

- 5) Irrigation project offices operates water diversion regulators based on the regional office's water allocation at the main regulators. Beyond that, the project officers can adjust the regulators within their project area.

The daily record of water level of up and down stream of regulators, and weekly past progressive cultivation area need to be submitted to regional office and RID main office as well, in order to do monitoring and advising.

The RID regional office will set up a Adhoe Center and Working Group for Helping the Farmers During Dry Season, in the drought year, in order to provide efficient water allocation and to solve the problem arising during the dry irrigation season. The working group consists of the O&M engineer of the region office as the chairman, and others from the project engineers and whoever in charge of the activities. There are no representative from outside RID and neither from the other government agencies or the farmers.

The adhoe committee at district level was set up in some irrigation projects to solve the water conflict and dispute. It consisted of the representative from the district office as a chairman, the others were policeman, RID staffs, head of village and the representative of the farmers from both sides of conflicts. The committee held the meeting, discussed and set the rule and regulation upon agreements among farmers.

3.2 Proposal for Institutional Improvement

The problems associated with water allocation in the Chao Phraya basin may come from one or the other activities concerned, those are as followings:

- 1) Farmers do not follow the crop plan set by government. The actual production is always higher than the target. Therefore, the shortage of water occurs in some areas.
- 2) The different in water demand coming from various kinds of land use.
- 3) Water pollution from industrial sector, agricultural sector, and from urban area.
- 4) Lack of communication and cooperation among the government agencies concerned such as RID, EGAT, DOAE, MWA, HD and etc. The water supply is not provided at right amount and time as their demands.

- 5) Increase in water utilization in the upper Chao Phraya area from Bumipol and Sirikit Dam to Nakorn Sawan. The higher demand is in both government and private sectors particularly in the area outside irrigation project.

Improvement of the present institutional procedure in water allocation is one of the activities in making efficient utilization of water in this specific area. The institutions concerned with water allocation will be responsible for planning, implementing and monitoring activities relevant to allocating water with right amount, time and place according to demands. From the past experience, it is revealed that the water demands for other uses besides dry season crop do not change much from year to year. So, the irrigation water demand during dry season will be the major constraint. The water allocation activities start from making the crop and water allocation plan. At this stage, it seems like a land use control by government because the working committees set a target or a limit in dry season paddy areas by means of water supply. The location of target area comes from the past year data of irrigation project office. The committee uses this kinds of information with others to estimate water demand and set a plan for the amount of water allocation. Local agencies concerned can use this expected amount of available water at specific areas as a tool to make a crop plan with local institutional agencies concerned and with the farmers (see institutional organization in Fig. 3.2), as some kind of bottom-up approach. The same applies to the implementing and monitoring stages. It needs more participation from local agencies concerned, water user institution, and farmers as well.

One source of available water for Chao Phraya Delta, is also from Meklong and Pasak river basins. It will be more completed in water allocation in the future due to increase in water demand of all activities of different sectors. It is recommended that the subcommittee is set up for each main river basin under the National Water Resource Committee called as "Subcommittee for Chao Phraya (or the other main ones) River Basin Management." The main tasks of this subcommittee is to make strategic water resource development plan, water allocation plan and the other activities to overcome the water shortage and conflicts within its river basin. The organization function and coordination with existing institutions is shown in Fig. 3.1. Chairman of subcommittee should be Inspector General from the office of Prime Minister. The members consists of representative from EGAT, RID, NEA, BMA, MWA, PWA, HD, DI, DIW

