from 1991 to 2010, the national economy is expected to grow at an average rate of 7.25 percent per year. The industrial sector would be the leading growth sector throughout this period, with an expected average annual growth of 8.1 percent, compared to expected annual increases of 7.5 percent in the service sector and only 2.85 percent in the agricultural sector.

It can be expected that the BMR's share of the manufacturing sector will grow along with the national growth in the GDP of that sector. That is, as the manufacturing sector of the entire country expands, the BMR's manufacturing sector will have a corresponding growth so long as the BMR's portion of the manufacturing sector remains essentially the same. In fact, it is expected that the BMR's share of the manufacturing sector will increase slightly, from around 73 percent now and in 1996, to about 76 percent in 2011 (Table 4.4), (Appendix 4.2).

Along with the above projections of growth in the BMR's industries, two major observations about the BMR's specialization in the manufacturing sector should be addressed. First, despite the Board of Investment's (BOI) policy of "non-promotion of industry in the BMR," the average annual growth rate of the number of factories in the BMR has been roughly 8 percent for the past three years (1987-1989). This was even higher than the average annual growth rate of 5.4 percent over the past 10 years.

**Table 4.4 Projected Share of Gross Domestic Products by Manufacturing Sector
Share by Type of Manufacturing (BMR/Country)**

BMR Region	Unit : Million Baht					
	1986	1988	1991	Projected 1996	2001	2006
-Food & Beverage	18.01	16.24	15.77	14.29	12.81	11.41
-Textile	24.63	25.68	25.92	26.72	27.82	28.96
-Sawmill & Wood	1.84	1.80	1.80	1.81	1.81	1.83
-Paper & Printing	2.46	2.09	2.02	1.86	1.72	1.57
-Chemical	8.04	7.92	7.58	7.11	7.62	8.21
-Nonmetal	1.08	1.22	1.11	1.07	1.07	1.07
-Basic Metal	1.40	1.14	0.80	0.70	0.69	0.66
-Other Machineries	14.94	17.74	18.21	19.79	20.89	21.58
BMR GDP	72.41	73.83	73.23	73.36	74.43	75.30
						76.01

Source: Thailand Development Research Institute

In fact, the impact of BOI promoted firms is fairly meagre when compared with investment in industries in the BMR. With the exception of electrical machinery industries in 1989, BOI promoted firms account for only a small percentage of the country's firms, from 0 to 7.5 percent in each industrial category, with an average of 0.24 percent of all firms in 1983, and 2.5 percent of all firms in 1989. In comparison, an average of 50 percent of all the country's firms were in the BMR in the same period, ranging from a low of about 9 percent for the tobacco industry, to a high of 98 percent for the wearing apparel and leather and footwear industries.

Thus the BOI's policy can be seen to have little effect on the investment atmosphere in the BMR as a whole. That is, the industrial sector in the BMR continues to expand. While the rate of expansion may have been slightly lower than the growth rate of the whole country in the past 3 years (Table 4.5) predictions of future growth for the industrial sector show that the BMR will even increase its dominance in this sector.

The second major observation, when looking at the GDP share of the manufacturing sector, is that the patterns of specialization of the BMR and of the entire country were more or less the same in 1986 and 1988. Pronounced specialization can be found in the light industries (textiles), the food-processing industries, and the electrical and machinery industries (Tables 4.6 and 4.7). The projected pattern of specialization will remain similar, though there will be an increasing specialization in the chemical and related industries, with a decline in the food processing industries.

With its advantageous location at the site of the country's major ports (needed to import raw materials for processing import substitution goods, and to export goods from the export-oriented industries), as well as the largest market for domestic products, it is expected that the BMR will continue its leading role in the manufacturing sector of the country for the next five years and longer. Concentration of light industries, electric and machinery industries, chemical and related industries, and the food processing industries in the BMR is expected to increase over the next 20 years.

It will be critical to provide adequate infrastructure for this expected industrial development. Most important will be the preparation of adequate facilities in the most appropriate locations for the more environmentally hazardous industries. They need to be located in areas where their impact on the urban environment will be controlled and minimized.

Table 4.5 Percentage Share of BOI Promoted Firms by Industry, 1983-1988

Unit : Percent

Industry	BOI Promoted Firms in 1983			BOI Promoted Firms in 1985			BOI Promoted Firms in 1987			BOI Promoted Firms in 1988		
	BOI	BMR	COUNTRY	BOI	BMR	COUNTRY	BOI	BMR	COUNTRY	BOI	BMR	COUNTRY
311,312 (Food)	0.28	19.45	100.00	0.44	21.64	100.00	0.95	21.13	100.00	4.04	17.62	100.00
313 (Beverages)	0.00	40.46	100.00	0.00	40.57	100.00	0.00	41.52	100.00	0.00	40.65	100.00
314 (Tobacco)	0.00	5.68	100.00	0.00	8.60	100.00	0.00	9.90	100.00	0.00	9.35	100.00
321 (textiles)	0.20	87.05	100.00	0.00	88.49	100.00	1.24	88.58	100.00	1.18	88.97	100.00
322 (Wearing apparel)	0.00	98.89	100.00	0.77	98.85	100.00	0.00	98.61	100.00	0.18	98.34	100.00
323,324 (Leather and Footwear)	0.00	98.98	100.00	0.38	99.04	100.00	2.49	98.76	100.00	4.32	97.53	100.00
331,332 (Wood products & Furniture)	0.04	45.71	100.00	0.05	49.43	100.00	0.59	47.44	100.00	0.91	47.46	100.00
341,342 (Paper products & Printing)	0.04	91.49	100.00	0.05	94.62	100.00	0.00	94.40	100.00	0.39	94.60	100.00
355,356 (Rubber & Plastic Products)	0.57	84.35	100.00	0.45	83.37	100.00	1.08	83.32	100.00	6.09	83.49	100.00
351,352 (Chemicals Products)	0.47	82.46	100.00	1.71	84.23	100.00	3.13	83.61	100.00	7.38	82.97	100.00
353,354 (Petroleum Products)	0.00	80.77	100.00	0.00	74.07	100.00	0.00	67.74	100.00	0.00	69.70	100.00
361,-2,-9 (Non metals)	0.54	21.89	100.00	0.21	21.73	100.00	0.32	20.05	100.00	0.95	19.60	100.00
371,372 (Basic metals)	1.95	86.16	100.00	3.03	89.61	100.00	1.18	90.20	100.00	2.94	89.91	100.00
381 (Fabricated Products)	0.11	85.74	100.00	0.21	85.22	100.00	0.36	83.08	100.00	1.26	82.57	100.00
382 (Machinery & Parts)	0.02	42.85	100.00	0.04	41.68	100.00	0.02	40.36	100.00	0.05	39.74	100.00
383 (Electrical Machinery)	1.69	86.68	100.00	3.35	86.72	100.00	5.96	84.22	100.00	21.80	84.06	100.00
384 (Transport Equipment)	0.00	51.86	100.00	0.00	53.61	100.00	0.00	49.73	100.00	0.00	48.32	100.00
385-391 (Others)	0.69	44.05	100.00	1.27	46.40	100.00	2.48	46.31	100.00	6.32	46.75	100.00
TOTAL	0.24	54.38	100.00	0.39	55.99	100.00	0.76	54.30	100.00	2.51	52.22	100.00

Source: Board of Investment

Table 4.6 Projected Share of Gross Domestic Products by Manufacturing Sector
Share by Type of Manufacturing (Country/Country)

Unit : Percentage

Whole Kingdom	Projected				2001	2006	2011
	1986	1988	1991	1996			
-Food Processing	30.56	27.40	26.18	23.13	20.40	17.92	15.69
-Light Industry	27.66	28.83	29.00	29.82	31.01	32.23	33.40
-Sawmill & Wood	2.66	2.59	2.56	2.54	2.51	2.51	2.54
-Paper & Printing	3.34	3.02	2.97	2.76	2.55	2.34	2.13
-Chemical & Related	12.00	11.53	11.68	11.86	12.07	12.41	12.83
-Nonmetals	3.68	3.89	3.74	3.71	3.71	3.72	3.74
-Basic Metals	1.63	1.35	1.31	1.17	1.05	0.93	0.82
-Machinery & Electronics	18.47	21.39	22.55	25.02	26.71	27.93	28.85
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Thailand Development Research Institute

Table 4.7 Projected Share of Gross Domestic Products by Manufacturing Sector
Share by Type of Manufacturing (BMR/BMR)

Unit : Percentage

BMR Region	Projected				2001	2006	2011
	1986	1988	1991	1996			
-Food & Beverage	24.87	21.99	21.54	19.49	17.21	15.15	13.29
-Textile	34.01	34.78	35.40	36.43	37.38	38.45	39.51
-Sawmill & Wood	2.55	2.44	2.46	2.47	2.43	2.43	2.45
-Paper & Printing	3.40	2.83	2.76	2.54	2.31	2.09	1.88
-Chemicals	11.11	10.73	10.36	9.69	10.24	10.91	11.67
-Nonmetals	1.49	1.65	1.52	1.46	1.44	1.43	1.40
-Basic Metals	1.94	1.55	1.10	0.95	0.92	0.88	0.82
-Other Machineries	20.64	24.03	24.87	26.98	28.07	28.66	28.97
BMR GDP	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Thailand Development Research Institute

ESTIMATED INDUSTRIAL LAND USE NEEDS

Despite the rapid growth of industries in the BMR, the area required for industrial expansion does not appear too great. This has important implications for the regulation and control of industrial location. If the area required is not too extensive, the provision of required infrastructure, especially that needed for pollution and waste control, is easier. If the area is limited and concentrated in certain sites, the ability to monitor and control pollution and waste is greater.

Tables 4.8 and 4.9 show the estimated land use for industries in the BMR in 1996 and 2011. The current industrial area was calculated by multiplying the number of registered factories in each size group by the maximum area for a factory of that size group. According to the MOI's classification, household-sized factories have a maximum land area of 0.5 rai, small-sized factories can have up to 2 rai, medium factories use up to 6 rai, while large factories will use more than 6 rai. In order not to underestimate the current industrial land use, the maximum areas for the household, small, and medium size groups were selected and an average of 20 rai was assigned for large factories. Even with this generous assumption about the land used by each firm, the estimated area used at present for industries in the BMR came to 32,535 rai, or only about 0.7 percent of the total land area of the BMR's six provinces. This is considerably less than the Department of Land Development's (DLD) estimate that about 2 percent of the land in the BMR is already used for industry, based on analysis of satellite images. The difference can be attributed partly to the many factories, mainly household-and small-sized, that have probably not registered with the MOI. For purposes of this analysis, we assume that only half the industrial area is accounted for by registered factories, and an equivalent area is being used by unregistered factories (see also Appendix 4.3 and 4.4)..

