Figure 5-12 PROJECT ACTIVITIES BY MODEL PROJECT AREA AND EXPERT (2)

Project Activities	Model Project Area						Long-Term Expert						
	①	②	③	④	⑤	⑥	A	B	C	D	E	F	G
4. Excution of Field Monitoring													
- Water quality				○	○	○		△	○				
- Irrigation/drainage facilities/functions		○	○	○	○	○		△	△		○		
5. Practice of Data Compilation													
- Filing of field monitoring and daily collected data	○	○	○	○	○	○		△	△	○			
- Past records of intake water, irrigation area, reservoir release, etc	○								△	○			
- Irrigation/drainage system diagrams		○	○	○	○	○		△			○	△	
6. Practice of Software Development													
- Design of data compilation sheet/chart	○	○	○						△	○			
- Review of hydrological patterns	○	○							○	△			
- Review of water use pattern	○	○	○	○	○	○		○	△	△			
- Computer program for data compilation and water allocation planning	○	○	○					△	△	○			
7. Investigation and Research													
- Proper calculation methods of water allocation	○	○	○					○	△	△			
- Countermeasure for illegal diversion	○		○					△				○	
- Required organization for supervision and patrolling of canal and field			○	○	○			△				○	
- Farming practice for planted crop			○	○	○	○		△				○	
- Crop production cost and profitability			○	○	○	○		△				○	
- Cosumptive use of upland crop				○	○			△				○	

Note ① ; Water management center. ② ; Reginal 7 office, Chao Phraya Dam and Five head regulators.
③ ; Reginal 8 office, Koke Kathiem project area. ④ ; Rangsit Tai project.
⑤ ; Phasi Charoen project. ⑥ ; Bang Ban project.
A ; Team leader (Water resources planning). B ; Irrigation eng. (Water operation).
C ; Hydraulic eng. (Field monitoring). D ; System eng. (Data management). E ; Design eng. (Irrigation facility). F ; Agronomist(On-farm management). G ; Coordinator(Training program).
○ ; Main-assignment, △ ; Sub-assignment.
Short-term experts are also required in accordance with each activity, if necessary.

Figure 5-12 PROJECT ACTIVITIES BY MODEL PROJECT AREA AND EXPERT (3)

Project Activities	Model Project Area						Long-term Expert						
	①	②	③	④	⑤	⑥	A	B	C	D	E	F	G
7. Investigation and Research													
- Soil moisture and growing stage			○	○	○			△				○	
- Storage capacity of creeks and effective use of storaged water in creeks					○			○			△	△	
- Amount of water supply to fish pond					○			△				○	
- Measures for water quality management					○			○			△	△	
- Measures for flood protection						○		△	△		○	△	
8. Preparation of Guideline/Criteria													
- Making of gate calibration		○							△		○		
- Operation/maintenance of introduced equipment and device	○	○							△	△	○		
- Calculation methods of water allocation	○	○	○					○		△			
- Appraisal methods of field conditions	○		○	○	○			△	△			○	
- Rehabilitation of creeks					○			△	△		○	△	
- Repair/maintenance methods of irrigation facilities		○				○		△			○		
9. Execution of Training/Education													
- Basic concepts of water management	○						○						○
- Framework of management activities	○						○						○
- Operation/maintenance of facilities	○	○								△	○		○
- Water management at basin level	○						○						○
- Water management at main canal level		○	○					○			△		○
- Water management at FTO level		○	○					○			△		○

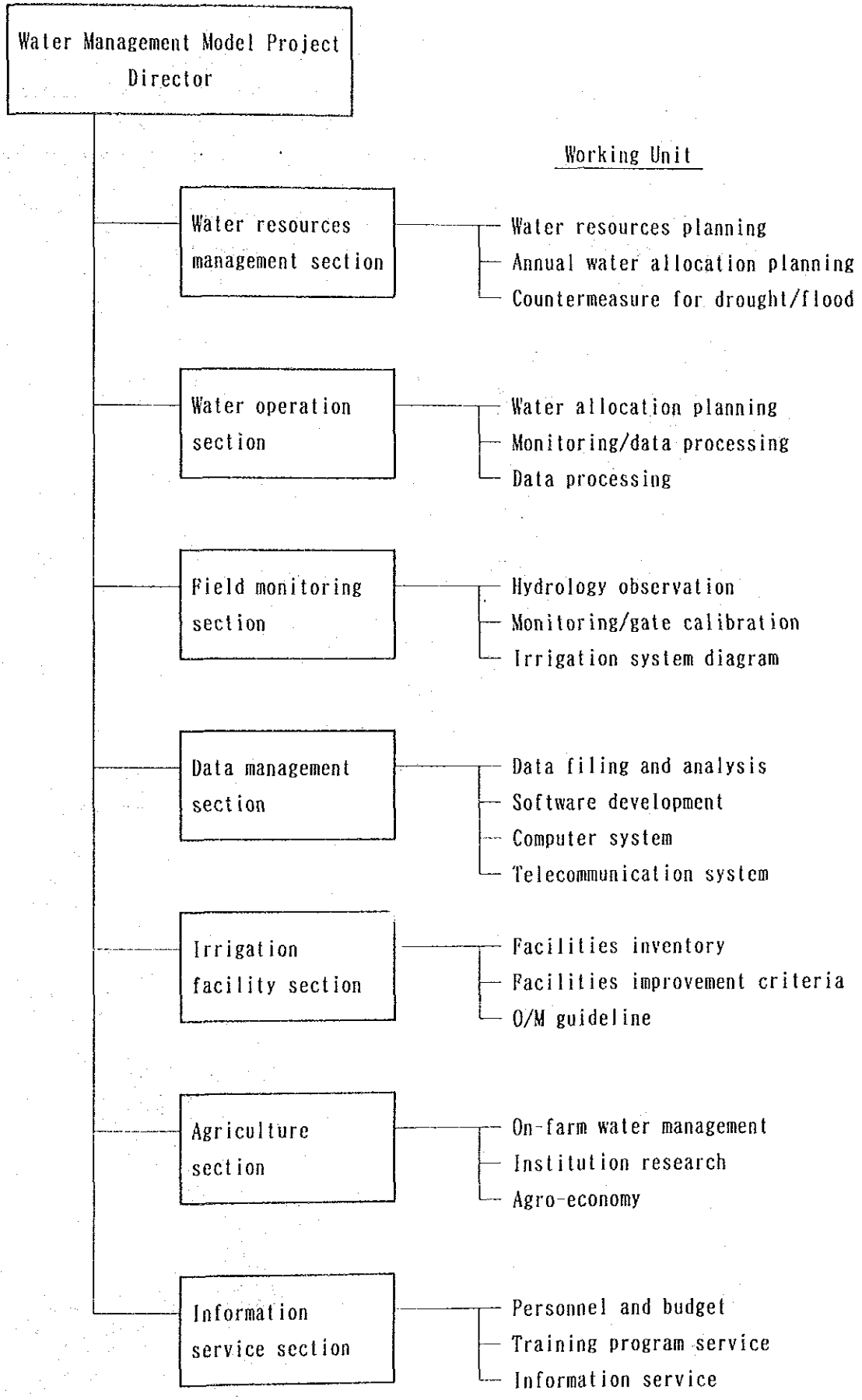
Note ① ; Water management center. ② ; Reginal 7 office, Chao Phraya Dam and Five head regulators.
③ ; Reginal 8 office, Koke Kathiem project area. ④ ; Rangsit Tai project.
⑤ ; Phasi Charoen project. ⑥ ; Bang Ban project.
A ; Team leader (Water resources planning). B ; Irrigation eng. (Water operation).
C ; Hydraulic eng. (Field monitoring). D ; System eng. (Data management). E ; Design eng. (Irrigation facility). F ; Agronomist(On-farm management). G ; Coordinator(Training program).
○ ; Main-assignment, △ ; Sub-assignment.
Short-term experts are also required in accordance with each activity, if necessary.