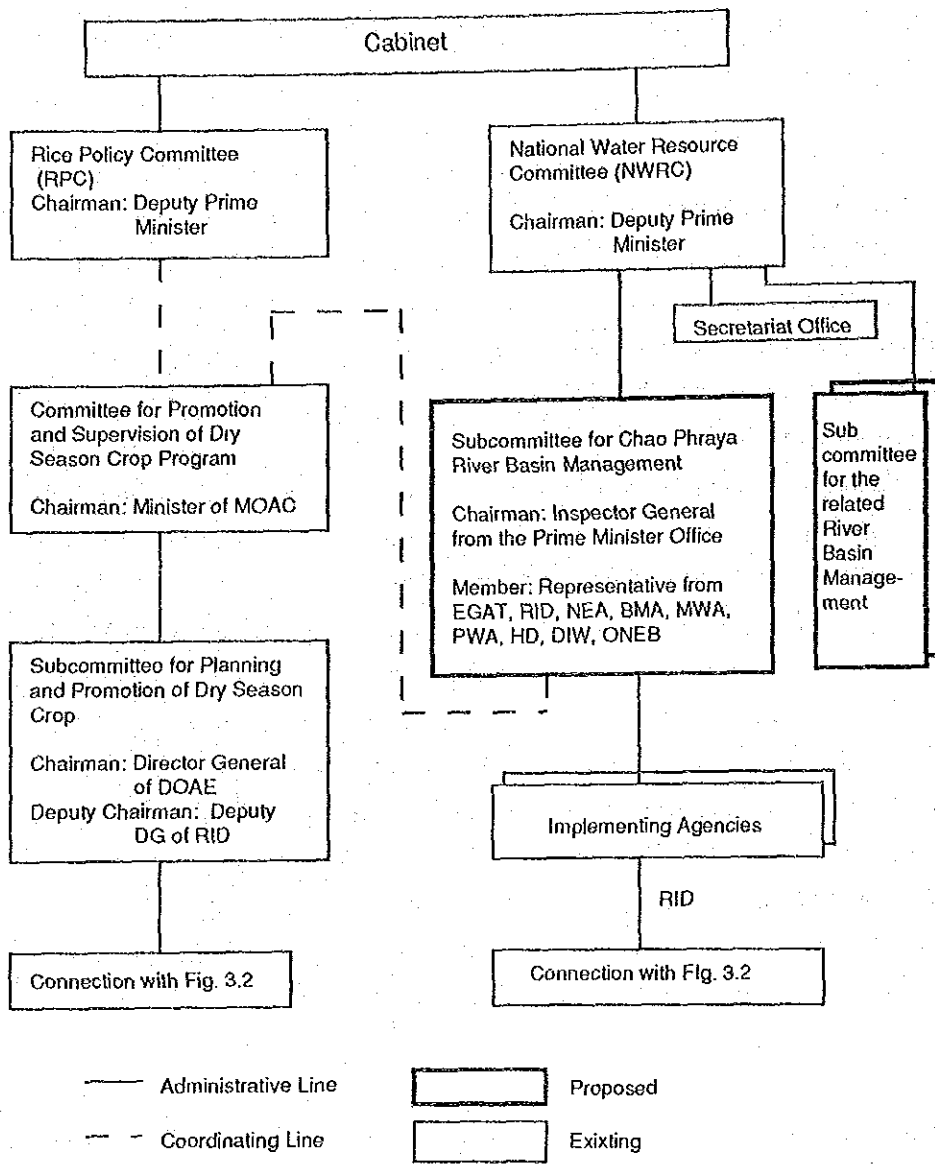


Fig. 3.1 Proposed Institutional Organization at Policy Making Level of Water Allocation for Chao Phraya River Basin

and OBEB. The secretariat office of NWRC must be upgraded and strengthening in order to have capability enough to handle and coordinate among relevant subcommittee concerned.

3.3 Proposal for Farmer's Organization and Local Government Participation

As earlier mentioned, the present water allocation process in the top-down approach. The crop plan was not effectively implemented in the past. Farmers should come to involve in the decision making process of water allocation. For the view point of irrigated agricultural management, there are various activities by many agencies and people. Local institutional organizations should be set up in order to have effective participation in the activity from the farmers, government agency staffs and any interested private sectors. The necessary institutions are nearly established already in the locality. The institutional organization for local participation in water allocation is proposed as shown in Fig. 3.2.

The bottom up approach needs well functioning water user organization otherwise the government agency staffs could not oversee in a large. The process in strengthening the water user organization have been already mentioned in the proposed water user organization. Whenever a farmers' organization is strong the less number of farmers representative may deal with the government agency staff. All the activities relevant to water allocation should be decided by the farmers under the water user cooperative with the supervision and guidance of the Zone Working Team as shown in Fig. 3.2. Furthermore, the crop and water allocation plans can meet the actual needs more properly and implemented on the full understanding of the farmers.