A second assumption is that there will be no increased efficiency of land use for the industries. In other words, any increase in production will require an equivalent increase in land area. If the production of 10 units of good 'A' requires 2 rai in 1990, then the production of 20 units of good 'A' in 1996 will require 4 rai, and the production of 50 units in 2011 will require 10 rai. While experience elsewhere in the world shows there is likely to be increased efficiency in industrial land use over time, the assumption that there will be no increased efficiency allows us to estimate and plan for the maximum area that would be needed for each type of industry.

Table 4.8 Estimate of Industrial Land Use for the BMR in 1996

	Estimated Existing Land Use	Current Sectoral GDP in BMR, 1988	Expected Sectoral GDP in BMR, 1996	Expected Land Use for 1996
Food Processing	2728.5	19398.0	37347.0	5253.2
Mineral, Other	1076.5	1453.0	2795.0	2070.8
Light Industry	7822.5	30674.0	69815.0	17804.3
Chemical & Related	3722.5	9467.0	18571.0	7302.3
Machinery & Electronics	12343.5	21193.0	51714.0	30119.9
Other	4841.5	6018.0	11419.0	9186.6
MAXIMUM INDUSTRIAL LAND AREA REQUIRED IN THE BMR IN 1996				71,737.0
Total Area in the BMR, (Rai)	4,848,841.0			
Total Industrial Area Estimated for 1996	71,737.0			
Percent of Total Area of BMR Required for Industry	1.48%			

Table 4.9 Estimate of Industrial Land Use for BMR in 2011

	Estimated Existing Land Use	Current Sectoral GDP in BMR, 1988	Expected Sectoral GDP in BMR, 2011	Expected Land Use for 2011
Food Processing	2728.5	19398.0	80491.0	11321.8
Mineral, Other	1076.5	1453.0	8506.0	6301.9
Light Industry	7822.5	30674.0	239289.0	61023.6
Chemical & Related	3722.5	9467.0	70671.0	27788.4
Machinery & Electronics	12343.5	21193.0	175407.0	102162.8
Other	4841.5	6018.0	31215.0	25112.6
MAXIMUM INDUSTRIAL LAND AREA REQUIRED IN THE BMR IN 2011				233,711.1
Total Area in the BMR, (Rai)		4,848,841.0		
Total Industrial Area Estimated for 2011		233,711.1		
Percent of Total Area of BMR Required for Industry		4.82%		

Productivity is measured by the sectoral GDP of each industrial category in constant 1972 baht for 1988, 1996, and 2011. The increased productivity for each industrial category is calculated by dividing the expected sectoral GDP for that year by the current sectoral GDP. The increased productivity for light industries in 1996, for example, is 69,815 (million Baht) divided by 30,674 (million Baht), or 2.276.

To find the expected land use for each industrial category, the estimated existing land use for that industry was then multiplied by its expected increased productivity. Again taking the case of light industries in 1996, the existing land use of 7,822.5 rai was multiplied by the expected increased productivity of 2.276. The maximum area required for light industries in the BMR in 1996 thus came to 17,804.3 rai.

Given these assumptions, the maximum land area required for industries in the BMR in 1996 was estimated to be 71,737 rai, or only 1.48 percent of the total land area of the BMR. In addition to the 17,804 rai required for light industries, another 30,120 rai will be needed for the machinery and electronics industries. These two account for well over half the required area. The most environmentally hazardous industries, the chemical and related industries, will require about 7,300 rai by 1996.

If the DLD 's estimates of existing industrial land use are taken as most accurate, then the amounts of land required for industries in the BMR in 1996 will have to be at least doubled. That is, about 140,000 to 150,000 rai will be needed for industries throughout the BMR, with about 15,000 rai required for chemical and related industries, another 35,000 to 40,000 rai needed for textiles and other light industries, and at least 60,000 rai needed for the machinery and electronics industries. This would still account for only about 3 percent the total land area in the BMR.

By 2011, the estimated area needed for industries rose to 233,700 rai, or slightly less than 5 percent the total land area of the BMR. According to this estimate, based on the existing land used by registered factories, the area needed for chemical and related industries would rise to about 28,000 rai. That required for textiles and light industries would come to over 61,000 rai. The largest area would still be needed for machinery and electronics industries, totalling about 102,000 rai, or nearly half the total industrial area estimated for the BMR in 2011.

Again, if we assume that registered factories account for only half the existing industrial area, then the area of existing land use and our estimates of future industrial

land use must be revised. We can assume that about 470,000 rai to 480,000 rai, or 10 percent the total area of the BMR, will be needed for industry by 2011. More than 200,000 rai will be needed for machinery and electronics industries and over 120,000 rai will be needed for textiles and other light industries. Approximately 55,000 to 60,000 rai, or slightly over 1 percent to 1.5 percent of the total BMR land area, will be needed for the most environmentally hazardous chemical and related industries.

SUMMARY

The problem, then, is not one of land availability, even if the higher estimate is accepted of 10 percent of the BMR's total land area being required for industry by 2011. The problem is one of industrial location, or how to concentrate industries in areas where their impact on the urban environment will be minimized. Concentration of industries, especially hazardous industries, in specified locations, such as in industrial parks, would allow for better monitoring and control of pollution and waste disposal. Facilities can be established in the industrial parks for the proper waste disposal of industrial and hazardous wastes.

Chapter 5

Concluding Remarks

THE CHALLENGES CONFRONTING ENVIRONMENTALLY SOUND MANAGEMENT OF THAILAND'S URBAN DEVELOPMENT ARE THREEFOLD:

1. To forecast alternative futures based on a reasoned understanding of current trends, public attitudes, and economic forces.
2. To evaluate alternative policies for influencing future development based on social, economic, and environmental impacts.
3. To select and implement effective policies in a fair and equitable manner.

TRENDS AND PATTERNS OF URBAN DEVELOPMENT

The suburban areas around Bangkok are the most rapidly growing in the nation, not only in population but in capital investment and employment as well. With only one-tenth of the country's population, the Bangkok Metropolitan Region (BMR) produces roughly three-fourths of the value added in manufacturing. Furthermore, population in the BMR is expected to grow almost 80 percent faster than the nationwide average during the 1986-2001 time period. While the recent growth of urban areas has been dramatic compared to past demographic trends in Thailand, it is not unusual when compared to worldwide trends in developing countries. Figure 5.1 not only illustrates recent urbanization trends in Thailand but also indicates the growth pattern that might have been expected had Thailand followed the urbanization patterns predominating in most of the developing world.

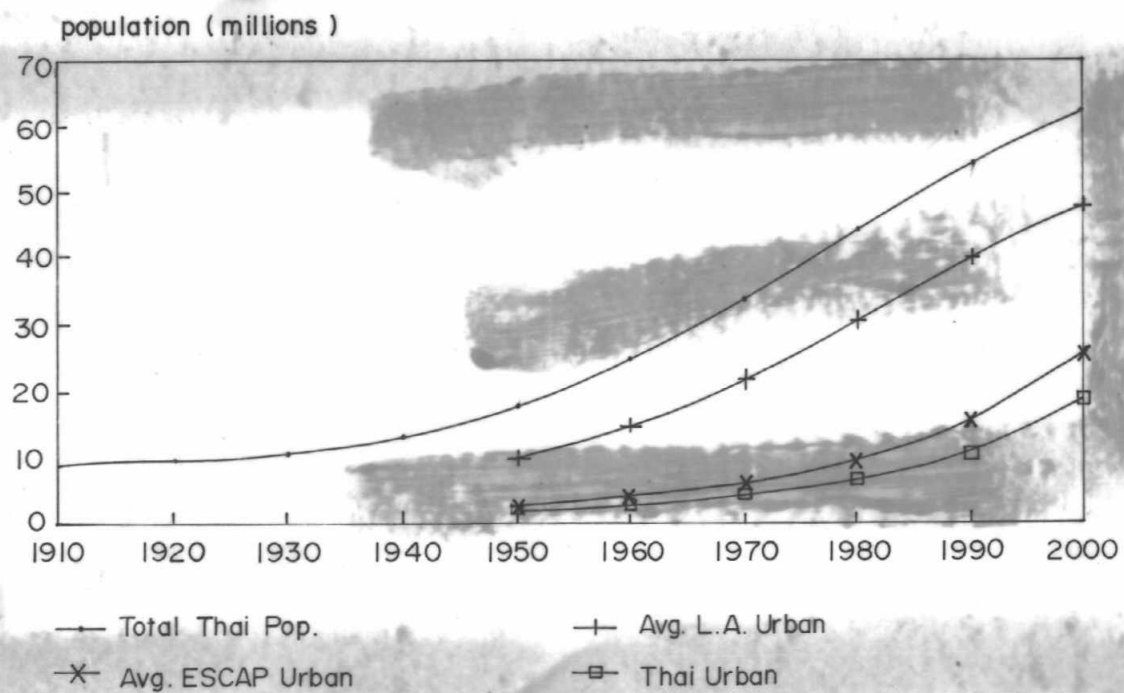


Figure 5.1 Changes in Total and Urban Population, 1910-2000

Source: ASEAN Population Programme, Population Mobility and Development Issues (1987).

Sources of Urban Growth

There is a well established correlation between economic growth, labor productivity, and the extent of urbanization. As incomes rise, more money is available for investments to improve productivity and fewer people are needed on the farm. Those workers freed up from farm labor find more productive and higher paid employment in the urban areas and in turn can provide more efficient services to rural areas. Thailand appears to be no exception to this general pattern. Economic growth and urban migration have both been accelerating in recent years.

What is significant is that Thailand's overall rate of urbanization has been relatively slow compared to other Asian countries, and particularly slow when compared to Latin American countries. Figure 5.2 illustrates the traditional relationship between urbanization and growth in GNP per capita. From this graph it is apparent that Thailand already has an exceptionally high average income for its current level of urbanization and that future economic growth is likely to be associated with even more rapid urbanization.

Industrial Trends

Despite the Board of Investment's (BOI) policy of not promoting industry in the BMR, review of industrial growth rates reveals that the BMR still receives by far the largest share of new industrial investment and that most of this goes to the rapidly urbanizing provinces surrounding Bangkok. This suggests that industrial growth in the BMR is largely independent of BOI policy and reconfirms the findings of the Sixth Plan which recognized that market forces and the private sector were the major determinants of the timing, scale, and direction of growth: "A policy to slow down the growth of Bangkok through physical planning alone will not be effective because they (the plans) cannot resist market forces."

Aerial photography and LANDSAT data reveal that there has been a major decline in the percentage of land devoted to agriculture in the suburban provinces surrounding the Bangkok Metropolitan Area (BMA). This is particularly true in Pathum Thani and Nonthaburi. Both these provinces experienced declines of over 10 percent during the period from 1987 to 1989 alone, and if current trends continue they will soon overtake Samut Prakan in non-agricultural land use.