Figure 5-12 PROJECT ACTIVITIES BY MODEL PROJECT AREA AND EXPERT (4)

Project Activities	Model Project Area						Long-term Expert						
	①	②	③	④	⑤	⑥	A	B	C	D	E	F	G
9. Execution of Training/Education													
- Water management at on-farm level		○	○	○	○	○		△			△	○	○
- Computer system and programming	○	○	○							○			○
- Crop diversification and water use	○			○				△				○	○
- Appraisal methods of field conditions			○	○	○	○		△				○	○
- Farming practice and water management				○	○			△			△	○	○
- Importance and meaning of unanimous water use		○	○				△					○	○
- Data compilation by computer system	○	○	○						△	○			○
- Repair and maintenance of irrigation and on-farm facilities			○	○				△			○		○
10. Public Information Services													
- Water use position in the basin	○						○						○
- Water use position in the region area	○	○	○				○						○
- Demonstration and dissemination to concerned agencies	○						○						○
- Demonstration to water user's groups	○	○	○	○	○	○	○	△				△	○
- Demonstration and dissemination of management activities	○	○	○	○	○	○	○	△	△	△	△	△	○

Note ① ; Water management center. ② ; Reginal 7 office, Chao Phraya Dam and Five head regulators.
③ ; Reginal 8 office, Koke Kathiem project area. ④ ; Rangsit Tai project.
⑤ ; Phasi Charoen project. ⑥ ; Bang Ban project.
A ; Team leader (Water resources planning). B ; Irrigation eng. (Water operation).
C ; Hydraulic eng. (Field monitoring). D ; System eng. (Data management). E ; Design eng. (Irrigation facility). F ; Agronomist(On-farm management). G ; Coordinator(Training program).
○ ; Main-assignment, △ ; Sub-assignment.
Short-term experts are also required in accordance with each activity, if necessary.

Figure 5-13 ORGANIZATION CHART OF MODEL PROJECT



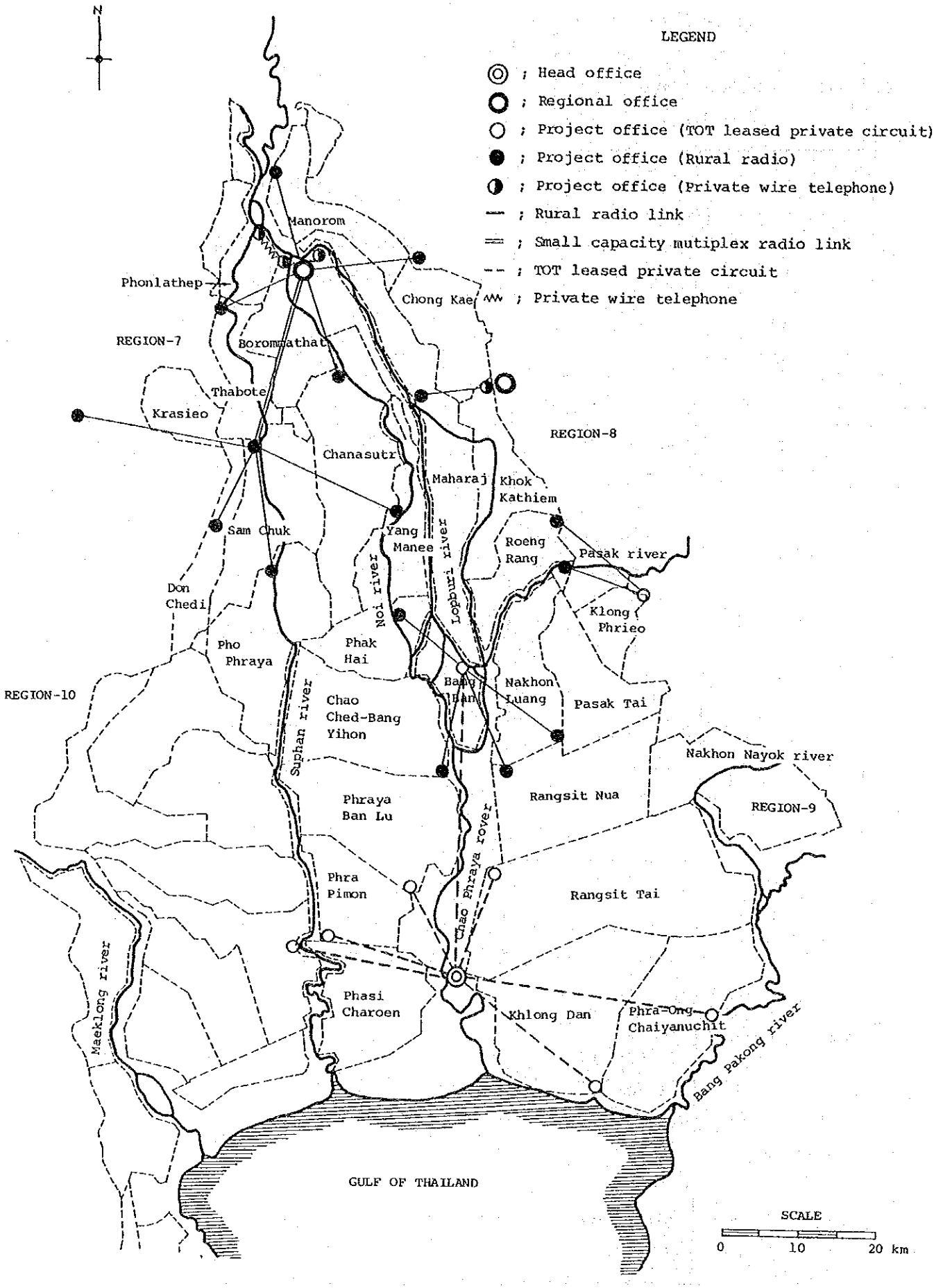


Figure 5-14 IMPROVEMENT PLAN OF LOCAL CIRCUIT (LEVEL -2)

