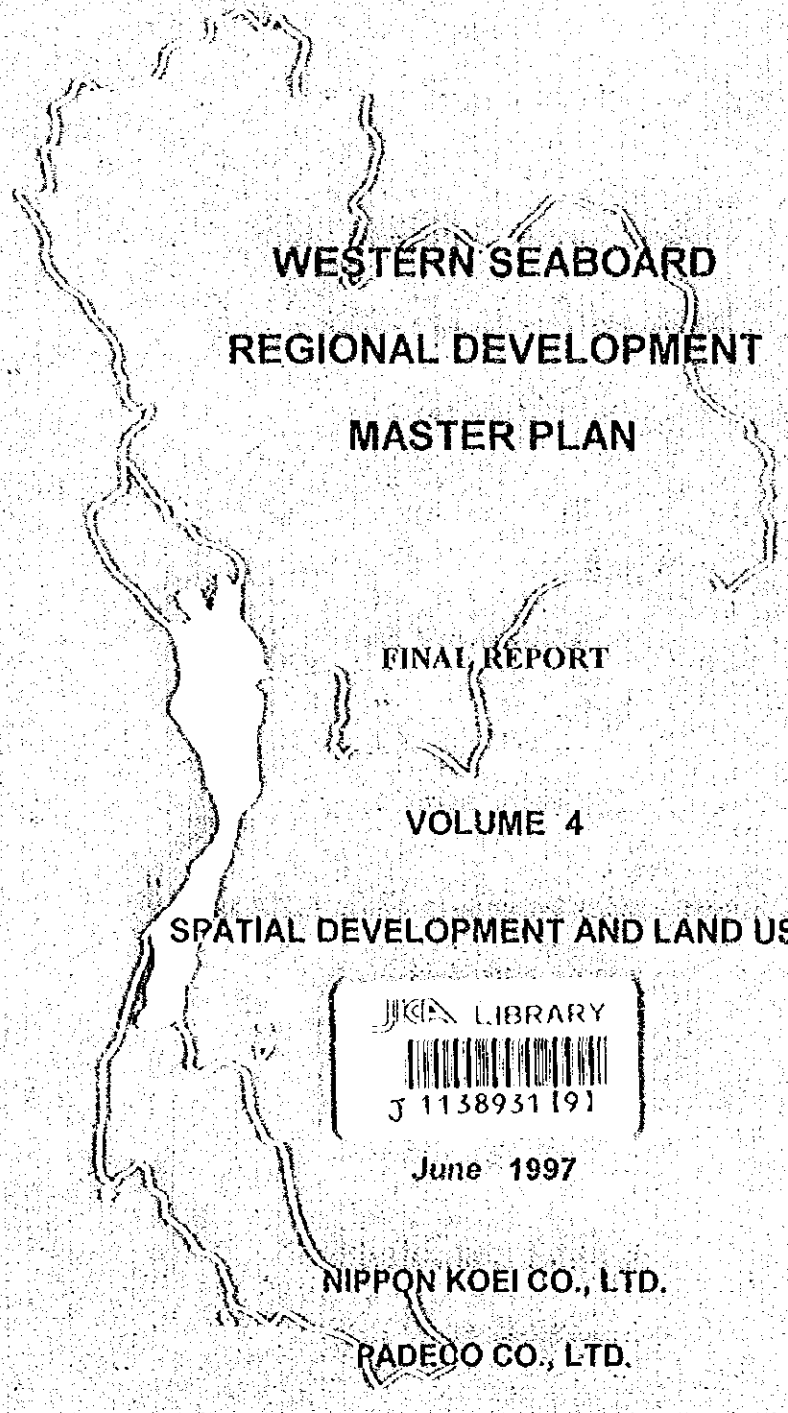
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NATIONAL ECONOMIC AND
SOCIAL DEVELOPMENT BOARD (NESDB)
OF THE KINGDOM OF THAILAND



WESTERN SEABOARD REGIONAL DEVELOPMENT MASTER PLAN

FINAL REPORT

VOLUME 4

SPATIAL DEVELOPMENT AND LAND USE

June 1997

NIPPON KOEI CO., LTD.

PADECO CO., LTD.

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LIST OF REPORTS

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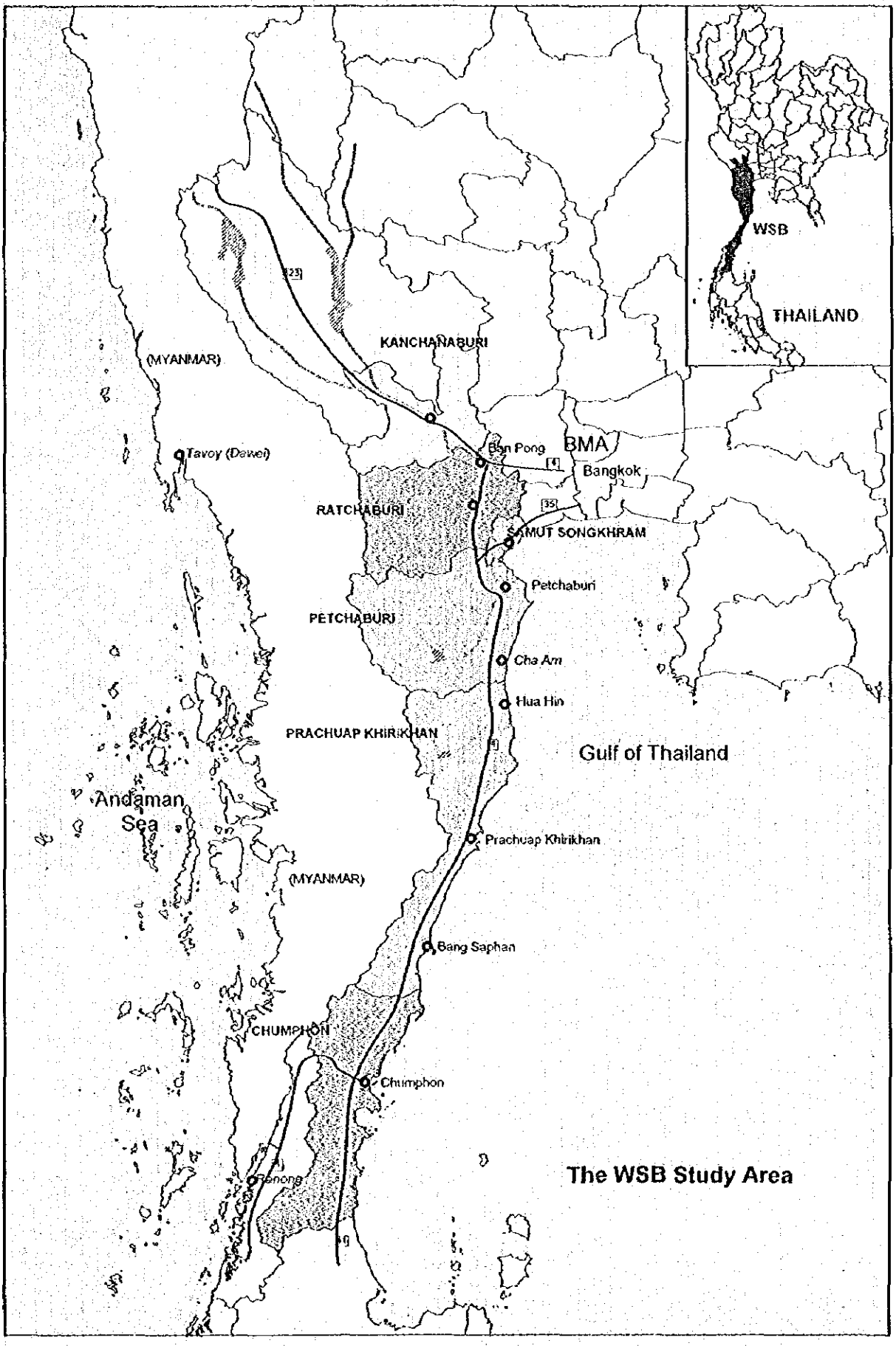
Currency Equivalents