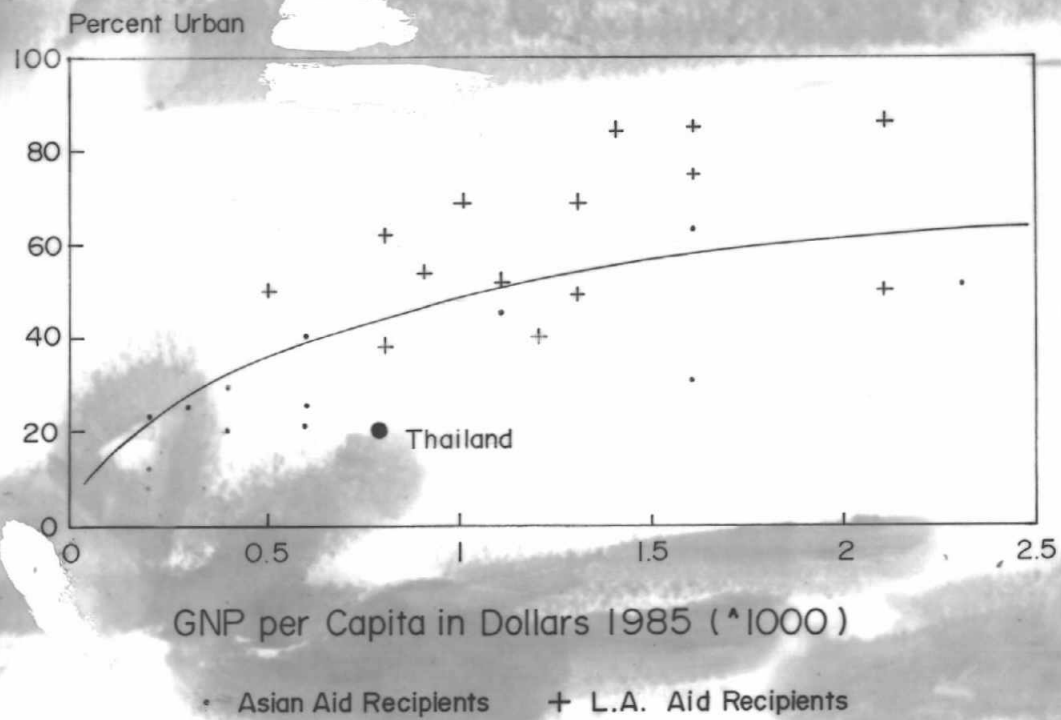


Figure 5.2 Relationship Between Urbanization and Income Growth

Source: Interim Report; Urbanization in the Developing Countries and its Implications for Foreign Assistance, 1988.

While land use in these provinces is obviously changing rapidly, only a relatively small proportion of the converted land is going to industry. In Samut Prakan Province for example, despite unprecedented industrialization for an area outside Bangkok, industry still occupies less than 8 percent of the total land area. In comparison to the 40 percent to 45 percent of rice land that shifted to aquaculture, or the 20 percent to 25 percent now employed by residential and commercial users, the land taken by industry is relatively insignificant. Because this industrial land is normally concentrated immediately adjacent to the highway, it often appears to the passerby to be more extensive than it is.

Far more significant than the actual area employed by new industry is the total environmental impact generated. Carefully selected factories with good pollution control equipment and effective enforcement programs need not have a significant adverse environmental impact. Conversely, even comparatively small industries, occupying only a few rai of land, can still impose major air, water, and solid waste pollution problems on the surrounding area if pollution is not adequately controlled.

Despite the major land use changes now taking place in the suburban fringe provinces, and despite the apparent need for land use and other environmental controls, we do not believe that these changes can adequately be addressed through the application of agricultural 'Green Belt' zoning policies. In fact, for reasons discussed in the recommendations section at the end of this paper, such policies alone may do more harm than good. Land use changes in these provinces can be seen to be a normal out growth of the ongoing trends in land prices. Land use controls which fail to take into account the market forces represented by those price changes will be no more than futile exercises in the drawing of colored maps.

Land Price Trends

Land price data in an unconstrained urban market normally represent a composite interaction of supply and demand for land as the foundation for investment in residential, commercial, or industrial activities. That is, the price people are willing to pay is closely related to their anticipated economic return. While theoretically land in these areas could also be used for agricultural purposes, once the price of land rises above 60,000 to 100,000 baht per rai the potential value of the property exceeds any conceivable financial return from agriculture.

Recent studies of land price trends in the BMR provide further evidence that market forces are the primary determinant of the demand for land for urban development. While land prices have been increasing at a rate of 20 percent to 30 percent per year, and newspapers commonly provide anecdotes of individual speculative turnovers, the distribution of residential land prices in the BMR has consistently followed international urban trends. International urban data from cities as diverse as Jakarta, Karachi, and Los Angeles all consistently indicate that the demand for land declines exponentially with the distance from the central business district.

$$V_x = V_0 e^{-hx}$$

Where V_x is the estimated price per unit area of a parcel of land, x is the distance of that parcel to the central business district, V_0 is intercept and h is the gradient of the distance.

Data collected by the Land Institute Foundation of Thailand reveal that market forces represented by distance from the central business district have continued to explain nearly 60 percent of the variation in residential land prices in the BMR during the past three years. Furthermore, if minimal infrastructure is considered (i.e., the presence or absence of water supply and paved soils), then nearly 80 percent of the variation in demand for land can be explained.

Figure 5.3 illustrates the distribution of land prices versus distance from the central business area of Bangkok.

Figure 5.4 represents the log of urban housing land prices as a function of the availability of infrastructure and the distance from the central business district.

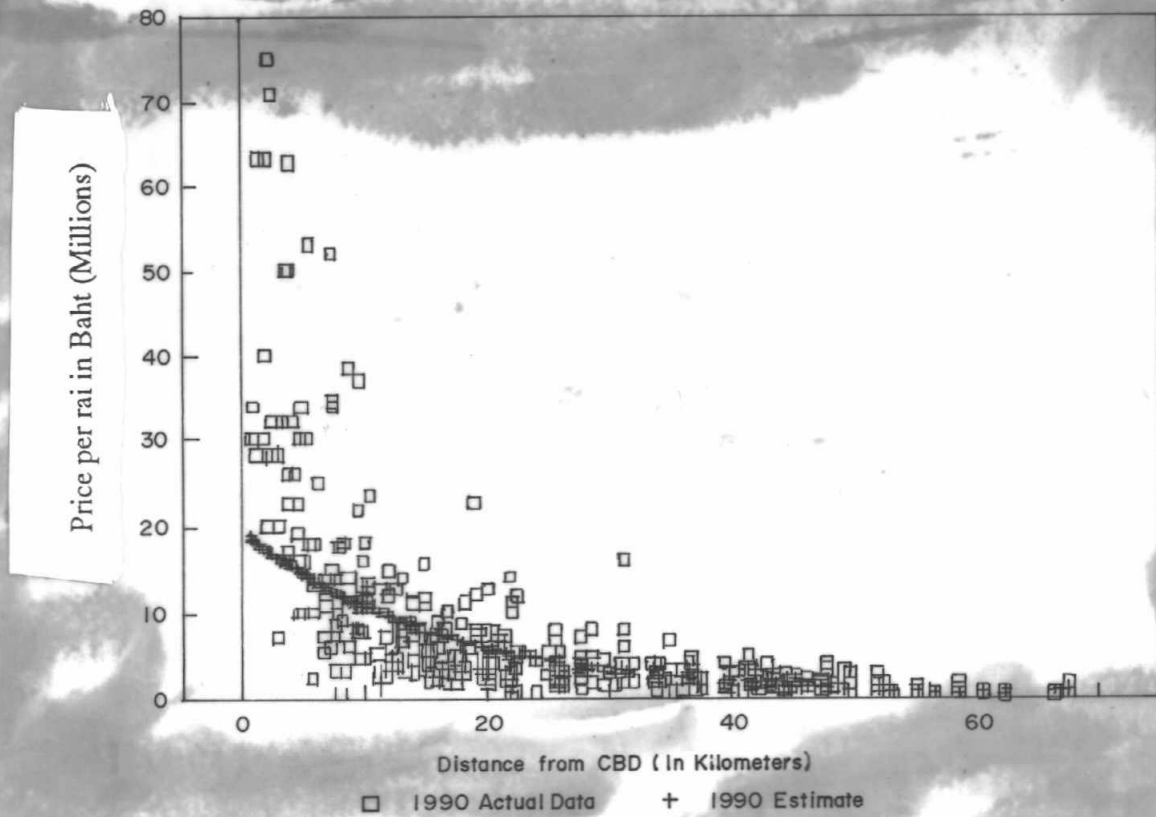


Figure 5.3 90 Land Price as a Function of .Distance

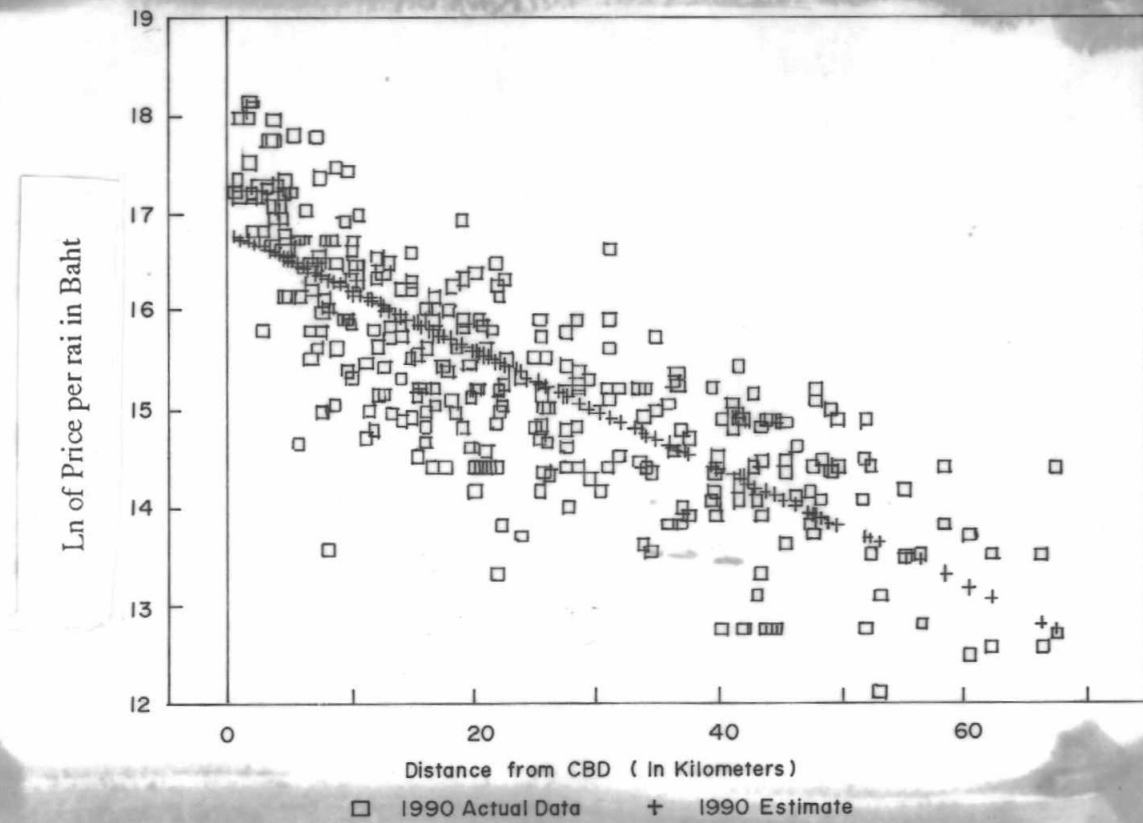


Figure 5.4 Log of 90 Land Price as a Function of Distance

While the data in Figure 5.3 and 5.4 say nothing about actual land use or about the duration of ownership and thus cannot be used to disprove general claims of speculation, the existence of this normal functional relationship does suggest that land in the BMR functions as part of a region-wide land market. Demand for land in the urban fringe is not so much part of an isolated speculative "bubble" of activity as it is part of a region-wide system responding to normal market forces. Investors are attracted to urban fringe land because it is still relatively cheap compared to land in the inner-city area, and yet still relatively accessible to the goods, services, labor, and markets provided by the BMR. Furthermore, the phenomenon most commonly observed in the BMR is not purchase followed by speculative long-term holding of land, but rather purchase promptly followed by conversion of land to its new intended use.