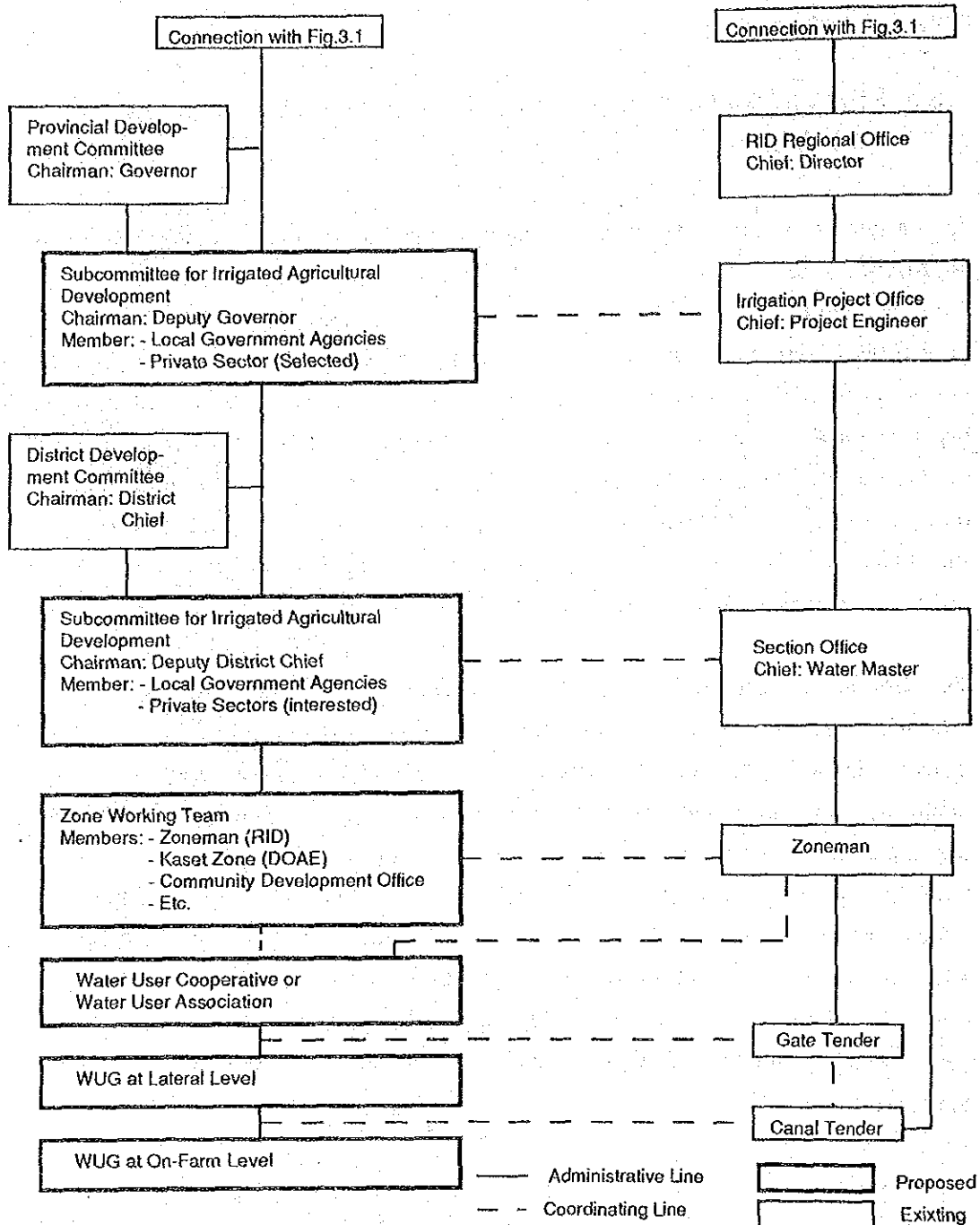


Fig. 3.2 Proposed Institutional Organization for Local Participation in Water Allocation in Chao Phraya Delta

4. LOCAL PARTICIPATION IN WATER MANAGEMENT TO PROMOTE AGRICULTURAL DIVERSIFICATION

At present, water shortage in dry season is crucial in the UCR. It is expected that local participation in water management from all sectors concerned, i.e., officials, farmers, other users, is very necessary. The participation should start from preparing cropping schedule, water allocation planning, operating and monitoring and also including making decision for some adjustment during the irrigation season.

Local participation from people or representative of all agencies concerned and parties of water beneficiaries will be an effective mean to alleviate the water management problem. They can share and compromise the need of water. The amount of water allocation and timing may be agreed upon and set accordingly.

To obtain an achievement on the local participation, it is proposed that the institutional organization should be set up and farmers should manage water by themselves. Institutional organization should be formulated in such a way that planning and implementation can be done efficiently. In addition, to encourage farmers to take part in water management, necessary incentives should be provided.

4.1 Possible Incentives for Farmers to Manage Water by Themselves

In term of water management, the following software and hardware incentives should be considered.

4.1.1 Reliability of Irrigation Water Supply

Farmers should be ensured that the irrigation water they manage is reliable. The term reliable means proper amount of water at the right place and right time. If it is expected at this stage that farmers will be responsible at tertiary level, the right place indicates the gate of tertiary turn-out.

Non-reliable irrigation water will discourage farmers to manage. They can not plan ahead effectively. The conflict may arise too soon. However, in order to make irrigation water reliable, the canals/laterals system and facilities must be in a good condition and RID projects staff must be well qualified. Thus, the system needs to be repaired and rehabilitated while the project staff need training.

4.1.2 Technical Assistance

It is apparent that farmers still lack of technical know-how in the fields related to irrigation agriculture, particularly for new crops to be promoted. When to irrigate and how to irrigate are to be explained and clarified by irrigation extension or agricultural extension or private sector as well. In addition, for the purpose of water allocation and distribution, the technique of rotation and scheduling need to be provided and trained to farmers. Again, government officials who will be responsible must trained as well.

4.1.3 Support for Tertiary Ditch Improvement

Irrigation for field crops or economic crops needs more intensive care than irrigation for rice field. Therefore, a distribution system in the tertiary area need to be sufficient and in good condition. At present, ditches conditions mostly are not favorable to serve the purpose efficiently. Ditches need to be repaired and rehabilitated. The cost may be high and farmers are not able to afford. It is proposed that, at the beginning stage, government should provide budget for supporting these necessities. RID may implement the rehabilitation programme and give support to farmers in term of construction/repair materials for repair and maintenance work. The support will encourage farmers to participate and they are willing to join the program.