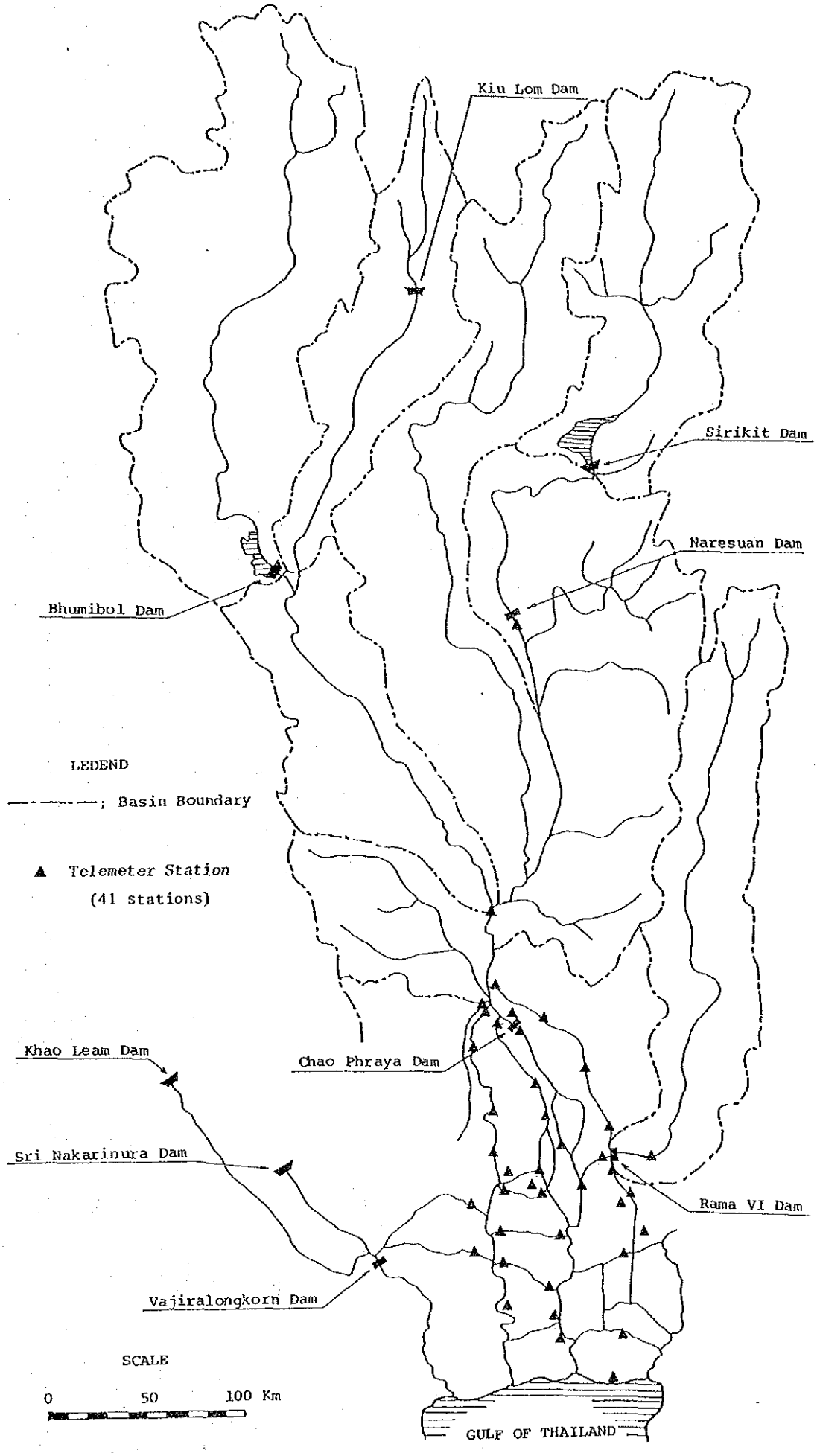
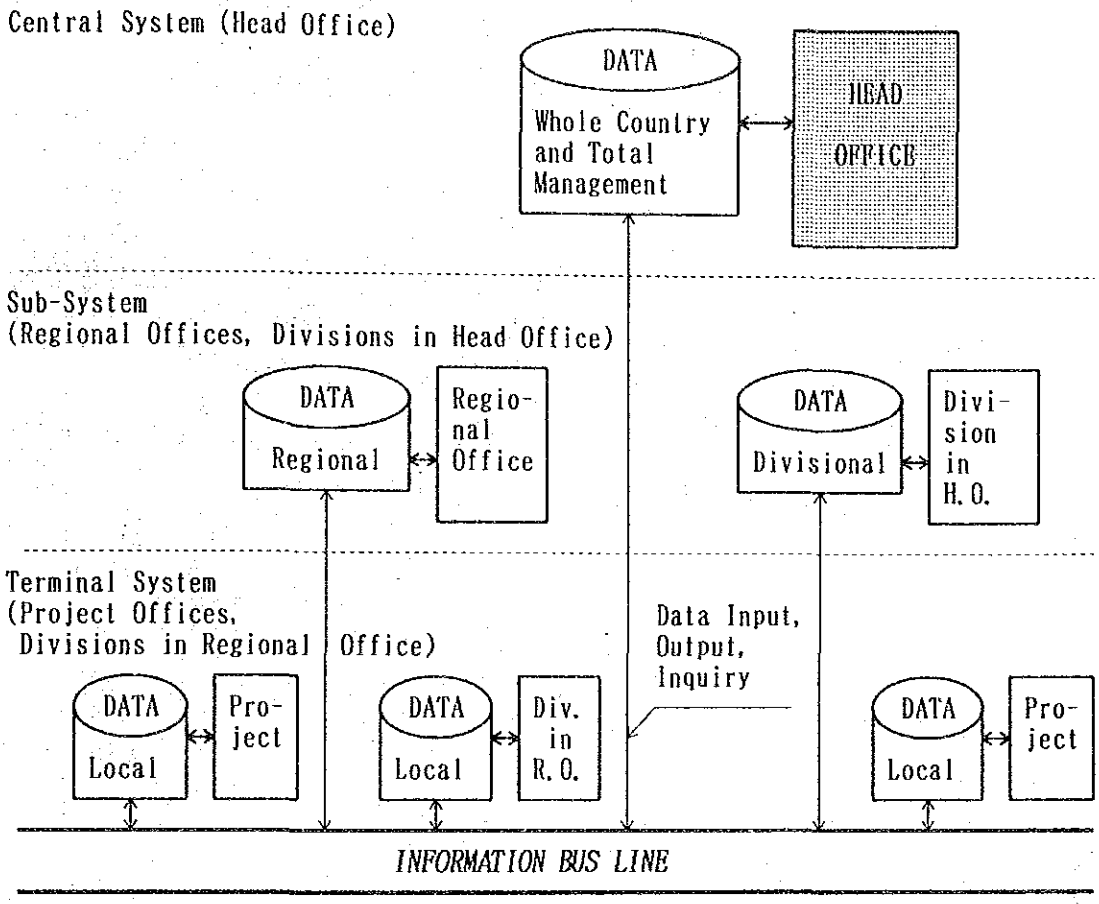


Figure 5-15 WATER LEVEL OBSERVATION STATION WITH TELEMETER (LEVEL-3)

Year	1st	2nd	3rd	4nd	5th
Work Items					
1. Preparation Stage					
Preparation					
Detailed design					
Pre-construction					
2. Construction Stage					
Procurement of equipment					
Installation work					
- Civil work					
- Installation					
Adjustment, Test					
3. Engineering Services					
Detailed design					
Supervision					

Figure 5-16 IMPLEMENTATION SCHEDULE OF MONITORING/COMMUNICATION SYSTEM IMPROVEMENT PROJECT



* Each office may have sub-systems with Divisional/Sectional data, as far as the sub-systems follow this concept.