Pollution Trends

Urban growth and the growth of manufacturing have been closely associated with growth in pollution. While precise data are not available for the suburban areas, information from the central areas is indicative.

Air Pollution

The problem of air pollution is becoming increasingly serious. Ambient monitoring data indicate substantial increases in all major pollutants.

Lead emissions from gasoline illustrate a clearly increasing trend and lead (from all sources combined) is potentially the most serious urban environmental health hazard. Monitoring data during 1983-1986 ranged from 0.1 to 1.0 micrograms per cubic meter (24 hour geometric means). Data obtained from 1987 to 1989 indicate a range of 0.6 to 5.45 micrograms, per cubic meter. While reported blood lead levels are somewhat inconsistent (study results range from 16 to 40 ug per decileter), even the lowest reported average is three time as great as that found in the United States and Western Europe. Lead at these levels is directly implicated as a major cause of strokes and mental retardation.

Increasing trends are also evident for suspended particulate matter 24 hour averages. 1983-1986 data ranged from 0.09 to 0.19 milligrams per cubic meter while 1987-1989 data ranged from 0.09 to 1.25. The National Environment Board (NEB) standard is 0.1 micrograms per cubic meter.

Carbon monoxide monitoring also shows a significant increase during this time period. Monitoring data from 1983 to 1986 were within the range of 1.0-9.5 milligrams per cubic meter while the 1987-1989 range grew to 1.13-52.65 milligrams per cubic meter. The NEB standard is 50 milligrams per cubic meter for one hour.

While one may not be certain whether the reported increases always reflect increasing pollution levels or perhaps simply improvements in monitoring, it still remains that the pollution levels for these substances are well above the standards for healthy air quality.

Water Pollution

Based on a TDRI study (1988) for the BMR, domestic sources account for about 75 percent of the total biochemical oxygen demand load, while factories account for the remaining 25 percent. Leachates from solid waste dump sites are also potential sources of water pollution. The majority of houses discharge wastewater directly into storm drains, which in turn normally discharge into nearby canals thus creating serious water pollution problems. All private factories are required to install suitable wastewater treatment facilities in order to obtain their annual operating permits from the Department of Industrial Works (DIW). Wastewater facilities must treat effluent to a standard defined by The Ministry of Industry (MOI). Smaller factories typically do not have their own treatment facilities, due to lack of space, funds, or both. Most of the khlongs in and around Bangkok are now so severely polluted that they are anaerobic and usually give off offensive odors. Many of the khlongs have also been encroached upon by illegal houses. These have decreased their drainage capacity and increased their BOD loadings.

Solid Waste

The major factors in urban solid waste generation are the increases in population and standard of living. The per capita production of solid waste is estimated to range from 0.64 to 2.97 kilograms per day for provinces in the BMR. It is estimated that total daily production in 1990 is about 5,400 tons and about 4,225 is currently collected. The uncollected volume is mostly dumped onto vacant areas nearby, while some is directly dumped into canals and/or rivers, or discharged into drainage systems.

In the BMR, solid wastes generated from community, industry, or in urban areas is currently collected by the Department of Public Cleansing (DPC) which is administered under the Bangkok Metropolitan Authority and local district offices for those areas outside the BMA. At present, some 80 percent of the population is served

with refuse collection. Bangkok, like most Thai communities, relies primarily on open dumping and open air burning for solid waste disposal. This open dumping causes serious environmental quality problems including impacts on public health as well as aesthetic problems for the nearby communities. All disposal facilities and dump sites are reaching capacity with the present operating efficiency of 59 percent and running out of dumping space. Present projections of waste and facilities available indicate that the BMA will exceed its capacity in the next 6 to 7 years.

CAUSES OF ENVIRONMENTAL DEGRADATION

In assessing the causes of environmental degradation in urban areas we are concerned not so much with a single pollutant or single type of industry as with the general pattern of growth itself. While a cursory review of the environmental problems of the BMR clearly indicates that they are correlated with urban and economic growth, it is far less clear that they are caused by that growth. Environmental degradation in the BMR is not so much a consequence of urban and industrial growth as it is the very predictable result of failure to supply urban and environmental infrastructure consistent with the demands of economic growth:

- High density development without adequate provision of mass transit and road networks has led to traffic congestion.
- High water demand without adequate municipal water supply has led to excessive groundwater pumping and consequent land subsidence.
- High density development without adequate drainage and sewerage has led to flooding and water pollution.
- Industrial development without adequate pollution control investment and enforcement has led to increased air, water, and solid waste pollution.

These are not inevitable consequences of urban and economic growth, but the result of failure to develop adequate institutional mechanisms to assure that those who benefit from new development also pay for the necessary infrastructure and pollution controls needed to protect the environment.

Developers, manufacturers, and landowners are currently allowed to reap major benefits, not only from their own investments but from the public infrastructure which made it possible. Furthermore, they do so without shouldering the full cost that their development imposes on the community environment. Failure to require landowners and

developers to pay their full costs ultimately becomes a subsidy to destructive development.

The Metropolitan Water Authority (MWA), under the current fee structure, cannot recover its cost for supplying water to outlying regions and as a consequence commonly arrives long after the new owner has already invested in wells and pumps for groundwater. Users of groundwater pay far less than the social cost of groundwater pumping and (because of lax enforcement) often nothing at all. Failure to charge full cost for these water resources in effect is subsidizing their overuse and consequent environmental destruction.

New industries generate major quantities of air, water, and solid waste pollutants with practically no enforcement. There are currently 51,441 registered industrial plants in Thailand and only 356 employees responsible for monitoring and enforcing government environmental regulations. Even when all government expenditures related to the environment are included, Thailand spends less than 0.24 percent of GNP on environmental protection. Far less than the 1 percent to 2 percent paid by OECD countries and less than the 0.38 percent paid by Korea (Table 5.1). Failure to enforce reasonable pollution control standards and failure to require that the polluters pay the costs of that enforcement, constitutes a subsidy to the polluter and a penalty to those who behave responsibly.

Assessments for property taxes in the most rapidly growing areas of the BMR (the areas which will demand the greatest investment in infrastructure) have been found to be consistently assessed at less than 50 percent of their true market value and often less than 10 percent. Property taxes in Thailand represent only 0.18 percent of GDP, which is less than one-half of the portion paid by property owners in Indonesia, Korea, or the Philippines, and less than one-tenth the portion paid in Australia, New Zealand, or Japan.

Private developers pay no impact fees and are not held responsible for providing adequate roads, drainage, or sewerage to service their properties. As shown in Figure 5.5, while the GDP has grown by roughly 75 percent during the last 8 years and the GRP has grown by approximately 100 percent, investment in public infrastructure has grown by only 10 percent.

Table 5.1 Comparative Environmental Investments

	Waste Water Annual C + O&M as % of GDP	Air & other Media Annual C + O&M as % of GDP	Total Annual C + O&M as % of GDP	Waste Water Annual C + O&M per capita	Air & other Media Annual C + O&M per capita	Total Annual C + O&M per capita
Australia	0.37%	0.19%	0.53%	\$23.72	\$12.34	\$36.07
Belgium	0.09%	0.21%	0.30%	\$6.36	\$14.24	\$20.61
Canada	0.14%	0.19%	0.33%	\$10.45	\$14.24	\$24.69
Denmark	0.19%	0.19%	0.38%	\$15.29	\$15.29	\$30.59
Finland	0.35%	0.41%	0.76%	\$21.04	\$24.17	\$45.21
France	0.36%	0.28%	0.63%	\$25.24	\$19.72	\$44.96
Germany	0.84%	0.82%	1.66%	\$65.80	\$64.22	\$30.02
Ireland	0.74%	0.84%	1.58%	\$21.52	\$24.55	\$46.06
Italy	0.35%	0.44%	0.80%	\$13.23	\$16.50	\$29.74
Japan	1.01%	0.72%	1.73%	\$49.71	\$35.47	\$85.18
Netherlands	0.26%	0.38%	0.64%	\$48.06	\$26.26	\$44.32
Norway	0.13%	0.57%	0.69%	\$10.24	\$45.37	\$55.61
Sweden	0.56%	0.80%	1.36%	\$48.92	\$69.88	\$118.80
Switzerland	0.27%	0.22%	0.48%	\$23.49	\$18.89	\$42.38
U.K.	0.50%	0.36%	0.84%	\$25.23	\$18.30	\$43.53
U.S.A.	0.65%	0.91%	1.56%	\$51.73	\$73.05	\$124.84
Avg. for OECD Countries	0.61%	0.67%	1.28%	\$40.23	\$44.59	\$84.83
China			0.70%	na	na	\$2.03
India				na	na	na
Indonesia			0.38%	na	\$1.71	\$1.71
Korea	0.20%	0.20%	0.40%	\$5.38	\$5.38	\$10.76
Philippines				na	na	na
Singapore			1.09%	na	\$106.86	\$106.86
Thailand	0.24%		0.24%	\$2.04	na	\$2.04

Source: Data for OECD

member countries:

Data for China, India:

Data for Singapore:

Data for Korea:

Data for Thailand:

POLLUTION CONTROL
COSTS & EXPENSE

OECD 10/84

UNDP WORKSHOP 2/90

BUSINESS TIMES

WEEKEND ED. 3/3/90

WORLD BANK SECTOR
REPORT, 1985ANALYSIS OF LEGAL,
AND BUDGET FRAMEWORK
FOR ENVIRONMENT & NATURAL RESOURCES
NIDA, JANUARY 1987