4.1.4 Training and Study Tour

Needs of training should be investigated and it is necessary to formulate a training program. As mentioned earlier, farmers need more technical know-how. Therefore training in classroom and on-the-job will be very useful and advantageous.

Study tour might be a necessary tool for convincing and training people. Farmers usually want to talk to farmers. They can exchange ideas and can see and hear a realities by themselves.

Training and study tour can not be made by farmers without a help from the government and private sector. Both sectors should support this program extensively.

4.1.5 Demonstration Plot

The best way to convince farmers is to let them see things by themselves. Successful demonstration plots in the project area are very essential. The major conditions affecting agricultural products in the plots should be the same as those in promoted areas of agricultural diversification. Many farmers feel reluctant to grow new crops if they are not sure about the output. Therefore, they must be encouraged by a good example. If they feel confident in a new crop, participation in water management can be expected.

4.1.6 Award

Award is considered to be one of the best incentives. The contest of water user organization should be held in several level, i. e., project level and regional level. The competition among groups of water users will result in better participation and more effectiveness in water management. Prize to be awarded should be a revolving fund for the winner group. For small scale water resource projects, there is a contest every year started from 1983. The use of revolving fund should follow the regulation set by the Prime Minister Office.

4.1.7 Law Enforcement

Law enforcement should be practiced in the irrigation system. Although it is not a positive incentive to farmers, it will discourage those who disobey and try to take advantage from the others. Meanwhile it is a safeguard or award to those who cooperate and follow the regulation. If no one breaks the law, the good cooperation among farmers may be obtained.

Law enforcement may not be taken so strictly if it caused social problem in the locality. However, it should be practiced in such a way that farmers are afraid to break the law. For instance, if they place a fish net in the lateral they must be warned to take out because it will retard the flow and may cause damage of the embankment. If they do not obey, the project staff can bring that fish net to keep at the police station. If they want to get back they must be fined and probation.

4.2 Proposed Institutional Set-Up and Mechanism

Local institutional organizations will be responsible for planning, implementing and monitoring activities concerning water management. The organization, therefore, needs to cooperate and coordinate with other organizations in the locality so that informations concerned can be used for activities. It is proposed that the organization should be set up and work under the existing organization for national rural development. Thus, there should be a subcommittee for irrigated agriculture under Provincial Development Committee, and a similar subcommittee under District (Amphoe) Development Committee. The subcommittee will be composed of representatives from local government agencies concerned at each level. The representatives from private sector and farmer leader should be considered as a member of the subcommittee as well.

Institutional organization should be established also at a zone level and an on-farm (tertiary) level. The structure of organization at this level will be based on the area commanded per zone. The zone area is different from administration area i.e., Tambon area. One irrigation zone may cover the areas that belong to 2 or 3 Tambon. To cope with this condition, DOAE has appointed Zone Extension (or Kaset Zone in stead of Kaset Tambon) to be responsible in zone area. Kaset Zone can work along with Zoneman of RID in the zone area.

It is also proposed that during the starting period, a water user group (WUG) should be established at on-farm level. The WUGs will help extension officials in allocating water, maintaining ditches, collecting agricultural information needed, and also distributing information to farmers. In the long run, when WUGs are strong they can join together and set up any kind of non-government organization for each zone. The organization can take care the lateral and all facilities in the zone area by itself. Furthermore, the organization may be strong enough to have a bargain power to do their own agricultural business. Hence the burden of responsibilities carried by RID and government agencies can be reduced. It is suggested that in the future RID should be responsible for technical assistance and supervision work to the organization. The implementation and operation work should be given to non-government organizations.

The structures of Proposed Institutional Organization were prepared for 3 types based on the category of the projects namely:

- Organization for Large and Medium Scale Project, as shown in Fig. 4.1
- Organization for Small Scale Project, as shown in Fig. 4.2
- Organization for PEA Project, as shown in Fig. 4.3