Figure 5-17 IMAGE OF DATA STORAGE AND MANAGEMENT

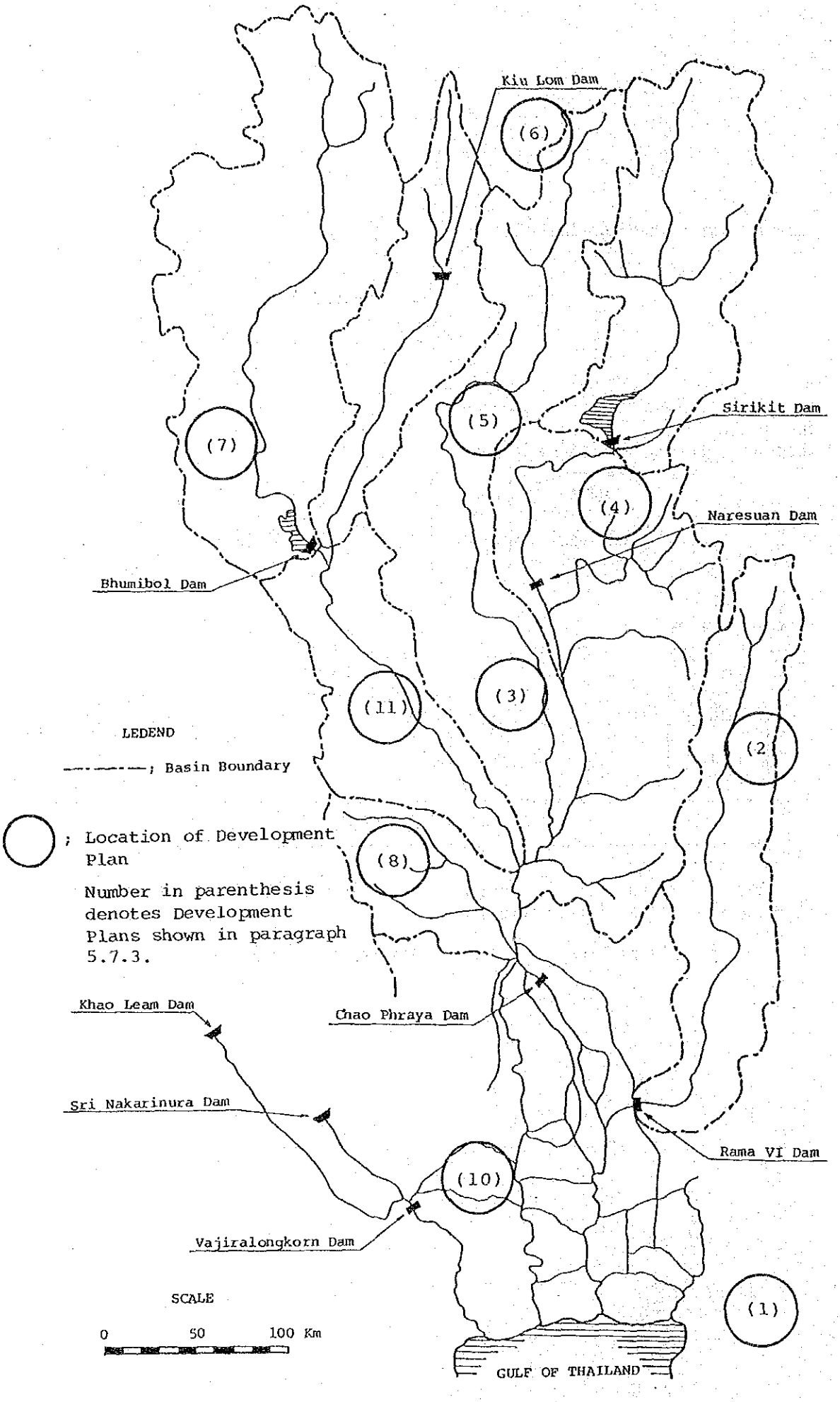


Figure 5-18 LOCATION MAP OF COMPREHENSIVE RIVER BASIN DEVELOPMENT PLANS

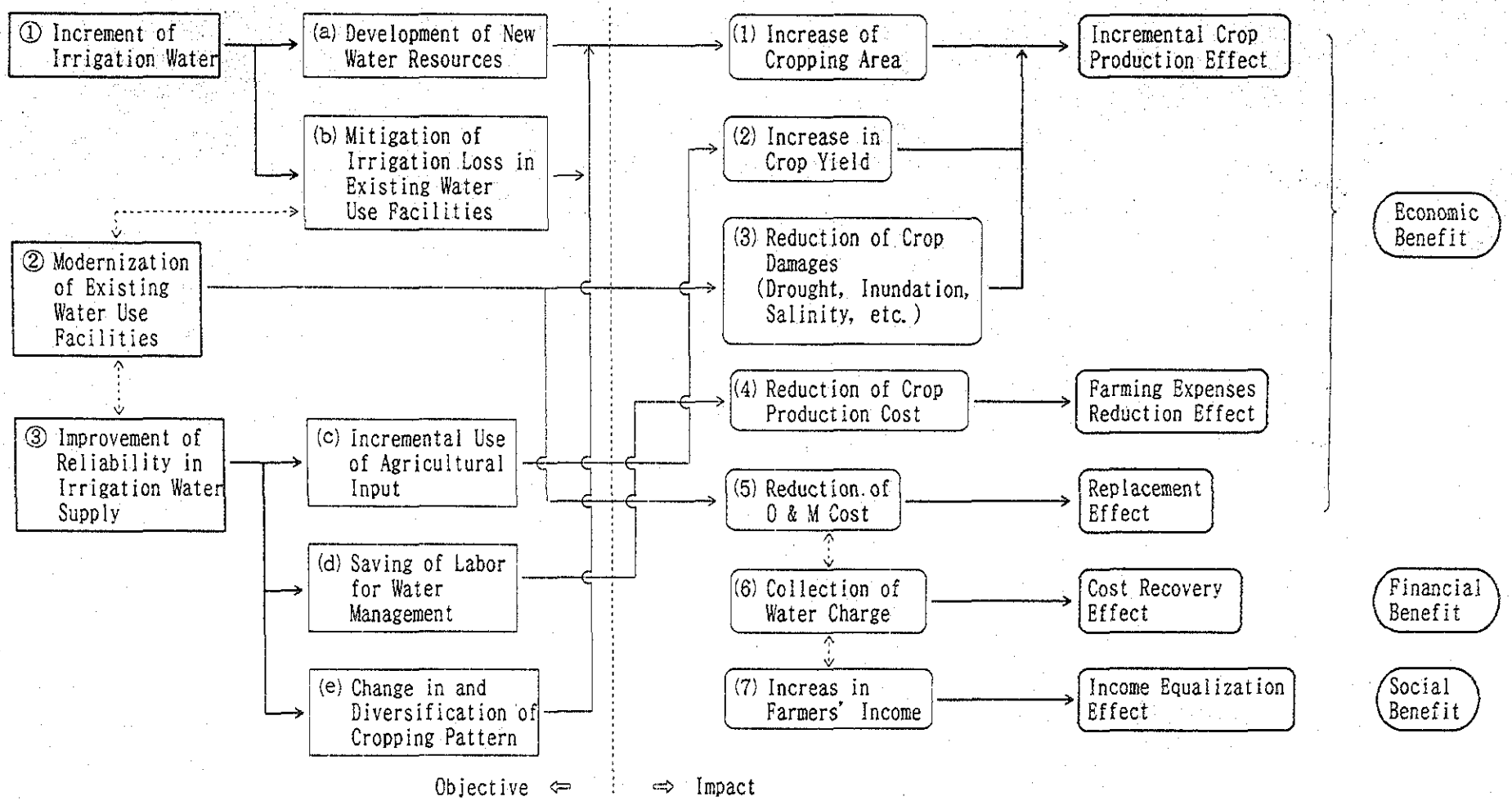


Figure 5-19 RELATION BETWEEN OBJECTIVE AND IMPACT OF WATER MANAGEMENT SYSTEM IMPROVEMENT

CHAPTER 6

PRELIMINARY PLAN FORMULATION
FOR
REGIONAL AGRICULTURE DEVELOPMENT

CHAPTER 6 PRELIMINARY PLAN FORMULATION FOR REGIONAL AGRICULTURE DEVELOPMENT

6.1 Future Image of Basin Agriculture

As described in the previous chapters, the agricultural sector in the Chao Phraya River Basin has been playing an important role in the national economy of Thailand. However, not only agricultural development in the entire basin but also the recent rapid development of the industrial sector in the area adjacent to Bangkok Metropolis is about to bring several problems physically as well as socio-economically, such as land use, water use, and overpopulation in Bangkok Metropolitan area (Refer to Figure 6-1).