US$ 1 = 25 Baht

1 Baht = US$ 0.04

(As of Mid 1996)


WSB
THAILAND
KANCHANABURI
(MYANMAR)
Tavoy (Dawei)
Ban Pong
BMA
Bangkok
RATCHABURI
SAMUT SONGKHRAM
Petchaburi
PETCHABURI
Cha Am
Hua Hin
PRACHUAP KHIRIKHAN
Gulf of Thailand
Andaman Sea
Prachuap Khirikhan
(MYANMAR)
Bang Saphan
CHUMPHON
Chumphon
Ranong
The WSB Study Area

VOLUME 4 SPATIAL DEVELOPMENT AND LAND USE

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Chapter 1 SPATIAL DEVELOPMENT

1.1 Regional Development Patterns

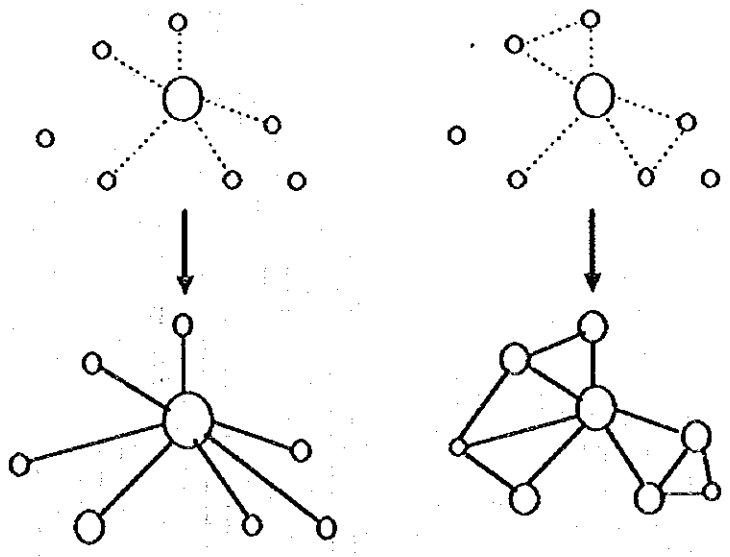
In formulating a spatial development plan and structure for the development of the WSB region, a few alternative "models" of regional development planning have been evaluated. In particular, the growth pole model, the regional network model, and the multiple access model have been evaluated in terms of their relevance and applicability to the WSB.

(1) Growth Pole Model vs. Regional Network Model

The growth pole model, a conventional strategy for spatial development, involves the designation of a single large city as a generic center for a predetermined region, with public investment concentrated in the large city, which is to serve its neighboring towns and hinterlands with multiple functions. Up to the 6th Plan, the Thai government had in principle applied this growth pole strategy for regional development planning. In each region, growth poles were designated and selected urban centers were linked to the growth poles.

In the 7th Plan, the Thai government adopted a new approach to urban and spatial development. In this approach, cities and towns in a region or subregion are taken as a cluster of urban centers, which complement one another with respect to different functions in order to realize better overall services for people in these centers and their hinterlands. This is termed the regional network model. The regional network approach is generally to be applied in the 8th Plan, as well as in the formulation of the national spatial development framework, which is proposing several clusters (e.g., a Northern urban cluster, a Lower North cluster, a Songkhla cluster).

The regional network approach strategy views cities and towns within a region or subregion as part of a cluster of urban centers or industrial zones. These centers interact with each other, as well as with their hinterlands (rural areas) to create a whole that is greater than the sum of its parts. The regional network approach as applied to urban development is schematically illustrated overleaf.



Growth Pole Model **Regional Network Model**

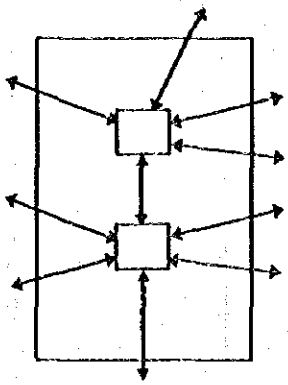
Applicability of these alternative models to the WSB may be summarized as follows;

(i) The Upper WSB is rapidly urbanizing with a spillover effect of the BMA. Development of the BMA itself of its with the growth pole model. From the regional development point of view, however, the Upper WSB cities are expected to develop as urban clusters in line with the regional network model for more autonomous development.

(ii) The Central and Lower WSB have a long stretch of narrow land with a few urban centers developed in a linear form. The urbanization drive due to the BMA spillover does not extend to these areas, and thus the application of the regional network model is difficult in this part of the Study Area.

(2) Multiple Access Model

Geographically, the WSB is narrow and elongated, located in between the Central and Southern regions. The WSB region is accessible from various directions, by land, sea, air, and satellite. Consequently, an alternative approach, termed the "multiple access model" and schematically illustrated below, may be effectively applied to planning for the development of the WSB.



Multiple Access Model

The multiple access approach is the opposite of the growth pole model. While the latter aims at spreading or extending the effect of the central city to its peripheries, the multiple access model attempts to spread the interactions with neighboring areas into a region or subregion.

The multiple access model may be applied to the WSB for the following reasons:

(i) The WSB is not only linked by a north-south artery along Route 4 but it is also accessible by land, sea, and air at various points.

(ii) The multiple access model will promote linkages of areas and regions, as well as linkages among economic sectors.