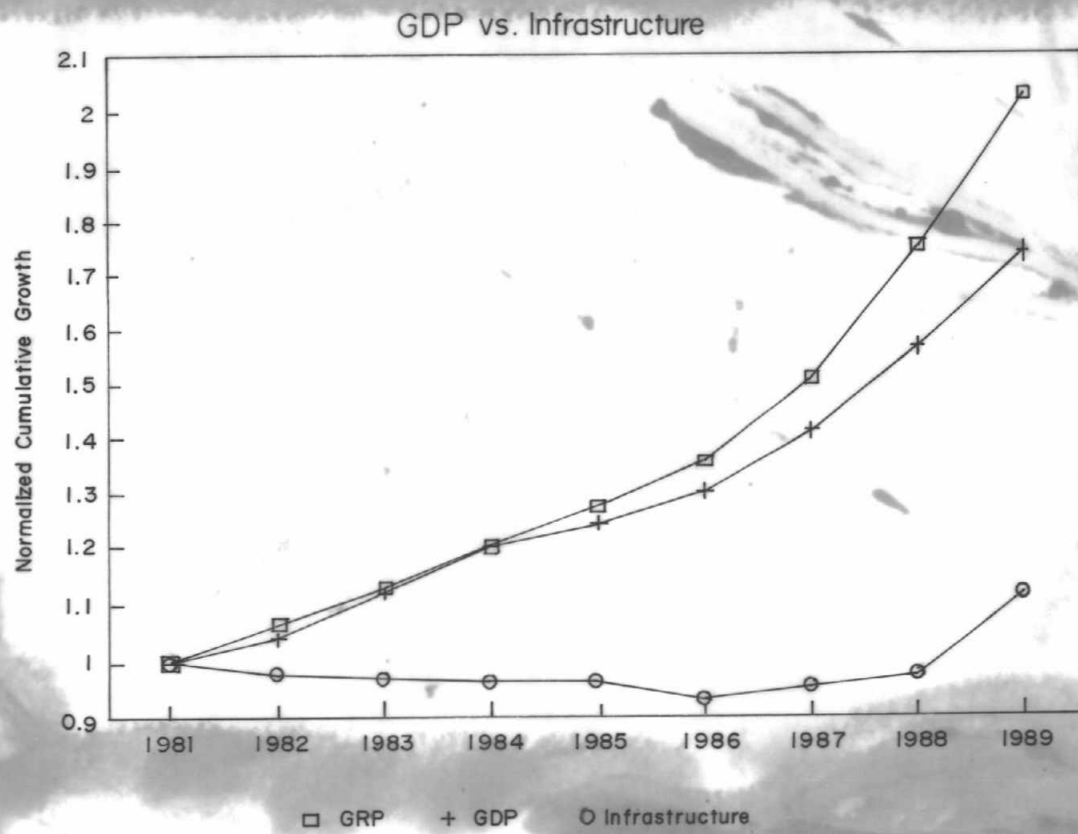


Figure 5.5 Differential Growth Rates

Landowners who withhold potentially developable urban land from the market and thereby compel utilities to provide service in leapfrog fashion also increase the cost of infrastructure and reduce its supply. This, of course, is true whether the landowner is an individual speculator or a state enterprise. Reasonable property taxes combined with the competing opportunity costs of alternative land uses can normally discourage this sort of behavior, but where the property taxes are low and/or the landowner has no ready alternative use for the land, then the landowner can withhold land at little apparent cost. This is particularly true where property is taxed at its use value rather than its potential value.

CONCLUSIONS

For most urban environmental problems confronting Thailand we find that the fundamental underlying cause is not urban land development *per se*, but failure to achieve adequate coordination between private development and investment in infrastructure (particularly environmentally related infrastructure). Land speculation and loss of agricultural land appear to be symptoms of the problem rather than true causes. When landowners and the beneficiaries of land development are not held responsible for protecting the environment and paying for the necessary infrastructure, sprawling environmentally unsound development is a predictable consequence.

The free market system has worked well for Thailand and these environmental problems do not constitute proof that policy makers should abandon market principles in favor of a rigid system that seeks to regulate supply and demand for developable land. Rigid control programs have consistently proven themselves inferior to market mechanisms in Europe, and evidence from India regarding efforts to rigidly regulate urban land resources indicate that they have been failures there as well. Instead, we recommend that Thailand adopt a comprehensive system of land use planning that combines free market incentives with land use controls. Just as sound land development cannot ignore the need for adequate infrastructure, sound land use planning cannot ignore the role of market forces in determining land use.

Chapter 6

Policy Recommendations

GENERAL RECOMMENDATIONS

1. The government should develop of a comprehensive system of land use planning.

Land development is closely associated with most of the environmental problems observed, and many countries have found land use controls to be an effective supplement (but not a substitute) for pollution control programs. The comprehensive land use approach recommended here must not rely exclusively on any one control measure but on a network of mutually reinforcing programs which would consider at least the following:

Zoning

Building Codes

Land Readjustment

Land and Building Taxes

Impact and Betterment Fees

Transferable Development Rights

Public Infrastructure Provision

Major Public and Private Investment Decisions

Zoning, the most visible sign of land use controls, is really only the "tip of the iceberg" of comprehensive land use planning. Unless it is built on a strong foundation reinforced with supplementary control measures, and unless it is fully consistent with major market forces, it just cannot provide an effective control program.

2. The form or combination of land use controls selected should be directly related to the problems identified and the resources available.

Zoning

Zoning can be effective in protecting critical environmental areas or in separating conflicting land uses where the areas involved are restricted to relatively small spaces, where the problems are objectively identified, and where the public is supportive and adequate enforcement is assured. Zoning has not generally been effective in accomplishing large-scale shifts in development patterns or in changing aggregate supply or demand. Furthermore, where it significantly limits the location and supply of residential land, for example, it becomes a major source of inflation in housing costs.

Building Codes

Building Codes, such as setback requirements, height limitations, and floor area ratios, where effectively enforced, can limit environmental impacts and help to keep the impacts of development within the carrying capacity of a community. When these tools are effectively tied to the availability of infrastructure (width of soi, for example) they can also help to provide an incentive to upgrade that infrastructure. Codes of this type have been particularly effective in India in limiting traffic congestion.

Land Readjustment

Land readjustment, by combining small properties and improving access and infrastructure, can help remove constraints related to the development of otherwise inaccessible parcels of urban and suburban land. By helping to bring this land to the market for more efficient use and development, it reduces the pressures on agricultural land in the urban fringe and also makes more efficient use of existing urban services. Land readjustment has been particularly effective in Taiwan, Korea, Japan, and Germany in helping to develop otherwise inaccessible land.

Land and Building Taxes

Where effectively employed, land and building taxes can provide two major benefits related to protecting the environment: First, by increasing the cost of holding idle land, they reduce speculation and urban sprawl. Second, where assessments are kept current with rising land values, they can be an effective source of revenue to recover the cost of government infrastructure expenses. Australia and New Zealand have been particularly effective in using tax policy as an instrument of land use control.

Impact and Betterment Fees

Impact and betterment fees are generally employed as one-time charges against the landowner to pay for the cost of new infrastructure. They have been successfully employed in Taiwan and Korea, particularly for water supply and sewerage, and in the rapidly expanding urban areas of the United States and Canada for a wide range of urban services. Because these fees confront the potential developer at the same time that he or she proposes new land development, they help to assure that the full costs (including costs of protecting the environment) are included in the investment decision. Impact fees have also been found to be particularly popular in rapidly urbanizing areas because they are often the only effective mechanism to assure that infrastructure funding proceeds in proportion to private investment.

Public Infrastructure Provision

Public infrastructure provision is a major factor in land use policy in at least two ways: First, as previously discussed, it is a primary factor in determining the carrying capacity of land and the consequent amount of development which can be effectively sustained. Second, the availability of roads and other major urban services is subsidiary only to location in determining demand for land. Land use policy experience worldwide generally indicates that land use controls cannot be effective if they are not coordinated with control of public infrastructure. New roads, for example, through privately held agricultural land in close proximity to urban areas inevitably become factors in urbanization themselves.

Transferable Development Rights (TDRs)

TDRs are ideally suited to situations where the overriding objective is to limit overall density while preserving equity and minimizing government interference. Under the TDR approach if, for example, the goal were to limit a particular type of development to one-fourth the normal density for example, each landowner would be issued one-fourth of a TDR for each acre of his land. The government would then require that all developers obtain at least one full TDR for every acre they sought to develop. Landowners under this system would then be free to trade or sell their TDRs for whatever amount buyers were willing to pay. Under such a system the losers (those who give up their rights to develop) are fully compensated by the gainers, and the mutual objective of limiting development within the designated area is achieved.

Variations of this approach can also provide for a portion of the development rights to be held initially by the government and then auctioned off to developers as a means to raise revenues for recovering the cost of necessary infrastructure. The auction

system recently proposed by representatives of the Bangkok Metropolitan Authority is an example of the transferable development right concept. It still recognizes the role of market demand in urban development yet employs a market-based land use control system to achieve public objectives.

Systems of both types have been employed successfully in both North America and Western Europe for land use and pollution control, and a basic variant of this system has been used extensively in the United States to control the growing of certain agricultural commodities.

Major Public and Private Investment Decisions

Major public and private investment decisions and the policies which determine them are obviously major factors in determining the success or failure of land use planning. Effective land use controls must be closely coordinated with policies of BOI as well as decisions by various state enterprises on the location of their facilities.

Not only do new state enterprise decisions impact urban development, but old decisions do so as well. Government policies which exempt state enterprises from property taxes or restrict state enterprises from selling or relocating their properties greatly limit the opportunities for coordinating these investment decisions through normal land use controls. A private landowner, for example in a rapidly urbanizing area, will ultimately be pressured by rising taxes and opportunity costs to develop his property to its highest use. A state enterprise (or a private enterprise exempt from property taxes), however, will be relatively immune to such forces. Properties held by the Tobacco Monopoly and the State Railway authority are prime examples of this phenomenon.

3. Land use controls should be coordinated with major infrastructure and investment decisions as well as current land use.

Public infrastructure, particularly roads, and drainage and water supply, are major factors in determining land use. If infrastructure is not coordinated with land policy then important land use objectives will be undermined. Similarly, if too much time lapses between identification of current land use and the development of a land use plan, both the effectiveness of the plan and public confidence will be undermined.

4. The land use control programs selected should pose the minimum possible interference with the land market necessary to achieve the stated objective.

This does not mean giving up on land use controls but it does mean that greater emphasis should be placed on land use controls which coordinate with market forces rather than those which seek to oppose them.

Land use controls (including impact fees, taxes, and the BMA proposed auction of permits for nonconforming uses) which impose payment requirements on developers rather than arbitrary development prohibitions, for example, employ market demand as a lever to secure additional resources to protect the environment. Exclusionary zoning, by contrast, not only brings no additional resources to the effort but actually withdraws resources because of the extraordinary enforcement demands.

5. The land use control programs should be well grounded in Thai experience or in the documented successes of other relevant countries.