It is no doubt that the basin will continuously play its importance, and it is prerequisite to implement an agricultural and rural development under a slogan as "Establishment of Physically Enriched and Active Rural Community", paying more attention to the followings;

(1) Increase in cropping intensity and land productivity

- Efficient utilization of irrigation water
- Introduction of high yielding variety of crops
- Introduction of diversified crops
- Establishment of on-farm water management organization

(2) Increase of farmer income and creation of new employment opportunity

- Establishment of unified production zone for high profitable crops and securing their market
- Marketing out in shape of not raw but processed material
- Introduction of agro-industry and activation of agri-business

(3) Introduction of higher technology in farming practices and reduction of production cost

- Provision of farming infrastructure and mechanization of farming
- Efficient use of post-harvest facilities

(4) Establishment of attractive rural community and prevention of outmigration

- Environmental conservation including forest, water resources and ecology system
- Provision of rural infrastructure
- Establishment of farmers' solidarity through water use and crop cultivation

The above items are interrelated each other, and the final goal of agricultural development is to establish rural communities which are independent from the governmental financial support, within the frame of the water management system in the Chao Phraya River Basin.

6.2 Land Use Planning

On the basis of "General Potential Land Use Map" published by DLD (Department of Land Development), the Study area divided into three, namely (1) land suitable for upland crops with good drainability (19.6%), (2) land suitable for paddy (23.5%), and (3) land not suitable for any crops (56.9%). The land suitable for upland crops extends terraces, especially in Region 3 having two million hectares. The land suitable for paddy develops in Region 3, 7, 8 and 9, in which lowlying land with cleyey loamy soil extends widely, and these four Regions occupy about 85% of the paddy land in the Study Area.

When examining possibility of crop diversification with comparison between the present land use pattern and the result of study on land potentiality as explained above, those Changwats of Lampang, Lamphun in the Chao Phraya upper basin and Chiang Rai, have potential to increase upland than at present. Similarly, upland can be expanded in Changwats of Tak, Kamphaeng Phet, Phichit, Sukhothai, Uttaradit, Nakhon Sawan in the middle basin, and Uthai Thani, Chainat, Suphan Buri, Sing Buri and Ang Thong in the lower basin.

In Changwats of Ayutthaya and Pathum Thani where an acidic soil is distributed widely, the land suitable for upland crops is hardly available, except introducing the raised bed farming method practised in Rangsit area and the suburbs of Bangkok Metropolis, which requires a quite big amount of investment as well as enough amount of irrigation water during dry season.

In addition, there exist several problems on the land use planning as stated in para 4.7.1. Under such situation, the district division (zoning) is prerequisite to implement efficient water management for the entire basin. Especially, it is necessary to urgently commence the required preparatory arrangement of basic data for the zoning in the Chao Phraya Delta which includes Bangkok Metropolitan area, playing important role economically and socially.

6.3 Crop Diversification and Cropping Pattern

6.3.1 Crop Diversification and Farmer

According to the forecast by FAO, paddy supply in the international market will be enough to meet demand of import and paddy price will be continuously kept low level, resulting in increasing of stock. Under the situation, Thailand's agriculture is pressed to change to diversified agriculture from traditional paddy farming. Introduction of crop diversification is encouraged in the 6th NESDP to increase farm income. Thus, the biggest problem facing

by Thailand's agriculture is to develop a diversified agriculture while maintaining paddy production and export to some extent to meet domestic demand and to get a foregin exchange.

However, it is not easy for those farmers who depend on traditional paddy cultivation to immediately diversify their farming style through introduction of cash/horticultural crops, and such restricting factors as soil and water against the crop diversification should be considered. Furthermore, domestic balance of supply and demand for vegetables is almost being kept, expansion of their production would cause decrease in the farm gate prices, without considering to exploit a foreign market.

As a consequence, for promotion of the crop diversification, careful attention should be placed on firstly selecting suitable crops for natural conditions such as soil, climate, etc., secondly exploiting a foreign market and establishing marketing channel and system to the said market, thirdly strengthening small farmers by giving extension services and financial support.

6.3.2 Crop Selection

Crops presently grown in the entire basin are classified in accordance with RID Region, as summarized below;

The above crop selection and land use are being practised by reflecting the local conditions such as topography, soil, irrigation water availability, etc., in the respective Region.

Therefore, future crop selection would be principally made on the basis of the present ones, taking into account possibilities to expand promising crops within the land use potential in the respective Region.

6.3.3 Cropping Pattern

In this moment, several cropping patterns are considered prospective, taking into consideration land use potentials, farmer's familiarity with crop cultivation, production target set forth in the extension program under the 6th NESDP and so on, of which typical patterns by Region are summarized in the following Table 6-1.

6.4 Post Harvest and Marketing System

In the jurisdictions of RID Regional Offices No. 1, 2, 3, 7, 8, 9 and 10, there exist about 3,500 rice mills of various sizes with total capacity of 95,000 tons of paddy/rice warehouses with capacity of 76,000 tons. In Changwat Ayutthaya, there exist 55 large rice mills (daily capacity of over 20 tons) with total capacity of 42,720 tons, which occupy nearly a half of the aggregated capacity in the said jurisdictions. This is because the Changwat is located in the central part of the Chao Phraya Delta and Chao Phraya River flows there through to play an important role for inland water transportation.

According to the surveyed in 1983, about 80% of paddy marketing was handled by local rice millers and traders, while public agencies such as Public Warehouse Organization (PWO) and Marketing Organization for Farmer (MOF) occupied only 7% and 13%, respectively. Regarding marketing of milled rice, rice brokers in Bangkok handled nearly 90% of that, and the said public agencies did 7% and 4%, respectively. While 76% of marketed milled rice was for domestic markets and the rest for export.

Since the sector of post harvest and marketing for an agricultural product is considered significant, which bridges agricultural production side with farmers' income, the market information system is considered an important mechanism for fully

and systematically integrating production and marketing in line with the guidelines laid down in the "Programme Development of the Production System, Marketing and Employment" of the 6th NESDP.

6.5 On-Farm Level Water Management and Farmer's Organization

6.5.1 Promotion and Strengthening of Organization

Generally, a water use organization is to be, as its primary objective, established to evenly and properly allocate irrigation water as well as to operate and maintain irrigation facilities in good condition, in a commanded area. For this objective, water use organizations have been established in the irrigated area of the basin. Although those organizations represented by the People's Irrigation in Chiang Mai valley are well operated and managed, those in the large scale irrigation project of the middle and lower basin might not perform its designated function as expected.

There are several problems presently prevailing in the water use organization, which are summarized in the following two points.

- Promotion of systematization, and
- Strengthening of existing organizations.

Counterplans for the above subject are considered as follows;

- to unify variety and planting time within commanded area by each farm turnout.
- to set up special division for promoting establishing organization in RID's Regional Offices and Project Offices.
- the staff belonging to this division will meet and discuss with farmers, village headmen, devoted farmers in daily basis to enlighten them.

- to distribute patrol cars loaded training equipments in RID's Regional Offices.