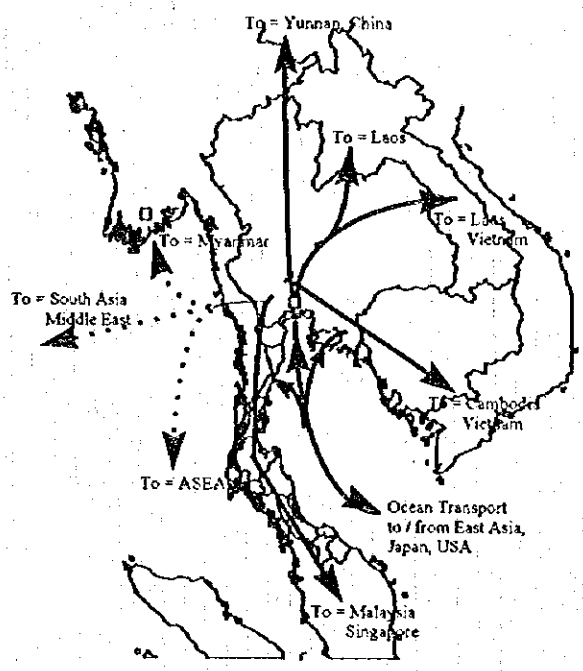
(iii) The development of the WSB region should be strategically promoted under a globalization policy and under the policy of subregional and interregional cooperation. Under the globalization policy, a free-trade regime is promoted, for which the multiple access model is ideal. Subregional and interregional cooperation can also be effectively promoted through the multiple access approach.

(iv) As in the case of regional network approach, decentralization can also be promoted because the multiple access model depends less on one large center such as the BMA.

A key to successful spatial development under the multiple access model will be to develop a central city with multiple functions. Spatial development following the multiple access model will, therefore, be supported by a multiplicity of transport modes to meet a diversity of needs; different points or areas in the region will be accessible from other areas by various modes of transportation.

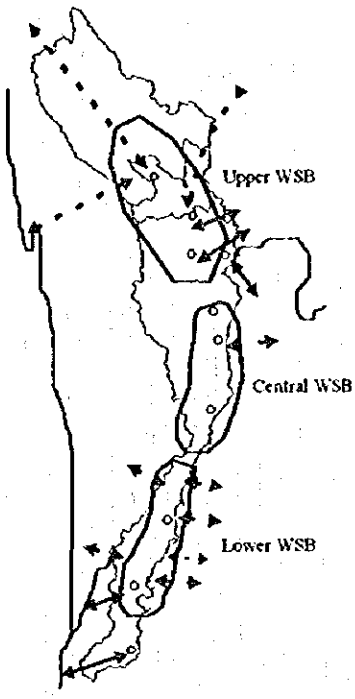
(3) Multiple Access Approach Applied to the WSB

As noted above, the multiple access model may be effectively applied to development planning for the WSB region. From the viewpoint of globalization and subregional cooperation, the WSB region will be positioned as illustrated below.



Globalization and Subregional Cooperation from the Viewpoint of the Regional Transportation Network

More specifically, the WSB will be accessible by air (Pathiu airport in Chumphon province), by sea (e.g., Bang Saphan deep-sea port, Chumphon port, Petchaburi or Samut Songkhram port, a specific port for an Independent Power Producer in Prachuap Khirikhan), and by land (to/from the Central and Southern regions). In the longer term, the WSB may be made accessible to/from Tenasserim (Tanintharyi) Division of Myanmar, in which direction a number of east-west corridors could be developed. The multiple access approach applied to the WSB region is illustrated below, mainly from the viewpoint of transportation access.



Multiple Access Model Applied to the WSB

It is noted that the multiple access approach will also have impacts on the development of the peripheries or rural areas. For instance, promotion of trade through the multiple access approach will involve rural areas, directly and indirectly.

1.2 Spatial Development Framework

Based on the regional socioeconomic situation and the development constraints/potential of the WSB region, the multiple access approach has been applied to formulate a spatial development framework for the selected Moderate Economic Development Scenario.

(1) Elements of Spatial Development Framework for the WSB

Spatial development of the WSB region, following largely the multiple access approach, will be supported by the following elements:

(i) North-South and East-West Arteries: Two arteries serving the WSB region, in north-south and east-west directions, should be conceived as a part of an international arteries network; a north-south artery linking Yunnan province of the People's Republic of China to the north with Malaysia/Singapore and Indonesia to the south, and an east-west artery linking Indochina (Cambodia, Lao PDR, and Vietnam) and Myanmar (and South Asia). The WSB is

strategically located at the major crossroads between these two international arteries.

(ii) Establishment of Sea Lanes: Since the WSB has a long coastline (559 km) on the Gulf of Thailand, sea lanes should be established as an integral part of the multimodal transportation system. Though the Inner Gulf has shallow water depths along the coast, some (limited) feeder port facilities could be developed, with Bang Saphan as the region's deep-sea hub port. Interregional linkage with the ESB and the SSB, as well as international linkage, should be promoted through the establishment of sea lanes.

(iii) Establishment of Alternative Links to Myanmar and Alternative Outlets to the Andaman Sea: At least two outlets to the Andaman Sea should be established/strengthened in the medium term. Natural choices would be Tavoy/Dawei in Myanmar and Ranong/Phangnga in the Lower WSB. Another link to Myanmar should be developed in the long run from the Central WSB.

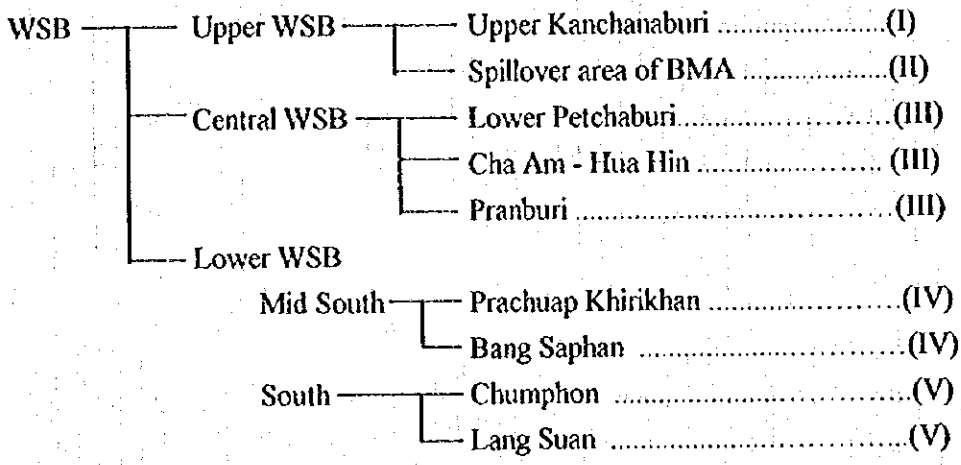
(iv) Promotion of a Communication Network via Satellite: High-speed digital communication networks via satellite will be developed in the near future, thereby accelerating globalization. Decentralization would be promoted since concentration in the BMA would be less attractive under such circumstances. The WSB region should be prepared for such an era.

(v) Improved Access to Arteries, Sea Lanes, and Communication Network: The major arteries, sea lanes, and communication networks via satellite would form axes, and several regional centers would be developed. These axes and regional centers should integrate the rural areas, and access to these networks should be improved at the same time.

(vi) Railway Rehabilitation to Serve Diversifying Needs: Railway systems tend to induce development only around stations, and in this sense, the railway mode is more consistent with the settlement pattern found in the Lower WSB. Railway rehabilitation will safeguard the potential for fast commuter train service and for bulk cargo transport. It will also promote interregional linkage with the SSB and the Central region.