While no one country's experience should preclude another from attempting new and innovative approaches, there are certain standards of land use control that have far reaching applicability. The American Planning Association, for example, has found the following criteria to be significant predictors of success in land use control:

Equity

Do the proposed land use controls treat landowners in similar situations equally?
Does it place the greatest burden on those most likely to benefit from the change?

Efficiency

Does the proposed land use control program achieve the objective at minimum aggregate cost, including costs to both the government and to the land users.

Objectivity

Are the administrative determinations relatively free from subjective judgement?
Does the control program avoid or minimize any incentive for bribery?

Acceptability

Does the general public subject to the land use controls generally agree with and understand the purpose and operation of the control program? Does the society/community involved have a good track record in enforcing and accepting enforcement of other relevant standards?

REVIEW OF GOVERNMENT LAND USE PROPOSALS

(In Light of General Policy Recommendations)

The proposed land use plan for Samut Prakan as currently understood falls short of these general recommendations for land use control in several areas: It appears to rely exclusively on one form of control, e.g., zoning, and fails to effectively coordinate with either infrastructure decisions or potential economic incentives. These factors combined with the major inequities and inconsistencies in current development patterns and limited enforcement experience indicate a high probability of failure. Ironically, even if the zoning program were to be successfully implemented, it would still fail to solve the basic underlying problem of inadequate investment in environmental infrastructure. A comparison of the proposed land use and current patterns of demand highlight some of these problems. If land in close proximity to major urban centers and adjacent to a major highway, what would be the effect on the land value of that piece of land?

The most obvious problem would occur at the urban edge of such a parcel, particularly adjacent to a major highway. Even in a country with a long history of zoning enforcement and with strong public support, such major discrepancies of value would be difficult to sustain. While provisions for allowing a set percentage of nonconforming uses may appear to soften the impact of zoning, ultimately the quota of nonconforming uses will be exhausted and the same problem will arise again. The owner of parcel 'A' could theoretically have an incentive to pay as much as several million baht per rai in order to have the zoning changed in his favor.

Even if the zoning boundaries were not changed, the benefits of such a program would be questionable. Zoning in the absence of a comprehensive plan is rather like the man who seeks to control flooding by raising the height of his own property. Even if he succeeds, he only makes the problem worse for his neighbors.

A laudable exception to this pattern of rigid zoning is the "auction" system currently being studied by the Bangkok Metropolitan Authority. This innovative approach appears to have many of the advantages of the "impact fee" system discussed later in this paper, and could employ market forces to discourage large numbers of nonconforming uses while raising revenue to mitigate their impacts. Under programs of this type, the auction price represented by the demand for nonconforming uses can be

expected to rise as the availability of nonconforming permits declines and thus provides a disciplined rationing mechanism.

When land use controls fail to recognize the underlying importance of these market forces they tend to create at least the following problems:

1. They create major equity problems.
 - The individuals holding adjacent parcels of land would be treated vastly differently.
 - Because nothing would be done to decrease total demand for buildable land, the government would be sanctioning the transfer of wealth from an individual inside the 'Green Belt' to an individual who happened to hold property outside that designated area.
2. They exacerbate the problem of rapidly rising land prices which are already the largest source of inflation in housing costs (particularly for low and middle income families).
3. They create a major incentive for bribery and will tend to reduce public trust in government officials.
4. They still leave unresolved the major underlying problem of inadequate investment in infrastructure and environmental protection.

ALTERNATIVE POLICIES: ENVIRONMENTAL IMPACT FEES

As previously discussed, most of the environmental problems observed are caused by a failure to enforce environmental requirements and a shortage of funding for necessary infrastructure. Part of the funding problem can be met through improved property taxes, but because much of the problem is occurring in the rapidly growing urban fringe serious consideration should be given to the concept of environmental impact fees.

Environmental Impact Fees are defined as single payments required to be made by manufacturers, builders, or developers at the time of development approval and calculated to be proportionate to the cost of providing the physical infrastructure and environmental services needed to increase the carrying capacity of the land sufficiently to accommodate the new development and still protect the environment. The following list provides illustrative examples of potential uses of such fees:

- Flood protection
- Roads, water supply, sewerage, and sewage treatment
- Environmental auditors and monitoring equipment

- Parks and recreation
- Environmental funds to finance hazardous waste cleanup

The fees are charged against the primary beneficiaries of the land conversion and charged at a time when the beneficiaries are in the best position to pay. The exact allocation of burden between the landowner, the developer, and purchaser will depend on the elasticities of demand in the particular market. In a generally unconstrained land market where there are multiple suppliers and the consumers are relatively sensitive to price changes, then the cost is largely shifted backward to the landowner and the developer.

Under an environmental impact fee system, landowners and developers in certain designated areas are allowed to convert agricultural land to more intensive use only when they are prepared to pay for infrastructure improvements sufficient to adequately increase the carrying capacity of the land. The exact amount of such a fee is determined in advance in coordination with the land use planner and the exact amount of the required fee and the formulas used in determining it are published and made readily available to the public. An incentive system of this type operates in two ways:

1. It reduces demand for conversion of agricultural land by increasing the cost of conversion.
2. It increases the supply of funds available for controlling the environmental hazards associated with development.

In the United States and Canada, where these systems have been used most extensively, Impact Fees have been found to have four principle attractions:

1. They shift the burden of capital financing of infrastructure additions to the primary beneficiaries.
2. They synchronize the availability of funding for infrastructure with the increased demand created by development.
3. They reduce potential inequities among landowners and replace them with economic discipline.
4. They enhance the quality of life within communities by discouraging unwanted land uses and assuring that externalities associated with any such uses be reduced to the minimum.

In addition to these attributes, four other aspects seem particularly noteworthy for Thailand:

1. They represent a workable compromise between the rigidity and potentially questionable enforcement of a land zoning policy with the flexibility of the market place.

2. They allow land markets to respond flexibly to unforeseen shifts in market demand.
3. They reduce the need for subjective case-by-case decisions and the opportunity and/or appearance of favoritism.
4. They help to increase financial and planning capabilities of local governments most heavily impacted.

Although environmental impact fees are normally collected by the institution charged with issuing building permits within the municipality, the fees could just as effectively be assigned to an escrow account to be released in installments as the required infrastructure was provided. Such an arrangement would avoid the need for provincial authorities to ever actually receive the funds and could thus assure that the impact fees would not be transferred to the central government and could truly remain for use in the area impacted.

Because a major source of the environmental problem in Samut Prakan and other suburban provinces is related to the continuing disparity between private sector growth and investment in infrastructure, we recommend that the land use control system in the BMR rely more heavily on indirect controls such as impact fees which can serve to restore the necessary link between private investment and environmental infrastructure.

Example

Growth in Samut Prakan typifies that in the urban fringe provinces surrounding Bangkok. Growth and investment in Samut Prakan during the last several years has had two major distinguishing characteristics:

1. The growth has been extremely rapid:

- Population growth, at 5.1 percent per year, has been twice as fast as for the BMA and nearly three times as fast as for the whole Kingdom.
- New private sector investment has grown by an average of 4,528 million baht per year over the last four years and that new investment continues to grow at approximately 50 percent per year.

2. The private sector growth with its corresponding growth in traffic and pollution has exceeded the carrying capacity of existing infrastructure and the financial capacity of the existing revenue base (Figure 5.5).

- The provincial revenue base, including central government subsidies, has grown by only about 11 percent per year.
- The subsidy from the central government, which normally is a major source of investment revenue, has been highly erratic, actually declining between 1986 and 1989 and never keeping pace with private sector growth.

In the United States and Canada, where urban and environmental impact fees have been used most extensively, impact fees normally represent between 4 percent and 8 percent of total capital investment. If, by contrast, an impact fee of only 1 percent were levied against new capital investment in Samut Prakan (or any other rapidly developing province in the region), this would nearly double the revenues potentially available for providing badly needed infrastructure. Figure 6.1 illustrates the additional revenue potentially available to Samut Prakan through the adoption of a 1 percent urban environmental impact fee.

Fees of this type have proven to be relatively easy to administer in the countries that have employed them and could be handled either at the provincial or municipal level in Thailand depending on the geographic jurisdiction in which they were located. In either case the calculation of the required fee must be based on publicly available objective criteria and there must be provision for retaining the fee proceeds at the local level so that they can be used to finance the needed infrastructure.

At the municipal level, urban environmental impact fees could be treated in a fashion similar to that of a property tax, as local municipalities already have the authority to collect and retain property taxes for local use. Where new land development and industrial investment falls under the jurisdiction of provincial authorities, however, some additional provision would have to be established to allow retention of fees collected. One such mechanism would be the establishment of an environmental trust fund or escrow account specifically earmarked for use in the locality impacted.

An impact fee of this type would address both the demand and supply side of urban and environmental infrastructure. While fees at the 1 percent level are not likely to have much impact on private investment, larger fees (in the 4 percent to 8 percent range) in heavily impacted areas could be used to reduce demand and redirect rapid growth toward areas in greater need of additional investment. At the same time, collection of these fees would assure that the supply of revenues available for urban and environmental infrastructure would rise in rough proportion to the growth in environmental impacts. Revenues would decline during years of declining private investment but, of course, during those years there would be less need for additional infrastructure.

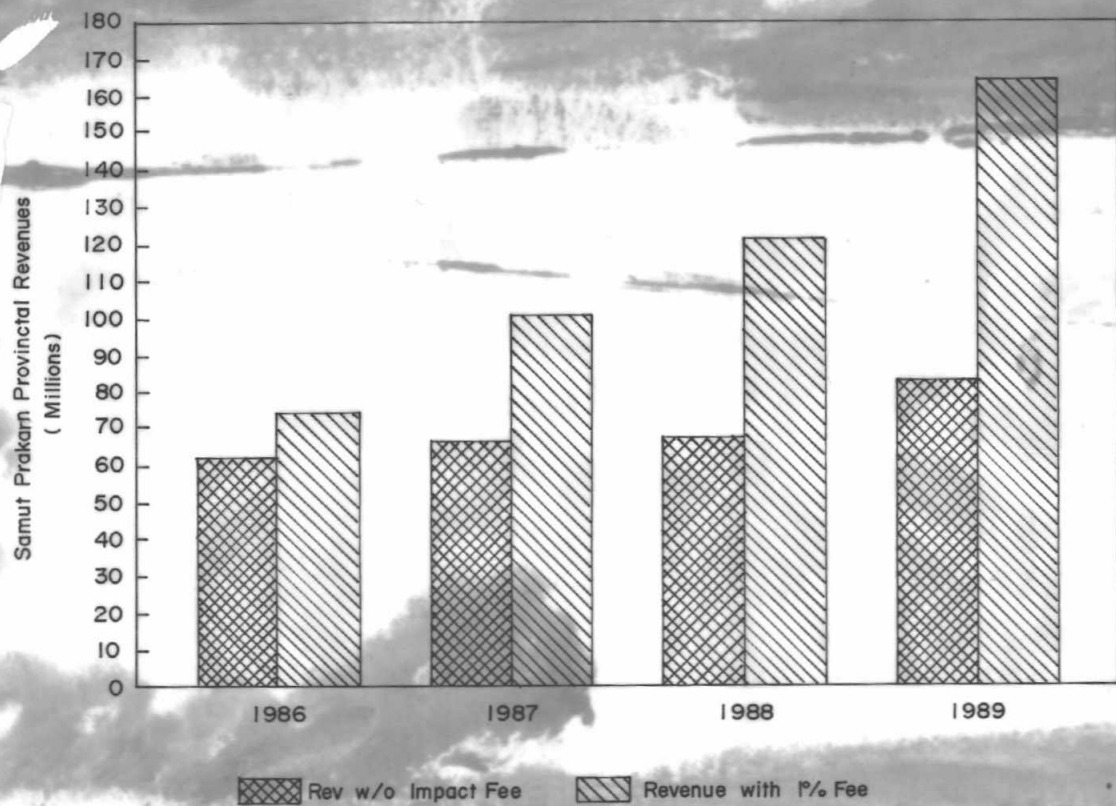


Figure 6.1 Environmental Impact Fees

Thus, we feel that an environmental impact fee of the type described can be a far more effective mechanism for controlling land use and the environmental impacts of rapid urbanization and industrialization than the reliance on zoning or "Green Belt" policies alone.