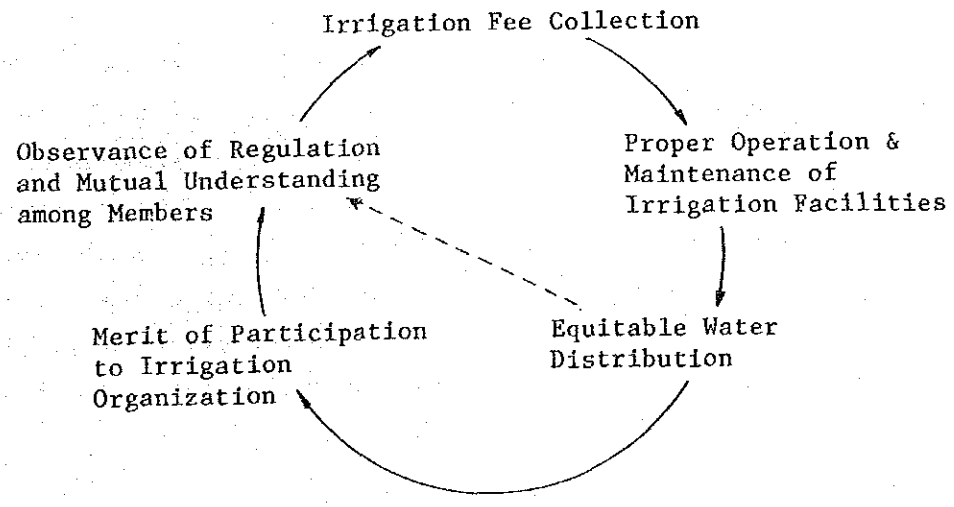
- to conduct training repeatedly to strengthen existing irrigation organizations in observing regulations, better fellowship among members, managing of organization, and leadership etc.

- to instruct organizations to hold member's meeting regularly and to grasp facing problems in organizations by attending RID's staffs

- to educate and train zonemen concerning with relation between crop cultivation and irrigation water requirement, and to make them to recognize importance of water control and management in accordance with crop growing stages.

6.5.2 Collection of Water Charge

For proper management of irrigation organization, irrigation fee which is used for management cost have to be collected fairly from members. If irrigation facilities would be operated and managed properly by using collected irrigation fee as a revolving fund and equitable water distribution which is the fundamental purpose of establishing irrigation organization, members would understand merits of participation, and organization itself would be managed in good condition. In spite that irrigation fee is collected completely from members, equitable irrigation distribution would not be realized without observance of regulation by members and mutual understanding among members. Therefore, following circulation system could be pointed out.



To realize the circulation system, education and training for members are indispensable in order to instill about necessity for irrigation fee collection and usefulness of it into the members.

6.6 Institutional Supporting System

6.6.1 Agricultural Extension

Agricultural extension services have to coincide with the policies aiming at crop diversification which is the major objective in Thailand's agriculture at present. As for paddy, increase in yield should be promoted by introducing farm management techniques aiming at reducing production cost, producing certified seeds, extending techniques on water management, fertilization and pest protection according to physiology of paddy. Meanwhile, strong extension services for upland crop are necessary for farmers who have depended upon paddy farming traditionally. For the purposes, (1) increase in number of extension staffs, (2) training on upland crop farming for the extension staffs, (3) establishment of demonstration farms, (4) production and distribution of the certified seeds, (5) establishment of experimental farms for experimenting crops suitable for each areas, (6) distribution of patrol cars loaded with training equipment, (7) extension and development of processing techniques of agricultural products, will be necessary.

6.6.2 Agricultural Credit

Presently institutional farm crediting is undertaken by the Bank for Agriculture and Agricultural Cooperatives (BAAC). Major activities of BAAC are financing to farmers and agricultural cooperatives in lower interest by using original fund introduced from the government and Central Bank. Finances for agricultural materials (fertilizers, machineries, seeds etc.) and for bargaining of agricultural products (paddy, maize, cassava etc.) are provided for farmers and additionally, the paddy pledging scheme is also dealt with a special business of BAAC.

6.7 Crop Diversification Promotion Center Plan

Due to stagnation in world market price of primary agricultural commodities, especially rice, not only profitability of paddy cropping at farmers' level has been deteriorated, but also Thai export earnings by the primary agricultural commodities has been decreased, resulted in wider deficit in her foreign trade. On the other hand, dry season paddy cropping acreage has been progressively increasing in parallel with promotion of constructing irrigation facilities including storage dams in the Chao Phraya River by which available water resources in the basin have become quite tight and marginal under the existing condition.

Such goods and services as irrigation water, agricultural commodities, money, information and so on, have common characteristics to cope with relation between supply and demand for the respective goods and services by continuous changes of their phases from one to another (See Figure 6-2). Since market prices for crops are depending upon the relation between supply and demand, and crop production has seasonality, it is one of key factor to manage flow/stock of crop for the sake of getting higher return. Water is also storable as far as proper facilities are provided. In the Chao Phraya River Basin, there are two big storage dams, Bhumibol and Sirikit. Through proper operation of water release from the dams, it is possible to control crop production for both wet and dry seasons over a couple of years.

Proper water management system should be finally established on the basis of an economic principle to achieve maximize profitability at farm level as well as at national level. In this connection, it is necessary to establish an institution which could suggest optimal cropping patterns for the entire basin, and guide and advise farmers and those concerned through appropriate and timely monitoring and management on trend of both domestic and international markets for agricultural commodities and the relevant information.

On the other hand, various constraints against the promotion of crop diversification can be summarized in the following three points, namely, (a) most of all farmers have not sufficient know-how about farming practices of diversified crops including irrigation method, (2) no marketing channel and system has not been available, (3) the existing irrigation facilities could hardly cope with sophisticated irrigation method to be required for diversified crops. A systematic approach to solve the said constraints has been undertaken within the Thai governmental agencies concerned.

6.7.2 Objectives

By introducing diversified crops which demand less irrigation water as well as providing more cash income to farmers than paddy, it is planned to increase overall cropping intensity during dry season, resulted in promising more efficient utilization of seasonal under/unemployment. as well as creating more employment opportunity through expansion of agri-business and agro-industry especially in rural areas.

By selecting promising crops both for import substitution such as oilseed crops, and export oriented such as fruits, flowers, fishery products, etc., it is duly expected to improve the prevailing deficit in trade balance.

6.7.3 Function

To realize the said primary objective of the crop diversification, the proposed Crop Diversification Promotion Center (Refer to Figure 6-3) will have the following functions;

Diversified Crop Cultivation

- To select suitable crop/plant/fish
- To research and experiment proper irrigation method including upland irrigation
- To provide appropriate education and training to farmers

Marketing Information

- To collect and monitor necessary information on market
- To arrange and compile the collected data and information
- To analyse and forecast demand for diversified crops
- To provide information services to various target groups

Planning

- To prepare proper zoning for targeted areas
- To coordinate the entire function of the center
- To prepare political directives/recommendation to targeted agencies

6.7.4 Preliminary Cost Estimate and Benefit

The required cost for establishment of the proposed crop diversification promotion center is composed of a study/design, facilities including building, equipments and supervision for construction. The total cost is roughly estimated at about 580 million baht including 27 million baht for the study/design component. Out of 580 million baht, 520 million baht is foreign currency portion.

Through implementation and operation of the center, the following utility or benefit will be directly/indirectly expected;

- To create new job to moderately and highly educated people with incentive;
- To raise efficiency in land and water utilization;
- To contribute to improve Thai trade deficit;
- To stabilize farmgate prices of agricultural products;
- To prevent over production; and
- To strengthen competitiveness in the world market.