(2) Subdivision of WSB

The WSB region is composed of geographic areas that are distinctly different from each other, agro-ecologically, morphologically, or otherwise. The WSB region may be subdivided in the following way (Alternative 1):



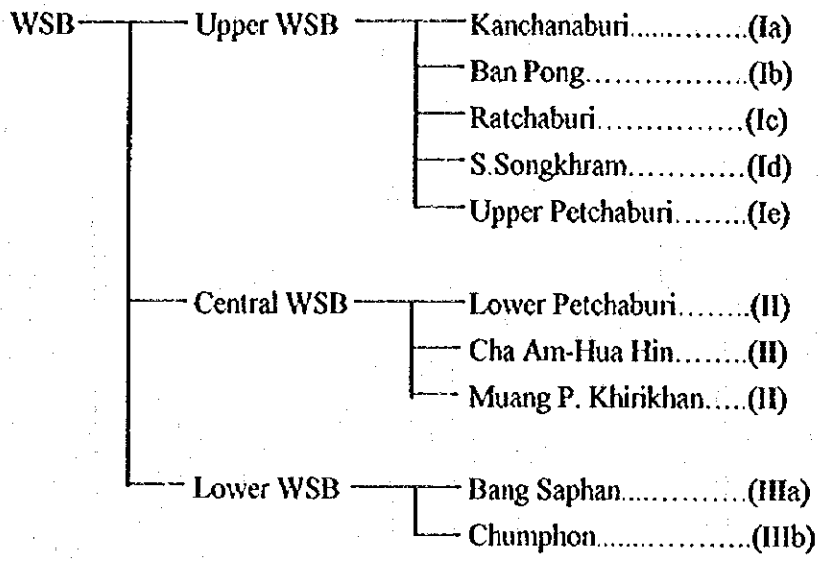
In Alternative 1, Muang Prachuap Khirikhan is categorized as part of the Lower WSB, together with the Bang Saphan area. Alternative 1, however, has some difficulties if evaluated by macro-zoning and zonal activities, particularly in the Central and Lower WSB. Major difficulties are listed below:

(i) There are two national parks (Had Wanakorn and Namtok Huai Yang) south of Muang Prachuap Khirikhan, and this Muang is desirably categorized into an "amenity zone" south from the Cha Am-Hua Hin area.

(ii) After Pathiu airport is opened in 1997, the Bang Saphan area will be more closely linked with Chumphon.

(iii) Tourism activities in Prachuap Khirikhan may desirably be integrated into the Cha Am/Hua Hin area, rather than into the Chumphon area.

An alternative subdivision (Alternative 2) proposal is the following:



The Upper WSB has a relatively large land area and abundant water resources; it is divided into the upland area of Kanchanaburi, which has unique agro-ecological conditions and the spillover area of the BMA, which is located within a radius of about 100 km from the BMA. The spillover area will cover the Ban Pong area, located in Ratchaburi province at the crossroads of major (international) north-south and east-west arteries; Samut Songkhram province; and the upper part of Petchaburi province (near Amphoe Khao Yoi). The Upper WSB may be characterized as an "industrial junction zone" from the industrial development point of view. The Central WSB covers Muang Petchaburi, and the Cha Am-Hua Hin area up to Muang Prachuap Khirikhan. The Central WSB is blessed with natural amenities though water resources are scarce in this subdivision. The Lower WSB, which will cover Bang Saphan, Pathiu airport, and the major part of Chumphon province, has potential for both industrial and agricultural development.

(3) Macro-Zoning for Development of the WSB

In view of the elements of the spatial development framework and subdivision of the region, a macro-zoning scheme for the WSB region has been devised for long-term planning purposes. Several areas in the region have been defined and characterized by the typical economic activities expected to develop in the areas, as well as by the opportunities to be made available for social and human development. Each zone has been identified by major urban centers within the zone, but agricultural and social activities in their rural hinterlands have also been reflected in the characterization.

(Ia) <u>Kanchanaburi eco-tourism and agro-industrial zone</u>:

(a) Major urban center: Kanchanaburi

(b) Characteristic activities: eco-tourism, agro-processing industry livestock (cattle fattening), upcountry vegetables

(c) Key infrastructure: Tavoy-Kanchanaburi corridor, tourism promotion infrastructure, livestock related facilities

The Kanchanaburi eco-tourism and agro-industrial zone has access to and from BMA as well as to Myanmar via Three Pagodas Pass. If and when the Tavoy (Dawei)-Kanchanaburi Corridor is opened, the zone would serve as a gateway to Myanmar and points beyond in South Asia, Europe, and the Middle East. The zone would not be industrialized substantially, except for the agro-processing industry; ecological conditions would be preserved to the maximum extent. Eco-tourism and livestock (cattle fattening), as well as the cultivation of vegetables and flowers for niche markets in BMA, would be promoted in this zone.

(Ib) Ban Pong industrial/distribution zone:

(a) Major urban center: Ban Pong

(b) Characteristic activities: distribution center, automobile parts, ceramics, suburban agriculture

(c) Key infrastructure: crossroads of the north-south and east-west arteries, fully equipped industrial estates

The Ban Pong distribution center and domestic market-oriented industrial zone is located at the crossroads of the north-south and east-west arteries, and at the point closest to BMA. A distribution center would ideally be located in this zone. Since automobile-related industries have traditionally been developed in Ban Pong, the zone is proposed as a site for further development of domestic market-oriented industries, including machinery, automobile parts, and the like. (The Kanchanaburi industrial park under construction along Route 323 in between Ban Pong and Kanchanaburi will be situated in this zone.)

(Ic) Ratchaburi administrative and industrial zone:

(a) Major urban center: Ratchaburi

(b) Characteristic activities: regional administration, power supply center, industries relocating from the BMA

(c) Key infrastructure: urban infrastructure, natural gas terminal and power station, direct road links with other provincial capitals

The Ratchaburi administrative and industrial zone is located in the center of the Upper WSB and is serving as a growth pole in this part of the region. The zone will have a terminal of the planned natural gas pipeline from Myanmar, and such gas-oriented industries as IPP power plants will be developed. The extent of industrialization in the area will depend on the feasibility of downstream natural-gas industries.

(Id) Samut Songkhram free trade and aquacultural zone:

(a)	Major urban center:	Samut Songkhram
(b)	Characteristic activities:	free trade area (FTA), retail/wholesale, aquaculture
(c)	Key infrastructure:	FTA facilities, high-grade urban infrastructure

It is proposed that a Samut Songkhram free trade and aquacultural zone utilize the land previously used as shrimp fields but which are now mostly abandoned. A part of the land would be reserved for protection and rehabilitation of the mangrove area and for aquaculture (e.g., cockle farming, mud crab restocking). In another part of Samut Songkhram, it is proposed to promote a free trade area (FTA) where processing industry, warehousing, retail/wholesale activities, as well as a residential, exhibition, and sports complex, are envisaged. The proposed FTA would also promote decentralization from the BMA.