LAND USE POLICY RECOMMENDATIONS

In summary, in order to enhance the urban environment we recommend the following land use policies:

1. Land preservation programs in the BMR should focus on programs closely tailored to preserve highly sensitive areas, and on policies which make more efficient use of urban lands.
2. Most environmentally fragile areas should be promptly protected as environmental protection zones through a ministerial regulation.
3. The current Building Construction Control Acts of 1979 should be enforced in all areas of the BMR.
4. The guidelines for urban development in rapidly growing cities, such as regional growth cities and new economically active cities like frontier cities, should be enforced in terms of zoning for the whole growth area.
5. Industries which require monitoring, especially hazardous industries, should be restricted to industrial parks so that monitoring and waste treatment systems will be more cost and personnel effective.
6. Along with the zoning, an environmental impact fee should be collected in a manner similar to the collection of a property tax. The scale of payment would vary according to the policy implemented to protect the environment in that particular zone.

Appendices

Appendix 1.1 Registered Provincial Population

PROVINCE & REGION	Area(km ²)	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
BANGKOK	1,568,737	4,870,509	4,999,515	5,153,902	5,331,402	5,468,286	5,018,327	5,174,682	5,363,378	5,468,915	5,609,352	5,716,779
SAMUT PRAKAN	890,280	488,266	511,598	535,858	557,292	583,320	623,514	640,316	662,612	689,631	741,905	789,060
NONTHABURI	622,751	361,926	372,887	386,741	403,809	422,392	456,588	478,199	504,424	525,475	571,871	596,381
PATTHUM THANI	1,528,157	309,162	317,337	324,468	332,111	341,336	357,909	366,767	384,713	402,080	415,193	435,409
NAKHON PATHOM	5,458,973	543,998	552,758	561,346	569,649	590,588	585,931	596,257	609,316	617,596	619,518	630,805
SAMUT SAKHON	854,234	254,514	259,022	265,464	270,744	278,949	296,714	301,631	315,373	327,677	334,170	340,952
CHON BURI	4,484,596	696,835	712,426	725,407	738,221	754,329	769,381	780,091	806,396	835,766	849,807	887,207
NAKHON RATCHASIMA	19,589,902	1,851,907	1,886,192	1,916,681	1,949,966	1,979,706	2,054,841	2,113,498	2,187,165	2,265,901	2,288,024	2,325,124
CHANG MAI	22,848,421	1,139,337	1,150,043	1,166,123	1,180,398	1,204,441	1,232,967	1,252,241	1,277,835	1,296,373	1,313,859	1,345,715
PHUKET	538,720	127,015	130,270	133,669	136,286	138,672	141,863	145,229	147,467	150,285	151,716	155,367
SONGKHLA	7,322,033	822,137	841,949	849,601	868,156	888,274	930,123	938,565	961,670	1,024,023	1,044,244	1,060,029

MUNICIPAL POPULATION

PROVINCE & REGION	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
BANGKOK	4,870,509	4,999,515	5,153,902	5,331,402	5,468,286	5,018,327	5,174,682	5,363,378	5,468,915	5,609,352	5,716,779
SAMUT PRAKAN	10,163	10,177	10,160	9,991	9,913	9,855	9,831	10,388	10,309	10,331	10,417
SAMUT PRAKAN	48,298	48,518	48,960	49,163	49,576	65,155	65,278	68,057	69,218	71,337	73,327
NONTHABURI	7,935	8,075	8,213	8,323	8,416	8,556	8,698	9,021	9,154	9,430	9,872
NONTHABURI	30,293	30,787	30,940	30,919	30,909	38,873	39,531	40,350	40,502	41,076	41,834
PATTHUM THANI	7,081	7,479	7,755	10,583	10,808	11,583	13,224	12,618	12,856	14,297	15,746
CHON BURI	29,726	31,777	34,867	36,507	38,525	40,475	42,009	45,815	49,548	52,562	56,402
NAKHON RATCHASIMA	8,027	8,156	8,306	8,438	8,568	8,175	8,268	8,832	9,003	8,976	9,008
NAKHON RATCHASIMA	14,002	14,185	14,430	14,516	14,633	14,705	14,619	15,434	15,644	15,962	15,915
NAKHON RATCHASIMA	88,131	89,101	88,876	89,381	89,216	41,107	41,403	42,809	43,865	44,815	43,914
CHANG MAI	106,886	97,839	100,146	101,594	104,190	190,762	192,036	200,051	206,758	207,504	204,982
NAKHON PATHOM	41,751	45,906	45,242	46,123	46,822	45,187	45,250	45,686	45,284	45,215	43,005
SAMUT SAKHON	11,136	11,206	11,593	11,890	12,138	12,446	12,545	13,456	13,634	13,634	13,785
SAMUT SAKHON	45,467	46,538	47,697	48,207	48,790	48,903	49,555	52,425	53,274	53,874	53,984
PHUKET	43,714	44,406	45,155	45,421	45,473	45,917	46,659	46,880	47,430	46,917	46,722
SONGKHLA	10,401	10,535	11,528	11,668	11,810	11,707	12,114	12,555	13,225	13,550	13,777
SONGKHLA	88,607	92,486	98,091	102,953	108,389	113,964	118,703	123,389	131,302	135,122	138,046
SONGKHLA	70,074	74,728	72,326	75,553	77,916	79,725	81,039	81,543	84,738	85,145	84,433

Appendix 4.1 Proportion of Factories in Bangkok

TSIC	Number of Factories				Total	Proportion				Total
	HH	Small	Medium	Large		HH	Small	Medium	Large	
311,312	784	352	43	5	1,184	66.22	29.73	3.63	0.42	100
313	27	70	7	6	110	24.55	63.64	6.36	5.45	100
314	1	2	1	4	8	12.50	25.00	12.50	50.00	100
321	319	465	103	16	903	35.33	51.50	11.41	1.77	100
322	184	1,024	271	12	1,491	12.34	68.68	18.18	0.80	100
323,324	158	215	24	3	400	39.50	53.75	6.00	0.75	100
331	720	285	45	2	1,052	68.44	27.09	4.28	0.19	100
332	435	216	27		678	64.16	31.86	3.98	0.00	100
341	236	80	18		334	70.66	23.95	5.39	0.00	100
342	1,103	345	38	4	1,490	74.03	23.15	2.55	0.27	100
355,356	1,074	586	71	2	1,733	61.97	33.81	4.10	0.12	100
351,352	274	286	72	4	636	43.08	44.97	11.32	0.63	100
353,354	5	6	1	1	13	38.46	46.15	7.69	7.69	100
361,2,9	109	116	40	4	269	40.52	43.12	14.87	1.49	100
371,372	182	120	10		312	58.33	38.46	3.21	0.00	100
381	4,086	907	73	5	5,071	80.58	17.89	1.44	0.10	100
382	1,574	441	46	1	2,062	76.33	21.39	2.23	0.05	100
383	398	279	45	2	724	54.97	38.54	6.22	0.28	100
384	891	276	49	6	1,222	72.91	22.59	4.01	0.49	100
385-91	1,406	724	104	2	2,236	62.88	32.38	4.65	0.09	100
TOTAL	13,966	6,795	1,088	79	21,928	63.69	30.99	4.96	0.36	100

Note: Thailand Standard Industrial Classification Codes Classed by Total Employees

Size classes :

HH	==	9 or less employees
Small	==	Between 10 and 50 employees
Medium	==	Between 50 and 500 employees
Large	==	More than 500 employees

Source: Department of Industrial Works, and Ministry of Industry

Appendix 4.1 (continued) Proportion of Factories in Nakhon Pathom

TSIC	Number of Factories				Total	Proportion				Total
	HH	Small	Medium	Large		HH	Small	Medium	Large	
311,312	58	40	26	3	127	45.67	31.50	20.47	2.36	100
313	2	4	2		8	25.00	50.00	25.00	0.00	100
314										
321	3	41	19	4	67	4.48	61.19	28.36	5.97	100
322	1		4	4	9	11.11	0.00	44.44	44.44	100
323,324		2			2	0.00	100.00	0.00	0.00	100
331	38	2			40	95.00	5.00	0.00	0.00	100
332	6	1			7	85.71	14.29	0.00	0.00	100
341	2	2	1	1	6	33.33	33.33	16.67	16.67	100
342	1	1			2	50.00	50.00	0.00	0.00	100
355,356	11	20	9		40	27.50	50.00	22.50	0.00	100
351,352	11	12	2		25	44.00	48.00	8.00	0.00	100
353,354										
361,2,9	8	15	8		31	25.81	48.39	25.81	0.00	100
371,372	3	4	1		8	37.50	50.00	12.50	0.00	100
381	9	9	1		19	47.37	47.37	5.26	0.00	100
382	26	13	2		41	63.41	31.71	4.88	0.00	100
383	2	2			4	50.00	50.00	0.00	0.00	100
384	17	16	3		36	47.22	44.44	8.33	0.00	100
385-91	51	12	5		68	75.00	17.65	7.35	0.00	100
TOTAL	249	196	83	12	540	46.11	36.30	15.37	2.22	100