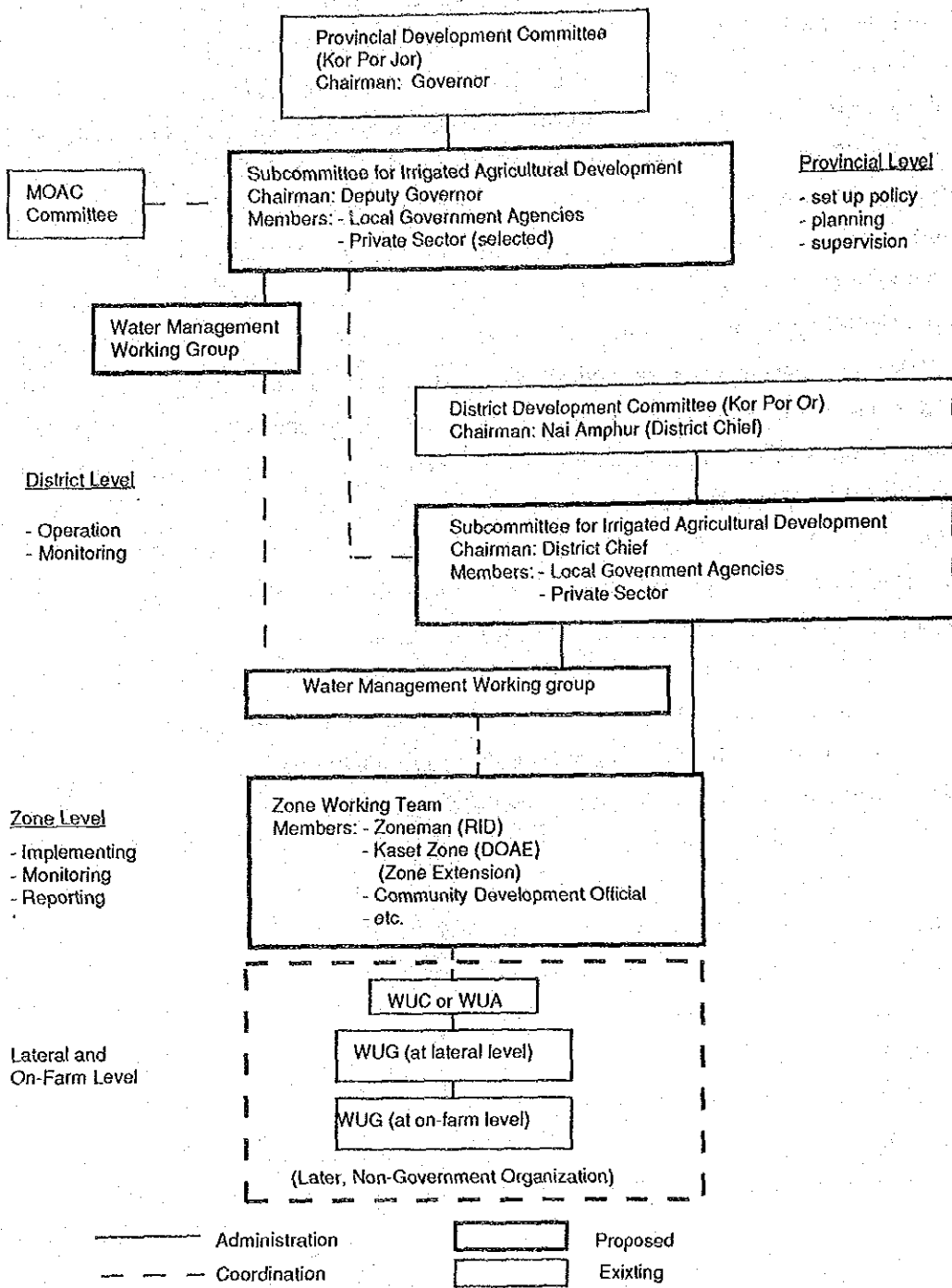


Fig. 4.1 Proposed Institutional Set-up of Large & Medium Scale Project

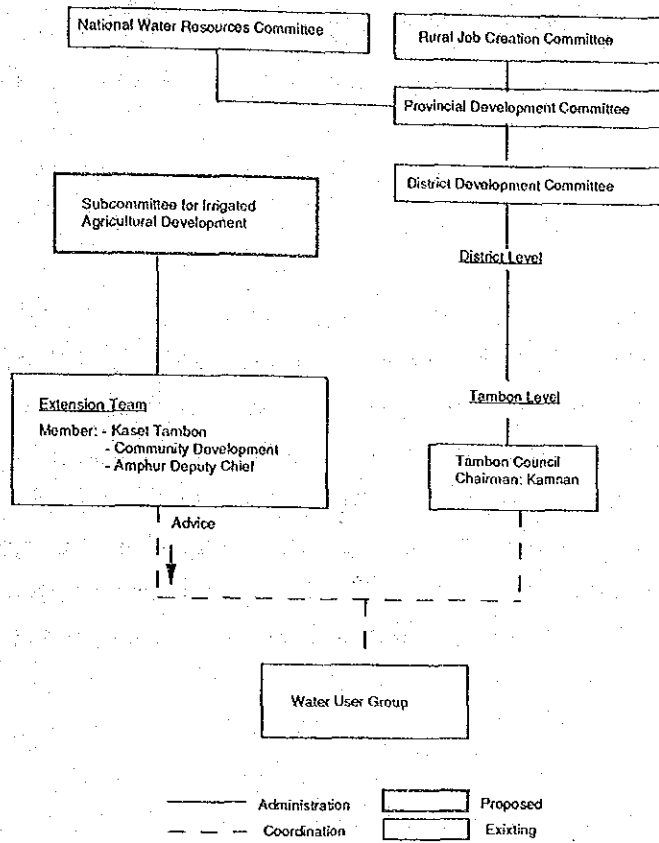


Fig. 4.2 Proposed Institutional Set-up of NEA Project

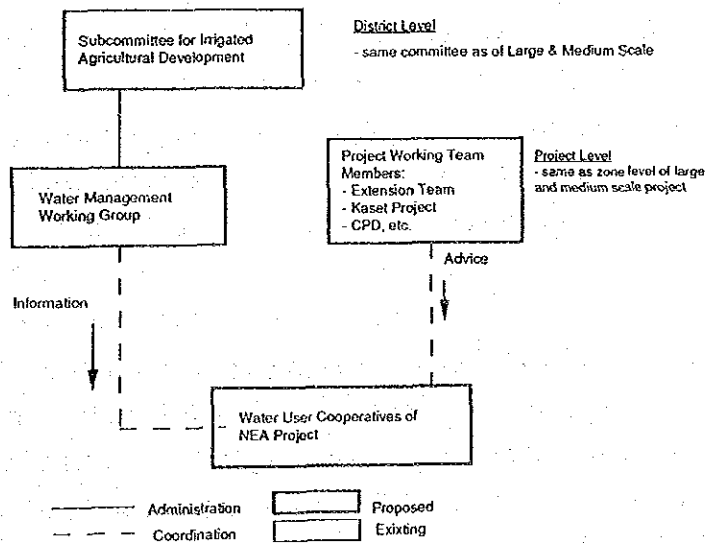


Fig. 4.3 Proposed Institutional Set-up of Small Scale Project

5. WATER CHARGE COLLECTION

The water charge which will be mentioned in this study; are concerned with the money collection for the water for irrigation, domestic, power generation and industry; taken from irrigation project. The agency consuming the water may be government agency, private sector or individual user like as a farmer. There are various prospective of water charges dependent on agency concerned. For instance, the charge is collected from farmers for O&M activity in their on-farm boundary or for electricity charge under the pumping irrigation scheme.

In Thailand, most of water charge will be used for O&M activity but not for cost recovery of water resource investment, except for land consolidation area charging for repayment of the land consolidation cost.

The present relevant legislation and actual practice on water charge collection and also proposals, will be mentioned.

5.1 Relevant Legislation and Actual Practice

There are two legislative acts enabling the government to recover the partial cost of investment and service operation. They are the Irrigation Act of 1942, and the Agricultural Land Consolidation Act of 1974.

Under the provision set out in the Land Consolidation Act, farmers in area under the land consolidation program "shall pay the expenses for repair and maintenance of the irrigation or drainage systems, roads or paths of conveyance to the farms and other utilities for common uses", may be called Operation and Maintenance fee. Under the Act, the rate at which payments are to be made by farmers for these activities is to be prescribed by the Central Land Consolidation Committee. The O&M fee are collected by the Agricultural Cooperatives in the form of Water User Cooperative accomplished with water

user group and spent in accordance with the stipulations of the said cooperatives. The O&M fee in land consolidation area is prescribed as :

Intensive type of Development as (1.6-1.8 persons)/rai x wage/day

Extensive type of Development as (1.35-1.6 persons)/rai x wage/day

In actual practice there is no uniformity across the country in either the amount or method by which payment is made; in some areas, farmer are not making any contribution at all. Generally the contributions of farmers towards O&M costs are made in one of two ways as : either by cash contribution, with the money being utilized to hire labor or to carry out the necessary maintenance works, or by farmers contributing their own labor to undertake such work. Furthermore, farmers tend to prefer the system of contributing their own labor for such work, rather than making a cash contribution. This allows their to use family labor at time of low on-farm demand for labor, when O&M work would normally be undertaken.