(Ie) Upper Petchaburi industrial zone:

(a)	Major urban center:	Khao Yoi
(b)	Characteristic activities:	processing industry, agro-industry
(c)	Key infrastructure:	fully equipped industrial estate and distribution center

The Upper Petchaburi industrial zone would be a relatively small area where an industrial estate could be developed near the junction of Routes 4 and 35. Construction of the industrial estate is underway. This zone, though located in Petchaburi province, would be involved in the Upper WSB.

(If) Central WSB amenity zone:

(a)	Major urban center:	Petchaburi, Cha Am, Hua Hin, Prachuap Khirikhan
(b)	Characteristic activities:	tourism/conference, research and development (R&D), educational/cultural center, communications, horticulture

(c) Key infrastructure: tourism infrastructure, science city/park, conference facilities, center for telecommunications

Since the Central WSB amenity zone is already serving as a tourism center (Cha Am and Hua Hin), the ecological conditions in the zone should be preserved to the maximum extent. As three national parks (Khao Sam Roi Yol, Had Wanakorn, and Namtok Huai Yang) are located north and south of Muang Prachuap Khirikhan, this zone has been extended to the south of Muang Prachuap Khirikhan. The zone would not be totally preserved for conservation, but it is proposed to locate a science city/park for technological research and development to promote knowledge-based industries.

(IIIa) Bang Saphan industrial zone:

(a) Major urban center: Bang Saphan
(b) Characteristic activities: heavy industry, power center, free trade area (FTA),
(c) Key infrastructure: deep-sea port at Bang Saphan, FTAs

The Bang Saphan industrial zone will have several points of access to and from the zone, including Bang Saphan deep-sea port. In longer term, an east-west corridor might possibly be opened to Myanmar. A heavy industry complex is being developed at Bang Saphan, and the Electricity Generating Authority of Thailand (EGAT) plans IPPs in and to the north of Bang Saphan. The Bang Saphan area will be a core of industrial development in the WSB.

(IIIb) Chumphon agricultural and distribution zone:

(a) Major urban center: Chumphon
(b) Characteristic activities: agriculture, particularly fruit production, livestock, fisheries, and distribution center,
(c) Key infrastructure: tropical fruit research center, regional airport at Pathiu, livestock center, feeder port, east-west corridor.

The Chumphon agricultural zone will also have several points of access for intraregional, interregional and subregional linkage, including a regional airport at Pathiu, Chumphon feeder port, an east-west corridor between Chumphon and Ranong, and a Marang (Myanmar) - Kraburi (Thailand) corridor. When this infrastructure is developed, the Chumphon area would serve as a distribution center for the WSB. The Chumphon zone has a high potential for fruit cultivation, livestock breeding, and fishery processing.

Based on the above macro-zoning, the spatial development structure of the WSB region illustrated in Figure 4.1.1 is proposed.

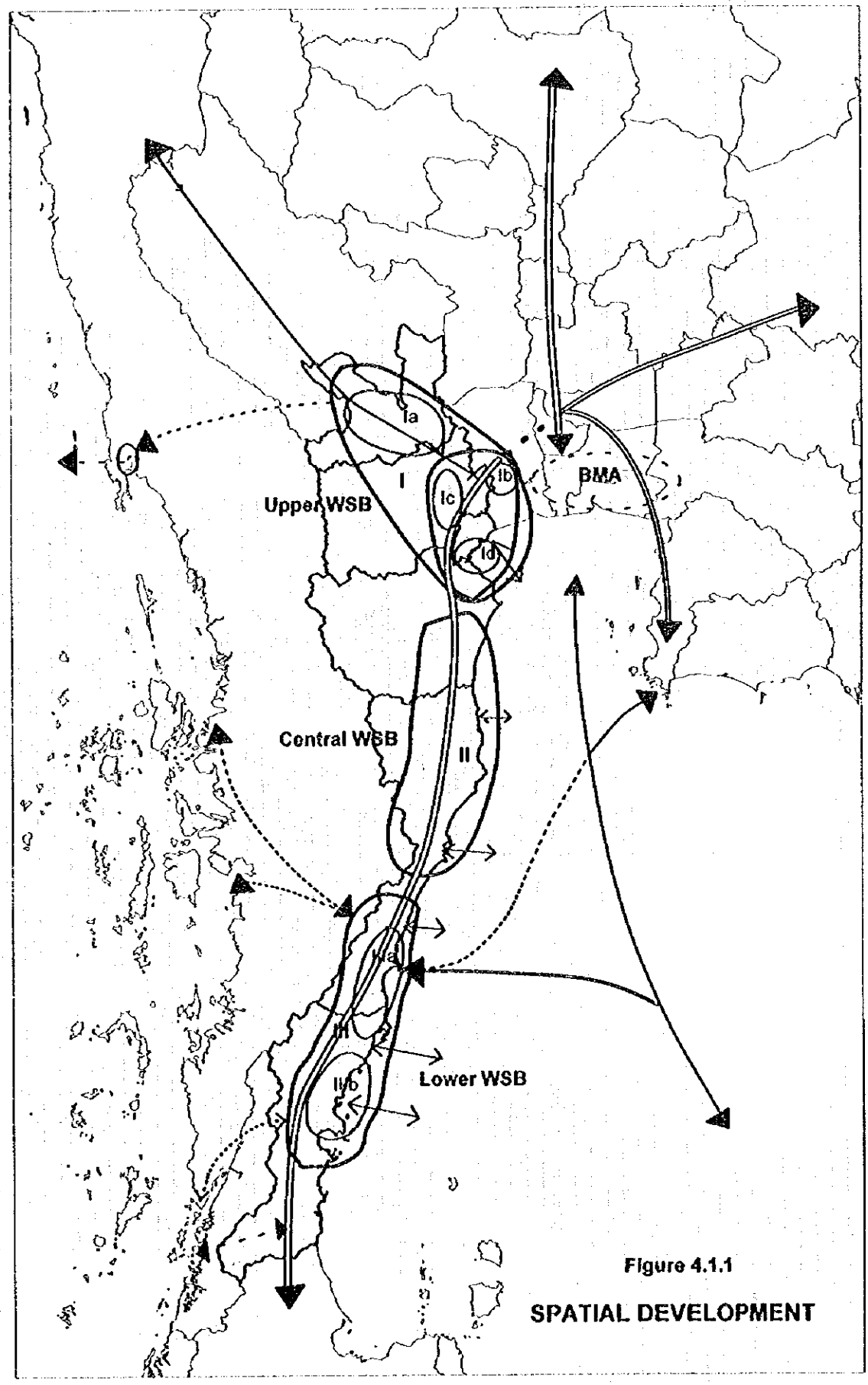


Figure 4.1.1

SPATIAL DEVELOPMENT

Chapter 2 CURRENT LAND USE

2.1 Composition of Land Use

2.1.1 Current Land Use

Land use in the WSB region is shown in Table 4.2.1 and Figure 4.2.1 based upon an assessment undertaken with the geographic information system (GIS) developed specially for this Study. As indicated, agricultural land accounted for about 55 per cent of the total Study area in 1995, while forest land accounted for 43 per cent. Farmland in the region occupied for farming purposes includes paddy fields (7.2 per cent), field crops (37.8 per cent), and fruit and tree crops (10.2 per cent). In comparing data from this GIS assessment of the Study area with national data on the composition of land use in 1992 as reported in *Agricultural Statistics of Thailand*, it is apparent that the proportion of forest area in the Study area still remains above the national level (26.3 per cent), while the proportion of land devoted to paddy fields is considerably below the national level (21.5 per cent).