Table 6-1 TYPICAL CROPPING ROTATION

Upper Basin - Region 1, 2

	Dry Season	Wet Season	Remarks
(1)	Soybean	Paddy	Most popular pattern
(2)	Groundnut	Paddy	
(3)	Tabacco	Paddy	
(4)	Garlic	Paddy	
(5)	Vegetable	Vegetable	Irrigated
(6)	Fruit	Fruit	
(7)	-	Wheat	Rainfed
(8)	-	Sesame - Mungbean	"
(9)	-	Soybean - Sunflower	"

Middle Basin - Region 3

	Dry Season	Wet Season	Remarks
(1)	Paddy	Paddy	Irrigated
(2)	Soybean	Paddy	
(3)	Maize	Maize	Rainfed
(4)	Mungbean	Paddy	
(5)	-	Soybean - Mungbean	Rainfed
(6)	-	Soybean - Soybean	"
(7)	-	Maize - Soybean	"
(8)	Sugarcane	Sugarcane	

Lower Basin - Region 7, 8, 9

	Dry Season	Wet Season	Remarks
(1)	Paddy	Paddy	
(2)	Maize	Maize	Rainfed
(3)	Sorghum	Sorghum	"
(4)	Sugarcane	Sugarcone	"
(5)	Fruit	Fruit	
(6)	Vegetable	Vegetable	Irrigated, Bangkok Suburbs

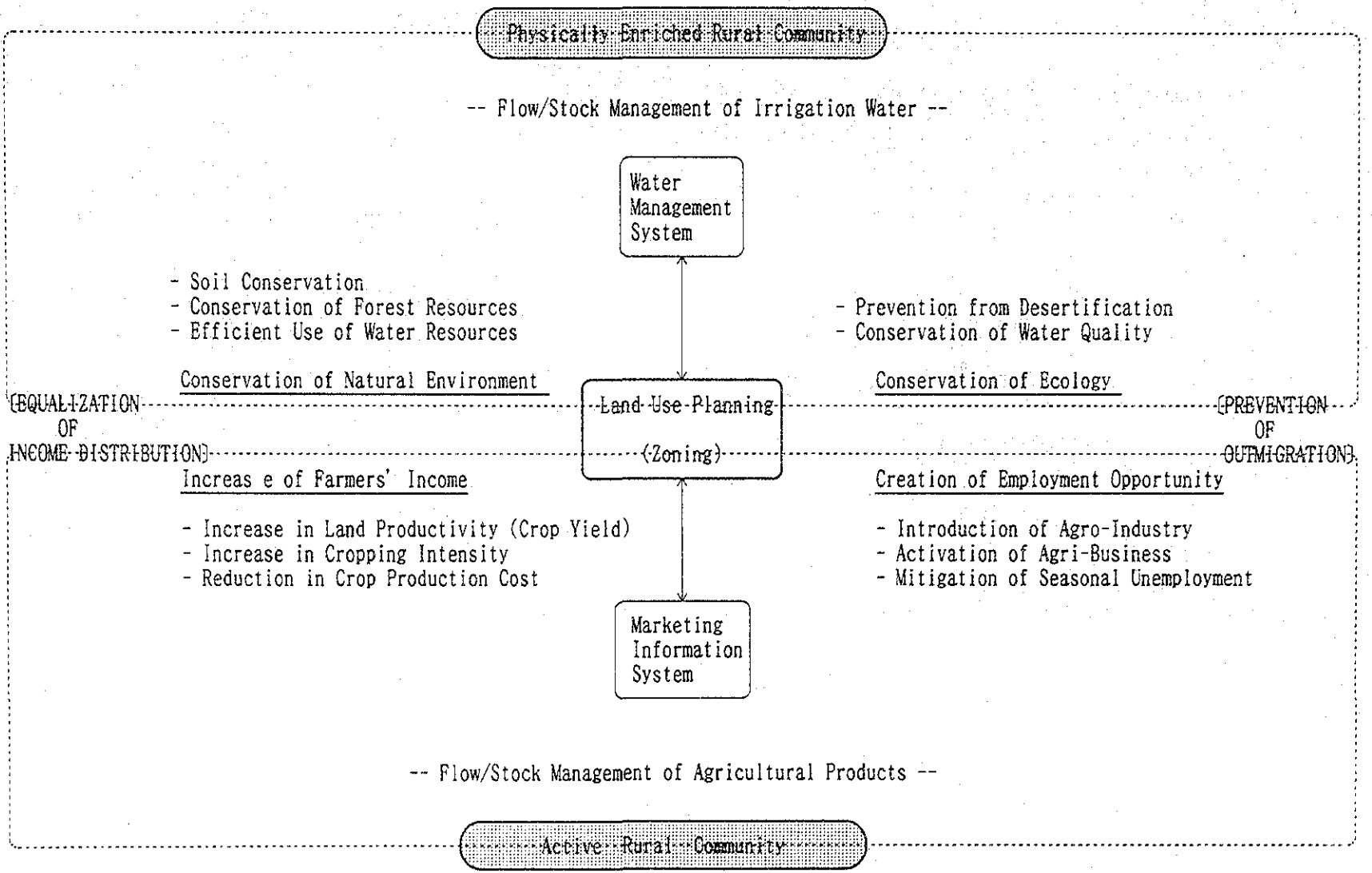


Figure 6-1 FUTURE IMAGE OF BASIN AGRICULTURE IN CAHO PHRAYA RIVER
(Perspective to 21st Century)