Under the terms of Land consolidation Act, farmers are expected to repay the costs of land consolidation, including the costs of leveling and grading. Normally, the repayment rate should be about 50% of the construction cost and the term of repayment is 15 years with as 2 year period of deferment and with a 12% interest rate. The Act also states that the annual repayment must not be less than 10% of the total amount. However, it is also specified that the farmers' ability to pay would be determined, and in practice the calculation of annual repayment installments is based on the paying capability of farmer. Requests for payment are sent out after land consolidation has been completed and land title to land has been registered. In addition, the Act requires that the Office of Agricultural Economics undertake an analysis to certify the farmers' ability to pay before cost recovery can begin.

Under the provision in the Irrigation Act, the government can collect the irrigation fee from the land owners whose land located in the irrigation project boundary or from the consumers using water for agricultural purpose in the area located outside project area. The charge is not higher than 5 Bahts per rai. The other users are charged at not higher than 0.50 Baht per cubic meter. According to this provision, the minister of MOAC set up and proclaimed the irrigation fee for the other uses (Industry, Domestic, and the other purposes) as followings :

Items	Description	Rate based on Monthly consumption (Baht/cum)
1	first 5,000 cum	0.20
2	greater than 5,000, but less than 100,000 cum	0.30
3	greater than 100,000 cum	0.50

The users have responsibility to establish a water meter by themselves. In case of the water meter did not function in the last month. The water charge rate would be as :

$$\text{Monthly water charge} = \frac{\text{Maximum} + \text{Average} + \text{Minimum (from previous month)}}{3}$$

Any sources of water, wanting to collect the irrigation fee for the other uses besides for irrigation, need to be proclaimed as "Registered Irrigation Channel", appointed by Minister of MOAC. At present, there are 28 irrigation channels and 2 reservoirs proclaimed, scattered in the country; 8 irrigation channels and one reservoir (Klong Prew, in Saraburi province) are located within UCR. The official records from Revenue Branch of RID indicates that there are 217 consumers around the country, and 146 of them have established water meters. RID can collect the irrigation fee as about 250,000 Baht per month. For various reasons, no irrigation fees are collected from farmers under the Irrigation Act.