2.1.2 Changes in Land Use

Recent changes in land use in the WSB may be characterized from a macroscopic viewpoint by two main phenomena: (i) an increase in the quantity of agricultural land and depletion of natural forests, and (ii) a shift in cultivation patterns from rice-dependent cultivation to upland cash crops (Table 4.2.2). Specific aspects of these phenomena are described below:

(i) With the enhancement of irrigation systems, the principal change in agricultural land use to occur has been from single rice cropping to diversified farming including poultry raising and vegetable and tree cropping. According to official statistics, between 1982 and 1992 paddy area decreased 30 per cent, while the area for fruit trees increased by 70 per cent and that for vegetables and flowers increased by 200 per cent; total farmland increased by 16 per cent in this period.

(ii) The conversion of agricultural land to other land uses has been confined mainly to small-scale factories, commercial shop houses, and residential estates.

(iii) The reduction in forest area over the last three decades, because of the clearing of forest land and land encroachment, in the Kingdom as a whole as well as in the WSB, is documented in Table 4.2.3. Some of the forest land in the Lower WSB has been converted into fruit tree or tree crop farms.

(iv) Other noteworthy changes in land use include a general reduction in aquacultural land, especially shrimp farming in the swampy coastal areas.

2.2 Land Use Activities

2.2.1 Agriculture

The historical expansion of agricultural land in the WSB region has nearly reached its practical limit. Further expansion of agricultural land in the region can only occur at the cost of deforestation.

Crop production in the WSB is dominated by upland crops, fruit crops, tree crops, and paddy. Upland crops account for 68 per cent of the cultivated area, paddy for 13 per cent, and fruit and tree crops for 18 per cent.

The cropping pattern of the WSB region can generally be classified into:

(i) single paddy cropping;
(ii) double paddy cropping;
(iii) mixed cropping of paddy and upland crops;
(iv) cropping of upland crops;
(v) cropping of fruit and tree crops; and
(vi) pasture cropping.

Agricultural land in the WSB is currently not intensively utilized. Based on analysis of an aerial survey and available statistics, the crop intensity of paddy land is estimated at about 130 per cent and that of farmland used for upland crops at about 100 per cent.

Most of the cultivated area in the WSB is less than 200 m above sea level and can be divided into two distinct zones:

(i) the flat, alluvial, mainly rice-growing areas located within the lower Mae Klong, and in Ratchaburi and Petchaburi provinces; and

(ii) the undulating belt that lies between the main rice-growing areas and the mountains, such belt running from Kanchanaburi in the north to Prachuap Khirikhan and Chumphon in the south (an area where upland crops and particularly sugar cane and pineapples predominate).

Paddy cultivation suffers from low yields in the flood-prone area. Double cropping of rice can be seen in the areas where water is available for a second crop of rice. Water supplies in the Petchaburi scheme will be insufficient to permit the full double cropping of rice.

Since the soils in rainfed areas are often deficient in nutrients, the development of specially adapted varieties might yield a relatively limited improvement. Rice-growing areas prone to deep flooding are planted with "floating rice." There is no potential to grow any crop other than rice in flood-prone area. High-yielding varieties suitable for double cropping are planted in areas with good water control. The off-season rice crop requires water for pre-saturation, while cane fields are dried off to stimulate sugar production prior to harvest.

The majority of Thailand's commercial pineapple area lies within Prachuap Khirikhan and Petchaburi. Coconut is planted broadly and is presently the main crop in the region. Prachuap Khirikhan has the largest area in the WSB planted with coconut, followed by Samut Songkhram, Ratchaburi, and Petchaburi. Trees in Samut Songkhram are grown on raised beds and irrigated through an intricate series of ditches. Coconut groves in the isthmus have been extensively rather than intensively husbanded. Improvements in yield and gross margin can only be achieved through a steady program of replanting followed by correct husbandry.

The main crop in the northeastern part of the WSB region is wetland rice as most of the soils in this area are poorly drained and flooded during the rainy season, either by river or rainwater. Short-term vegetable crops are grown in quantity in Damnoen Saduak in Ratchaburi province. In the tidal flat areas of Samut Songkhram, agricultural land is used for salt farming and coconut gardening. Formerly saltwater shrimp farming was dominant over an area of 6,000 ha in this province, but almost all of these shrimp fields have been abandoned because of a degradation of water quality. Salt production using the natural drying method, still a land use in this area, is no longer competitive with salt production using the chemical method and therefore it is likely that many of the area's salt farms will be used for other purposes.

In Petchaburi and Kanchanaburi, the principal crops are transplanted rice, corn, soybeans, mung beans, cotton, and sugar cane. Fruit crops and tree crops are grown in Prachuap

Khirikhan and Chumphon provinces. Coconut, rubber, coffee, oil palm, pineapple, and durian are dominant. In these provinces a variation of crops can be observed by height above sea level, as well as based on soil and water conditions. Coconut is grown on soils on erosion surfaces, on alluvial and marine terraces, and on sandy beach formations. In mountainous areas, the mixed planting of coffee and durian are observed.

Tables 4.2.4 and 4.2.5 present data on land holdings by size and tenure type, respectively. Average farm sizes in the WSB range from 2 ha in Samut Songkram to 6 ha in Prachuap Khirikhan; the larger holdings are found in the pineapple and sugar-cane areas. A little more than half of all farms are in the land's holding range of 1.6 - 9.4 ha in the Central region. Owned land under one tenure accounted for almost two-thirds (65.6 per cent) of all holdings in the Central region; the rate of rented land holdings is rather high in the Central region compared with other regions, about 15 per cent.

Despite an average annual rainfall in excess of 1,000 mm, large areas in the WSB basins suffer from water shortages during the dry season, as well as from flooding in the wet season. The fundamental problems are those of providing adequate storage and flood protection and minimizing waste.

There are 731,100 ha of potentially surface irrigable land in the WSB Region. At present, there is no additional capacity for irrigation in the major catchment areas other than in the Mae Klong river basin. Agricultural production is reduced due to water shortages in the dry season, and much of the flatter riceland adjoining the Lower Mae Klong and the Suphan/Tha Chin river tracts is flooded for a number of months during the wet season. Water use is hampered by the present canal layouts, designed a number of years ago as supplementary irrigation and emergency drainage structures.

2.2.2 Industrial Activities

Most factories in the WSB are concentrated in Kanchanaburi and Ratchaburi. Some of the factories located in provinces adjacent to the BMA region represent "spillover" from excessive industrial concentration in the BMA. An integrated steel industrial complex has recently opened in Prachuap Khirikhan province. Ratchaburi province has recently benefitted from the growth of textile manufacturing, mostly on a fairly small scale with enterprises typically having about 50-100 employees. In Ban Pong, there is a substantial bus body building industry.