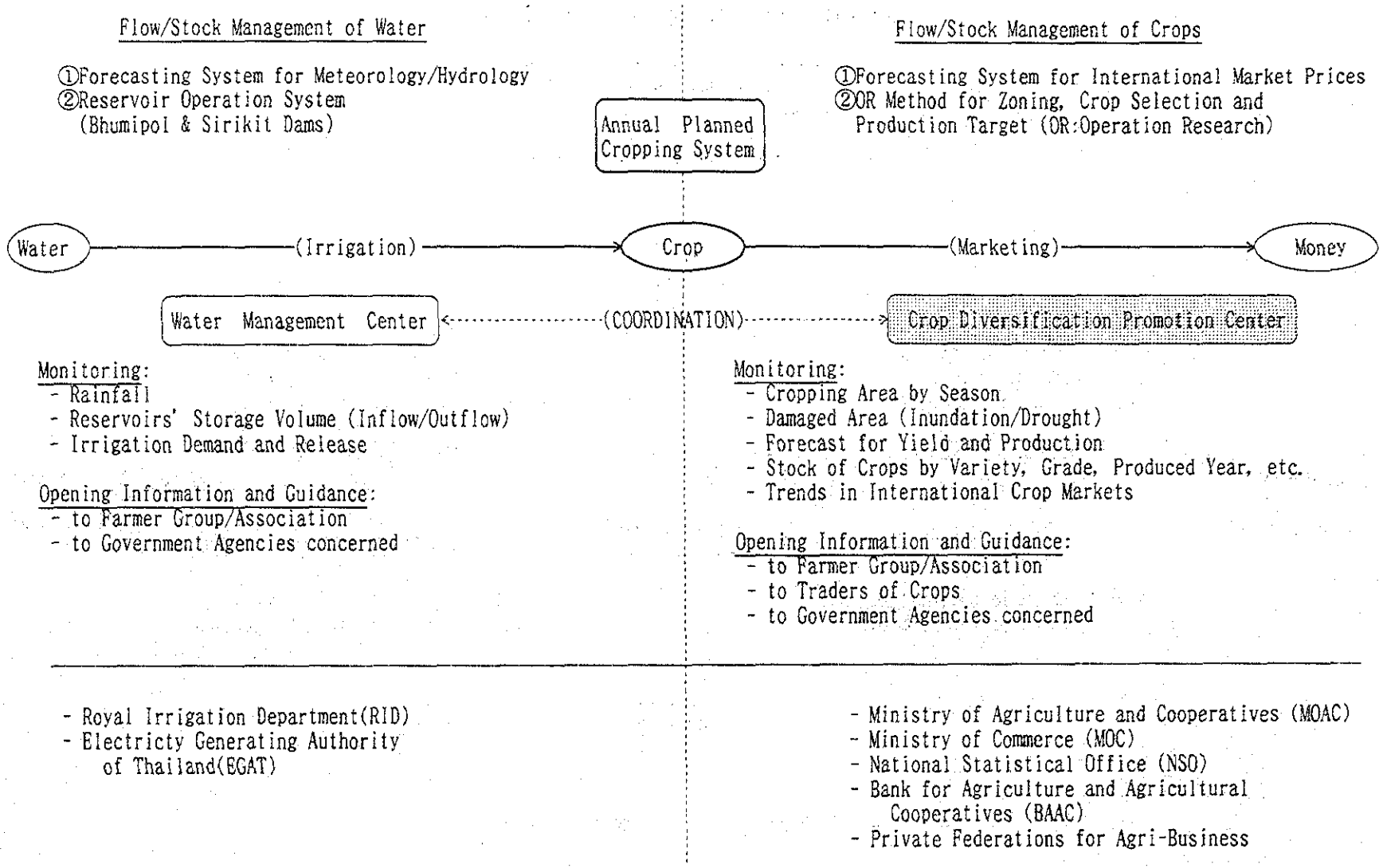


Figure 6-2 FLOW/STOCK MANAGEMENT OF CROPS/IRRIGATION WATER

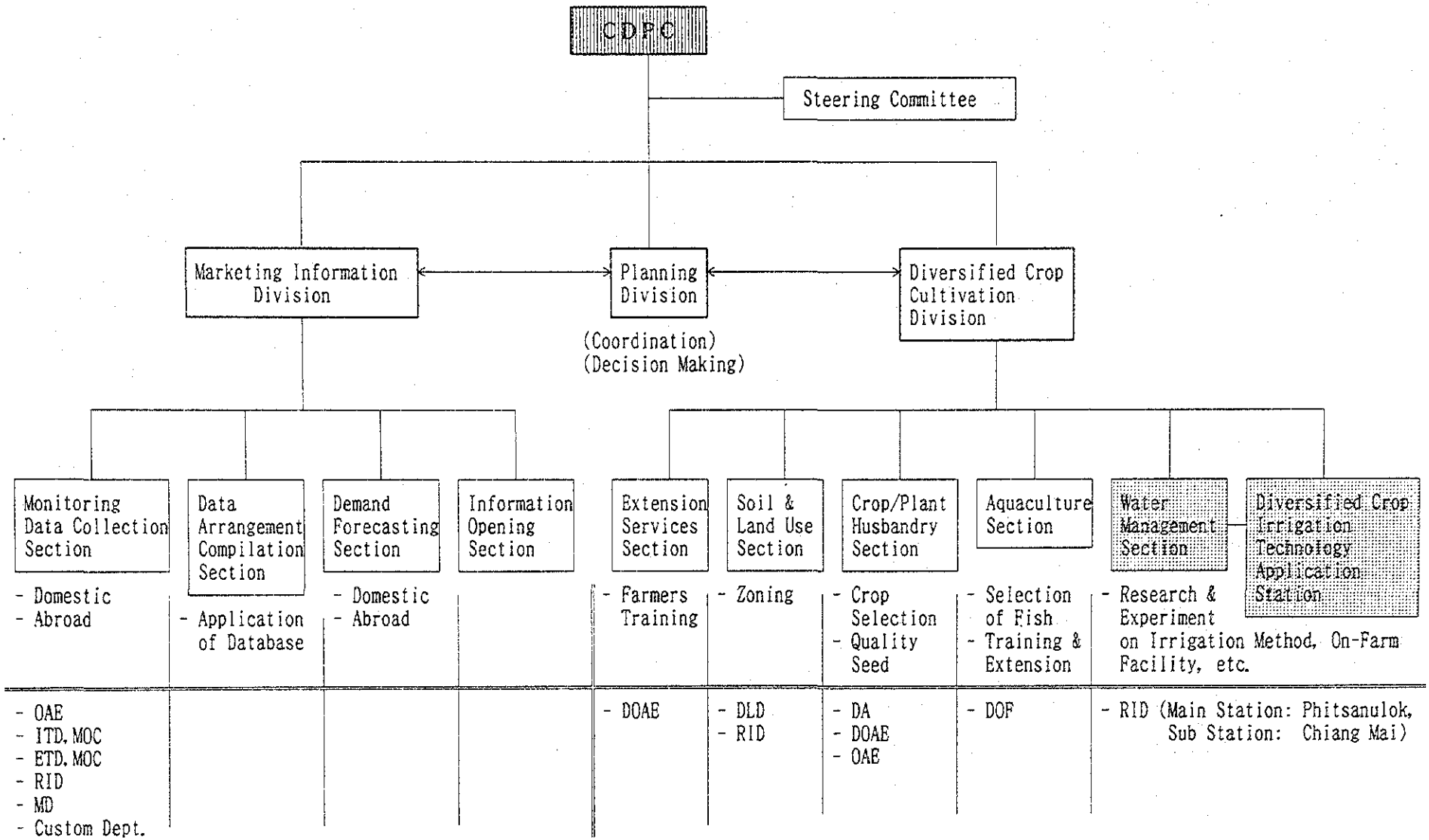


Figure 6-3 ORGANIZATION CHART OF CROP DIVERSIFICATION PROMOTION CENTER

MANNING SCHEDULE

Assignment	Name	1987												1988												1989					
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
Leader/General Management	Shigekatsu WATANABE																														
Water Management Planning	Koki MITSUNOBU																														
Hydraulic Model Planning	Masahiro YAMADA																														
Hydraulic Model Analysis	Hiroshi OHKUBO																														
Monitoring/Data Processing	Takanori TAKATSUKA																														
System Design (I)	Masaru MIZUKAMI																														
System Design (II)	Shinobu MAEDA																														
Data Communication	Takayoshi NAKABAYASHI																														
Irrigation & Drainage System	Kiyoshi OGAWA																														
Irrigation & Drainage Facilities	Satoshi SHOJI																														
Hydrology/Meteorology	Ryosuke SAKANASHI																														
Economy/Project Evaluation	Yoshitomo MIYANISHI																														
Soil Science/Land Use	Kazuo ABE																														
Agronomy/Social System	Kensuke IRIYA																														
REPORT		△ PO	△ Inc.		△ PR(0)			▲ Int(1)			▲ PR(1)			△ PR(2)	▲ PR(3)					▲ Int(2)			△ PR(4)				▲ DFR				▲ FR
PHASE				Phase(Ⅰ)										Phase(Ⅱ)												Phase(Ⅲ)					

Legend: Field Work in Thailand
Home Work in Japan

PO : Plan of Operation
Inc. : Inception Report
PR : Progress Report
Int. : Interim Report
DFR : Draft Final Report
FR : Final Report