The other form of charge is electricity charge of pumping irrigation schemes which have been undertaken by NEA, RID and CPD. The charges are based on units (kilowatt-hr) they consumer. The water user group or any kind of farmer organization will collect cash from the members and submit it to the agency concerned. They may collect based on either unit or area basis from the members depending upon their agreement.

5.2 Proposal Regarding Water Charge Collection

The main aims of water charge collection are to cover the O & M cost of irrigation facilities particularly at on-farm level and to recover costs of land improvement and consolidation regarding to the Land Consolidation Act. Water charge collection is practised only in the land consolidation areas. The charge rate is feasible for farmers. The methodology of collecting the charge

is also suitable. The problem is how to impose it. The success depends on the ability of farmers to pay, i.e., generation of sufficient incremental net farm benefits from irrigation to enable and justify payment. Quality of irrigation service is, therefore, one of the central to question from the government side. At first, the irrigation system should provide reliable and timely water supply service to the farmers. The farmers organization should be well functioning and efficient in carrying on O & M activity within their responsibility.

Irrigation Act can be imposed to the irrigation area even outside land consolidation project. Under the Irrigation Act, the government can collect irrigation fee to cover O & M costs of irrigation facilities, however, the fees prescribed herein have been found to be inadequate. Amendments to the Irrigation Act should be considering by the government with the view to increasing the fees and to activating the collection from all kinds of consumers. The money collected from agricultural sector should be used and managed by the water user organization. The farmers will be move economical oriented in the future. They may hire any interested private sector to partly handle O&M works.

All of water resource involving government investment should be proclaimed as a Registered Irrigation Channel, if the water is used for a non-agricultural purpose. Then the Irrigation Act can be imposed. The water charge should be collected from one who use the water affecting the base flow of a Registered Irrigation Channel. The water charge should be imposed direct way. The other forms of charge as land tax will not be suitable. It is too difficult to classify which areas are receiving the irrigation water.

6. WATER MANAGEMENT FOR INDUSTRY

For industrial water management, groundwater sources should be taken into consideration and planned for expansion of industrial activities in the UCR in the future. Several aspects of industrial water management are discussed.

1) Controlling over-extraction of groundwater

Local government, DMR and Department of Industrial Works (DIW) of the Ministry of Industry, and Department of Town and Country Planning should work to prepare a plan for Industrial Zone, and Urban Zone. Within the Zone, the plan should designate the areas for groundwater extraction. Industries must obtain official permit to use groundwater under the Groundwater Act. The drilling and use of groundwater as well as the disposal of wastewater shall be controlled by the Act.

For the plan to be prepared, steps should be taken as follows: (Fig. 6.1)