The service industry - being labor-intensive, requiring less working space, and operated mostly in shop houses - has the added advantage of serving as accommodations and as well as work places. For the convenience of transport, these shop houses are located in towns and areas along main roads. Overspill from metropolitan Bangkok can be seen in the east of the Upper WSB region.

While there are currently no industrial estates in the Western region, a plan to establish three industrial estates (Kanchanaburi, Petchaburi, and Ratchaburi) was approved by BOI. Two private industrial estates, in Ratchaburi and Prachuap Khirikhan, are also in the planning stage. A newly proposed site in the western part of Ratchaburi province offers lower land prices and less crowding but suffers from a shortage of water. A planned gas pipeline has stimulated industrial estate development.

2.3 Land Use Policies

2.3.1 Guidelines for National Economic and Social Development

The Seventh National Economic and Social Development Plan (1992-96), which included strategies and numerical goals suggestive of the principal direction of land use planning, mandated that at least 40 per cent of the country was to be under forest cover, and at least 25 per cent in conservation forests. These goals in the Seventh Plan dated back to the National Forest Policy announced in 1985.

Concerning urban growth, the strategies of the Seventh Plan were as follows:

(i) to help disperse manufacturing and industry to areas outside of the immediate BMA;
(ii) to improve the management of urban growth related to industrialization within the most rapidly urbanizing areas; and
(iii) to control and abate environmental pollution.

The development guidelines of the Eighth Plan had already been set. The emphasis is being put on strategies to strengthen the economy with environmental-friendly development, industrial development linking rural and urban areas, the creation of new economic zones, and infrastructural development in rural and urban areas in line with regional spatial development and land use.

2.3.2 Land Reform and Allocation Policy

Government policy related to land reform and allocation have important land use implications. Land allocation can be divided into four major categories according to their objectives: (i) land allocation for the purpose of solving problems of land rights and land ownership, with projects in this category including those under the Agricultural Land Reform Office (ALRO) and Department of Lands; (ii) land allocation for social welfare purposes; (iii) land allocation for development and conservation, with projects in this category including land consolidation and forestry village projects; and (iv) land allocation for special purposes.

The Agricultural Land Reform Act defines land reform as "the improvement of agricultural land tenure and land rights and the distribution of land for farming and residence." The ALRO is responsible for the implementation of the land reform program, which entails two primary activities: (i) improving land tenure and land rights on state (public) and private land; and (ii) developing agriculture in the land-reform area.

The ALRO has investigated the size and nature of state land holdings and has also negotiated with residents to either increase or decrease their land holdings to maintain an equitable distribution. The ALRO office has developed agricultural plots engaged in soil and water conservation, organized and provided training for cooperatives, supplied fertilizer, and engaged in reforestation, upkeep, and maintenance of community forests.

2.3.3 Industrial Decentralization Policy

The Board of Investment (BOI) announced in 1992 zoning to promote industrial decentralization. Tied in with this zoning, the BOI adjusts its criteria for granting tax privileges to promoted projects to attract investment in Thailand's provincial areas and to gradually tighten industrial controls around Bangkok. The country has been divided into three zones for this purpose. Promoted projects in Zone 1 receive the least tax privileges, while those in Zone 3 obtain the maximum tax privileges. In the WSB region, Kanchanaburi, Ratchaburi, and Samut Songkhram have been assigned to Zone 2, while the other three provinces, located in both the central and southern parts of the region, are in Zone 3.

Similarly, the Ministry of Industry has permitted the private sector to set up industrial areas with terms other than "industrial estate" (e.g., "industrial parks," "industrial centers") to avoid confusion with the facilities promoted by the public-sector Industrial Estate Authority of Thailand (IEAT). This move by the Ministry of Industry is aimed at the relocation of the

thousands of outdated small-scale, polluting industries into groups or compounds for better pollution management control.

In spite of the efforts described above, the majority of investment projects are still concentrated in the provinces near Bangkok, e.g., Phatum Thani and Nontha Buri.

2.4 Current Constraints and Issues

2.4.1 Major Constraints

Land use problems occur mainly from a conflict between the need to develop and the need to conserve land. Such problems include the logging of forests for agricultural use where soil protection is necessary to avoid erosion and landslides or the deforestation of mangroves, which are valuable natural resources for the aquacultural ecological system. In addition to these conflicts, problems in land use are caused by uncontrolled activities and inadequate measures, both in developed areas and conservation areas. In developed areas, problems usually occur under the guise of misuse and underutilization. In conservation areas, problems occur sometimes from the lack of appropriate measures for conservation.

Land use problems and issues in the WSB observed by field reconnaissance and studied from reports relevant to current land use are summarized below.

(i) Deforestation of land

As seen throughout Thailand, the problem of deforestation occurs in the WSB in ecological, social, and economic dimensions. The region's vulnerable forests, on which many of the rural poor depend, have been overrun by loggers and landless farmers. Also, forest land is being lost due to speculation. Ecological problems include the loss of priceless biological diversity, soil losses, the increase of river sedimentation, and the loss of fishery spawning grounds in mangrove forests. In the conservation forest areas, substantial encroachment and areas with a low stand density of trees have been observed.

Between 1978 and 1992, 14 Cabinet resolutions have been issued dealing with mangrove protection. Despite these resolutions and the resulting expenditures, the destruction of mangroves has proceeded, with consequent adverse impact on aquaculture.

(ii) Abandoned shrimp farms

Abandoned shrimp farms are observed in several provinces in the WSB region. For example, diversion to salt pans has been observed along National Highway 35. Research conducted by Office of Environmental Policy and Planning (OEPP) in 1993 estimated that an area of approximately 4,000 ha of shrimp fields, from an original area estimated at 6,080 ha, had been abandoned in Samut Songkram (provincial officials have informed that the total abandoned shrimp fields in Samut Songkhram has reached 12,800 ha). Many landowners have been observed selling top soil from their abandoned shrimp farms. Production of black tiger prawns has decreased significantly in Samut Songkram from its peak in the 1980s, although some of the prawn fields have been used for production of banana shrimp, fish, crabs, and cockles.[1]

(iii) Shortage of water for agriculture

Although the Lower WSB is endowed with rainfall of over 1,700 mm a year, the Upper and Central parts of the WSB are not endowed with as much rainfall. For example, rainfall in some areas of Ratchaburi province is less than 1,000 mm a year. Relatively small quantities of rainfall in the narrow river basins of the Central WSB result in water shortages. Even in the irrigated area of the Central WSB, only partial cultivation is possible in the dry season because the quantity of irrigated water is insufficient to support year-round cultivation.

(iv) Uncompetitive farms

Agricultural productivity differs by location. In the northern part of the WSB, where water supply is relatively favorable, land can be used for rice double cropping, while double cropping paddy rates in the southern part of the WSB are low. The yield of rice in areas where water availability is low (e.g., in Prachuap Khirikhan province) suffers from low productivity.