Appendix 4.1 (continued) Proportion of Factories in Nonthaburi

TSIC	Number of Factories				Total	Proportion				Total
	HH	Small	Medium	Large		HH	Small	Medium	Large	
311,312 313 314 321 322				3	3	0.00	0.00	0.00	100.00	100
323,324	2	2	1		5	40.00	40.00	20.00	0.00	100
331	101	52	12		165	61.21	31.52	7.27	0.00	100
332	24	18	2		44	54.55	40.91	4.55	0.00	100
341	1	1	1		3	33.33	33.33	33.33	0.00	100
342	10	3			13	76.92	23.08	0.00	0.00	100
355,356	11	12	1		24	45.83	50.00	4.17	0.00	100
351,352 353,354	11	14	4		29	37.93	48.28	13.79	0.00	100
361,2,9	17	15	4		36	47.22	41.67	11.11	0.00	100
371,372	3	2			5	60.00	40.00	0.00	0.00	100
381	52	12	8		72	72.22	16.67	11.11	0.00	100
382	63	13	2	1	79	79.75	16.46	2.53	1.27	100
383	10	7	3		20	50.00	35.00	15.00	0.00	100
384	28	4	1		33	84.85	12.12	3.03	0.00	100
385-91	69	10	3		82	84.15	12.20	3.66	0.00	100
TOTAL	402	165	42	4	613	65.58	26.92	6.85	0.65	100

Appendix 4.1 (continued) Proportion of Factories in Pathum Thani

TSIC	Number of Factories				Total	Proportion				Total
	HH	Small	Medium	Large		HH	Small	Medium	Large	
311,312	26	29	12		67	38.81	43.28	17.91	0.00	100
313	1	1	1	2	5	20.00	20.00	20.00	40.00	100
314										
321		7	8	10	25	0.00	28.00	32.00	40.00	100
322		2	8	3	13	0.00	15.38	61.54	23.08	100
323,324	3		4		7	42.86	0.00	57.14	0.00	100
331	26	29	9		64	40.63	45.31	14.06	0.00	100
332	5	3	5		13	38.46	23.08	38.46	0.00	100
341		3	6	2	11	0.00	27.27	54.55	18.18	100
342		1	1		2	0.00	50.00	50.00	0.00	100
355,356	1	17	5	1	24	4.17	70.83	20.83	4.17	100
351,352	7	20	10	2	39	17.95	51.28	25.64	5.13	100
353,354		1	1		2	0.00	50.00	50.00	0.00	100
361,2,9	4	15	15	1	35	11.43	42.86	42.86	2.86	100
371,372	1	6	8	1	16	6.25	37.50	50.00	6.25	100
381	8	11	6	2	27	29.63	40.74	22.22	7.41	100
382	34	13	8	1	56	60.71	23.21	14.29	1.79	100
383	1	4	7		12	8.33	33.33	58.33	0.00	100
384	16	6	4	1	27	59.26	22.22	14.81	3.70	100
385-91	45	13	4		62	72.58	20.97	6.45	0.00	100
TOTAL	178	181	122	26	507	35.11	35.70	24.06	5.13	100

Appendix 4.1 (continued) Proportion of Factories in Samut Sakhon

TSIC	Number of Factories				Total	Proportion				Total
	HH	Small	Medium	Large		HH	Small	Medium	Large	
311,312	63	40	14	2	119	52.94	33.61	11.76	1.68	100
313		1	1		2	0.00	50.00	50.00	0.00	100
314										
321	4	32	43	2	81	4.94	39.51	53.09	2.47	100
322		1	3	1	5	0.00	20.00	60.00	20.00	100
323,324		4	3		7	0.00	57.14	42.86	0.00	100
331	27	12			39	69.23	30.77	0.00	0.00	100
332	2	3	1		6	33.33	50.00	16.67	0.00	100
341	2	6	1		9	22.22	66.67	11.11	0.00	100
342	4	1			5	80.00	20.00	0.00	0.00	100
355,356	10	21	17		48	20.83	43.75	35.42	0.00	100
351,352	12	19	4		35	34.29	54.29	11.43	0.00	100
353,354	1	1	2		4	25.00	25.00	50.00	0.00	100
361,2,9	10	16	12	1	39	25.64	41.03	30.77	2.56	100
371,372	30	11	5		46	65.22	23.91	10.87	0.00	100
381	30	15	14		59	50.85	25.42	23.73	0.00	100
382	56	3			59	94.92	5.08	0.00	0.00	100
383	3	6	3		12	25.00	50.00	25.00	0.00	100
384	30	7	5		42	71.43	16.67	11.90	0.00	100
385-91	21	14	10		45	46.67	31.11	22.22	0.00	100
TOTAL	305	213	138	6	662	46.07	32.18	20.85	0.91	100

Appendix 4.1 (continued) Proportion of Factories in Samut Prakan

TSIC	Number of Factories				Total	Proportion				Total
	HH	Small	Medium	Large		HH	Small	Medium	Large	
311,312	76	88	62	6	232	32.76	37.93	26.72	2.59	100
313	1	2			3	33.33	66.67	0.00	0.00	100
314			1		1	0.00	0.00	100.00	0.00	100
321	27	150	93	21	291	9.28	51.55	31.96	7.22	100
322		14	21	4	39	0.00	35.90	53.85	10.26	100
323,324	118	36	18	1	173	68.21	20.81	10.40	0.58	100
331	105	39	15		159	66.04	24.53	9.43	0.00	100
332	14	16	10		40	35.00	40.00	25.00	0.00	100
341	9	12	14	1	36	25.00	33.33	38.89	2.78	100
342	21	9	2		32	65.63	28.13	6.25	0.00	100
355,356	47	70	28	1	146	32.19	47.95	19.18	0.68	100
351,352	39	59	32	2	132	29.55	44.70	24.24	1.52	100
353,354	1	1	1		3	33.33	33.33	33.33	0.00	100
361,2,9	9	23	24	3	59	15.25	38.98	40.68	5.08	100
371,372	16	45	43	4	108	14.81	41.67	39.81	3.70	100
381	155	142	63	3	363	42.70	39.12	17.36	0.83	100
382	157	83	22	1	263	59.70	31.56	8.37	0.38	100
383	11	38	29	3	81	13.58	46.91	35.80	3.70	100
384	70	50	48	12	180	38.89	27.78	26.67	6.67	100
385-91	72	46	34	3	155	46.45	29.68	21.94	1.94	100
TOTAL	948	923	560	65	2496	37.98	36.98	22.44	2.60	100

Appendix 4.2 Projected Gross Domestic Products by Economic Sector (Manufacturing Sector)

Unit : Million Baht,
Constant 1972 Prices

Whole Kingdom	Projected						
	1986	1988	1991	1996	2001	2006	2011
-Food Processing	27,583	32,734	43,311	60,437	77,135	97,181	125,027
-Light Industry	24,966	34,436	47,971	77,915	117,272	174,777	266,101
-Sawmill & Wood	2,398	3,094	4,234	6,632	9,503	13,633	20,236
-Paper & Printing	3,013	3,605	4,919	7,201	9,633	12,680	16,986
-Chemical & Related	10,832	13,778	19,326	30,983	45,649	67,291	102,262
-Nonmetals	3,323	4,647	6,190	9,684	14,021	20,178	29,785
-Basic Metals	1,473	1,614	2,161	3,061	3,961	5,043	6,535
-Machinery & Electronics	16,673	25,555	37,297	65,363	101,024	151,437	229,828
Total	90,261	119,463	165,407	261,275	378,198	542,221	796,760

Appendix 4.2 (Continued)

Unit : Million Baht,
Constant 1972 Prices

BMR Region	Projected						
	1986	1988	1991	1996	2001	2006	2011
-Food & Beverage	16,257	19,398	26,084	37,347	48,453	61,877	80,491
-Textile	22,231	30,674	42,878	69,815	105,224	157,007	239,289
-Sawmill & Wood	1,665	2,155	2,981	4,730	6,844	9,912	14,848
-Paper & Printing	2,222	2,496	3,343	4,865	6,490	8,517	11,377
-Chemicals	7,259	9,467	12,546	18,571	28,815	44,537	70,671
-Nonmetals	973	1,453	1,835	2,795	4,063	5,826	8,506
-Basic Metals	1,266	1,367	1,330	1,824	2,603	3,598	4,991
-Other Machineries	13,489	21,193	30,126	51,714	79,016	117,035	175,407
BMR GDP	65,361	88,203	121,124	191,661	281,508	408,309	605,579

Appendix 4.3 Proportion of Factories in BMR

TSIC	Number of Factories				Total
	HH	Small	Medium	Large	
311,312	1,007	549	157	16	1,729
313	31	78	11	8	128
314	1	2	2	4	9
Food Processing	1,039	629	170	28	1,866
321	353	695	266	53	1,367
322	185	1,041	307	27	1,560
323,324	281	259	50	4	594
Light Industry	819	1,995	623	84	3,521
331	1,017	419	81	2	1,519
332	486	257	45		788
Sawmill & Wood	1,503	676	126	2	2,307
341	250	104	41	4	399
342	1,139	360	41	4	1,544
Paper & Printing	1,389	464	82	8	1,943
355,356	1,154	726	131	4	2,015
351,352	354	410	124	8	896
353,354	7	9	5	1	22
Chemical & Related	1,515	1,145	260	13	2,933
361,2,9	157	200	103	9	469
Nonmetal	157	200	103	9	469
371,372	235	188	67	5	495
Basic Metal	235	188	67	5	495
381	4,340	1,096	165	10	5,611
382	1,910	566	80	4	2,560
383	425	336	87	5	853
384	1,052	359	110	19	1,540
385-91	1,664	819	160	5	2,648
Machinery & Electronics	9,391	3,176	602	43	13,212
TOTAL	16,048	8,473	2,033	192	26,746

Note: TSIC Code Classified by Total Employees

Size classes : HH == 9 or less employees
 Small == Between 10 and 50 employees
 Medium == Between 50 and 500 employees
 Large == More than 500 employees

Source: Department of Industrial Works

Appendix 4.4 Existing Land Use of Industry by Type

Unit : Rai

TSIC	HH	Small	Medium	Large	Total
311,312	504	549	942	320	2,315
313	16	78	66	160	320
314	1	2	12	80	95
Food Processing	520	629	1,020	560	2,729
321	177	695	1,596	1,060	3,528
322	93	1,041	1,842	540	3,516
323,324	141	259	300	80	780
Light Industry	410	1,995	3,738	1,680	7,823
331	509	419	486	40	1,454
332	243	257	270	0	770
Sawmill & Wood	752	676	756	40	2,224
341	125	104	246	80	555
342	570	360	246	80	1,256
Paper & Printing	695	464	492	160	1,811
355,356	577	726	786	80	2,169
351,352	177	410	744	160	1,491
353,354	4	9	30	20	63
Chemical & Related	758	1,145	1,560	260	3,723
361,2,9	79	200	618	180	1,077
Nonmetal	79	200	618	180	1,077
371,372	118	188	402	100	808
Basic Metal	118	188	402	100	808
381	2,170	1,096	990	200	4,456
382	955	566	480	80	2,081
383	213	336	522	100	1,171
384	526	359	660	380	1,925
385-91	832	819	960	100	2,711
Machinery & Electronics	4,696	3,176	3,612	860	12,344
TOTAL	8,024	8,473	12,198	3,840	32,535

Note: Maximum area required

HH = 0.5 Rai
 Small = 1 Rai
 Medium = 6 Rai
 Large = 20 Rai

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