The guidelines of the 7th National Economic and Social Development Plan stated that the area of farms for less marketable crops, such as rice and cassava, is to be reduced. It is noted that rice and cassava are dominantly planted in the northern part of the WSB. Sugar cane is also found in this area. More than 180,000 ha were used for sugar cane fields in the WSB in 1993/94; out of this total, the sugar cane farm area in Kanchanaburi accounted for more than

[1]Although the mangrove forest in Samut Songkhram province was gazetted as forest land in 1958, local residents objected and appealed to provincial agricultural authorities that mangrove forests be withdrawn from the forestry sector, with agricultural use their preference.

115,000 ha. As agroclimatic conditions and the labor force in Kanchanaburi are not competitive compared with northern and northeastern Thailand, there has been some relocation of sugar mills away from Kanchanaburi.

(v) Problem soils

Problem soils with unsuitable chemical and physical properties have been classified into seven types: saline soils, acid sulphate soils, sandy soils, soils with a hardpan, vertisol soils, peat soils, and skeletal soils. Acid soils cause less serious problems in rice cultivation areas that are well irrigated in the wet season. However, water deficiencies in the dry season raise the degree of acidity, which makes cultivation less productive. Soils in some lowland areas near the sea in the WSB are exposed to brackish water and contain a certain degree of salinity; consequently, these soils have some limitations as to the selection of cropping types.

Soil erosion refers to the detachment and transportation of soil by erosion agents. Wind, gravity, water, and waves are natural erosion agents. Soil erosion problems are significant in the mountainous areas of the WSB.

2.4.2 Issues

In land use planning, the most suitable land use(s) should be proposed and allocated based on a demand forecast and analysis of present and future land potential. Emphasis should be put on the following major issues taking account of the current land use situation in the WSB.

(i) Harmonized development with natural resource conservation

Conservation may be defined as the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining the potential to meet the needs and aspirations of future generations. Conflicts between development interests and conservation will undoubtedly increase in the future as land areas are more intensively used and the number of competing demands for any given area increases. Conservation is not a luxury but a vital activity to maintain long-term economic stability and quality of life.

Most conflicts involving conservation are not merely political debates but involve real issues that must be discussed publicly to ensure that the costs are minimized and the benefits maximized. Major issues in this relation include: (i) utilization of the watershed classification, (ii) utilization of legal zoning for conservation, (iii) utilization of agroforestry

and community forestry, and (iv) cooperation between government agencies, or between the public and the private sector.

(ii) Effective utilization of former shrimp farms

While many studies have reported that there is no way of making concentrated intensive shrimp aquaculture operations sustainable, recent research indicates that closed farming systems may be sustainable. The following directions may be considered for the use of abandoned shrimp farmland: (i) shrimp farming with a closed shrimp farming system; (ii) an aquacultural land use other than shrimp farming; (iii) agricultural land use; (iv) a salt bed for salt production using natural methods; (v) reforestation of mangrove areas where encroached; and (vi) land for urban functions including housing and industry.

Key factors affecting the land use planning of abandoned shrimp farms include economic viability, environmental requirements, and institutional requirements. The abandoned shrimp farms in Samut Songkhram province have a large potential for urban land use as they are located near Ratchaburi, which is the designated growth center of the region and only 65 km from the BMA. Moreover, planned interregional motorways as well as the proposed international linkage between Myanmar and Thailand will enhance the area's land potential and induce a change in land use. Major issues in this respect include: (i) application of advanced mangrove reforestation techniques; (ii) adoption of enhanced aquaculture techniques; (iii) consideration of the urban land use potential of a location; and (iv) utilization of land for the strategic development of the WSB.

(iii) Effective conversion of agricultural land on farms with weak competitiveness

Some crop types traditionally planted by farmers in the WSB have lost their marketability. An agricultural production system restructuring plan approved in 1993 has the objectives of reducing the area planted with paddy, cassava, coffee, and pepper, in order to produce other crops with higher productivity and to promote indigenous agriculture suitable for the region, to maintain the market prices of agricultural products, and to increase the income of farmers. Maize, soy beans, mung beans, cattle, dairy, fruits including mango, pomelo, durian, and mangosteen, oil palm, bamboo, and flowers are alternative crops and farming types recommended. Consistent with this restructuring plan, the conversion of farmland uses with weak marketability to more marketable alternative uses is now a vital issue. The following measures are required in this context: (i) expansion of irrigated area or land consolidation area; (ii) improvement of the transport of agricultural products; and (iii) establishment of agro-processing industry in proposed industrial area(s).

(iv) Expansion of irrigated and land consolidated area

The expansion of irrigated area is an important issue in the water resources sector, but it is also closely related to land use. Except for its water shortages, the WSB is endowed with natural conditions for multi-cropping, and in this sense there seems to be a large latent water demand in the region. Although it does not follow that all farmland in the region should be supplied with sufficient water for multi-cropping, the water supply factor is crucial for promoting agricultural production in the WSB. Low irrigation area rates are observed especially in Kanchanaburi, Prachuap Khirikhan, and Chumphon provinces. Expansion of irrigated/land consolidation areas is a vital issue if the region's agricultural sector is to compete in both domestic and international markets.

(v) Utilization of agroforestry

Since forest cover goals have been attained only by the designation of conservation areas, the concept of agroforestry was introduced in the Thai Forestry Sector Master Plan in 1993. Agroforestry refers to land use systems that combine tree-growing and the growing of agricultural crops, such as the combination of pasture and fodder for livestock. Agroforestry types may be grouped into the following combinations: (i) fruit trees and "multistory" type trees, (ii) tree and cash crops (hedgerow or "multistory" type), and (iii) pasture and shading/fodder tree types. Since the adoption of agroforestry ultimately depends on the decisions of farmers, its attractiveness depends on beneficial returns. Adoption of an appropriate agroforestry plan is essential in the land use plan for the WSB.

(vi) Integration of impacts of current projects or proposals

Infrastructural improvements influence land use to a great extent. Ongoing or planned infrastructural improvement projects in the WSB include the Ta Sae reservoir with a project area of 14,400 ha, a toll highway construction project between Ban Pong and Cha Am, the Pathiu airport improvement project in Chumphon province, and the Bang Saphan industrial area development project. Also worth noting, international linkages have become more important because of the location of the WSB region with respect to the north-south corridor between Yunnan province of the People's Republic of China and Singapore/Indonesia, and the east-west corridor from Vietnam to India via Myanmar and the Andaman Sea. If realized, these ambitious proposals would have substantial impact not only on the location of urban functions but also on agricultural land use as a consequence of the resulting

internationalization of the agricultural market. In addition, the related free trade zone proposals in this study would have significant land use impacts.

Factors that affect future land use include not only physical projects but also legal constraints and potentials. For example, proposals for industrial promotional zoning and conservation forest areas will affect physical dimensions of land use. Therefore, ongoing and planned projects and proposals should be selectively incorporated in the land use planning of the WSB after examining the rationale of the projects or proposals in each sector.