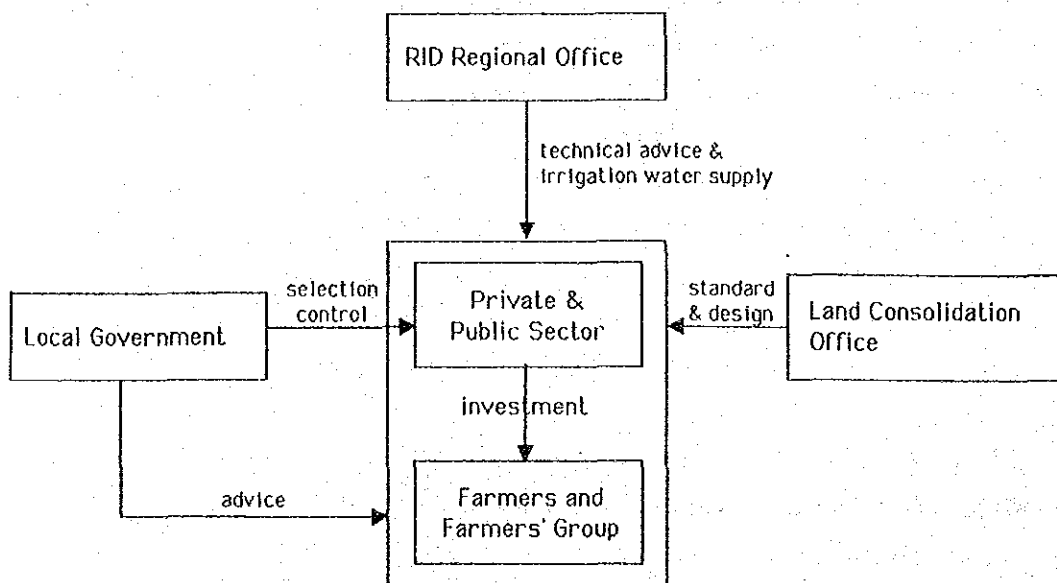


Fig. 6.1 Implementation of Land Consolidation

- (1) Establish a Planning Committee to take responsibility for overall planning in the UCR. The committee members include governors, related government agencies of each Changwat, DMR, DIW and the Department of Town and Country Planning.
- (2) The committee should work out a regional plan which identifies Industrial Zone, Agricultural Zone and Urban Zone. In addition the committee should set up means to implement the plan.
- (3) The Groundwater area should be designated in order to control the over extraction, and prevent land subsidence and saltwater encroachment. In the designated groundwater zone, the industry must obtain official permit to use groundwater. The drilling and utilizing of groundwater will be controlled by the Act.
- (4) It is revealed by a study of DIW that the quality of water for a factory does not need to be as good as drinking water. The study suggested that the wastewater from factories be treated for in the again. This technology is very expensive, but necessary to be studied further with reference to different types of industry.

2) Waste water disposal

Without town planning, waste water problem will be a critical issue in the area. Ayutthaya and Sara Buri are major place of industrial location in the UCR. There is a need to make a plan for this area before the problem becomes uncontrollable as in the BMR. Though the Factory Act 1969 and Poisonous Act 1967 are promulgated to control wastewater from factory, it appeared that many factories, particularly small ones, still do nothing about their waste. This is because the cost for disposal is too high for them. Private sector should be encouraged to participate in the collective treatment of waste within industrial estate (Fig. 6.2).

Local government should be encouraged to take supportive actions in this privately participated waste treatment. Most important factor is to encourage the awareness of local people in environmental conservation.

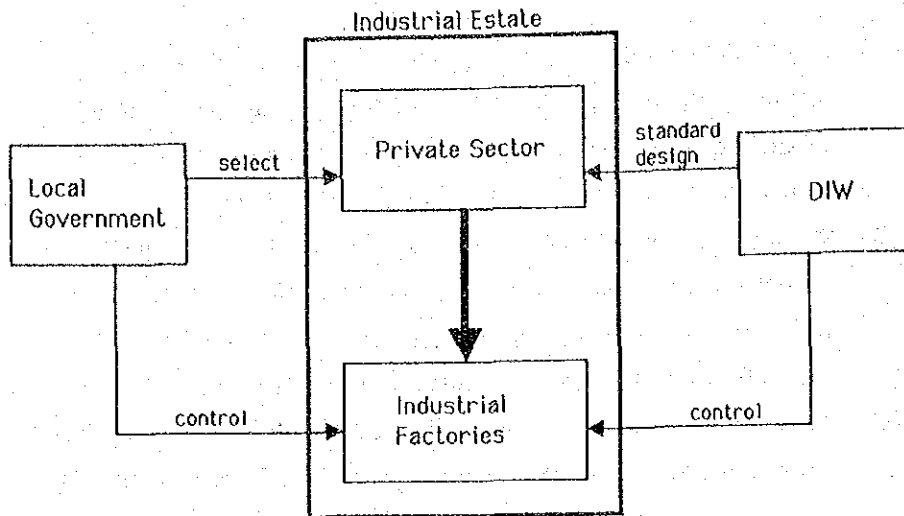


Fig. 6.2 Water Supply in Industrial Estate

- 3) Examination and amendment of relevant legislations to facilitate private sector water supply.

In order to facilitate access to water sources with pipelines by the industries, the government should scrutinize and amend various legislations and laws. This measure will help industries and also help the government control industrial water use by prohibiting pipeline which interfere with public interests. Responsible agencies are all the government agencies concerned with land uses, such as the Highway Department and the Ministry of Agriculture and Cooperatives. Coordination can be made by the Department of Industrial Works.

- 4) Registration with the amount of water abstraction by the industries.

This measure is aimed at proper water resources management by the government for the surface water and groundwater. At present, in the UCR, there is no such system of registering water intake from natural sources, except groundwater in Ayutthaya Province. In order to manage limited natural resources used by the public such as water resources, there has to be a governmental body to control the water use. Otherwise, natural water sources will be depleted and consumed with the amount of water which is used to be abstracted by other water users including those at downstream. The RID would be the suitable agency

for the surface water and the Mineral Resources Department for the groundwater.

5) Proper government control on industrial water rate.

This measure is intended that a private sector can play a role in industrial water supply. Particularly at a industrial estate, a private sector may develop water resource, supply water to industries, and treat effluent collectively. It will be necessary to provide various incentives for a private sector to perform such a role. The most important incentive would be to loosen the government control on the rate which a private sector can charge for water supply and water treatment. Such a consideration should be provided by the Industrial Works Department.

PART III
LAND USE

1. EXISTING LAND USE

1.1 Land Utilization

Land in the UCR is almost fully utilized. Especially, farm land in three Changwats of Sing Buri, Ang Thong and Ayutthaya occupies more than 80% of the whole areas. This is almost a full utilization ratio in flat terrain land.

Because of mountains and hill areas in Chai Nat, Lopburi and Sara Buri, the land utilization ratio is around 70%. Unclassified land, which includes the deteriorated forest, exists in these Changwats. (Fig 1.1)

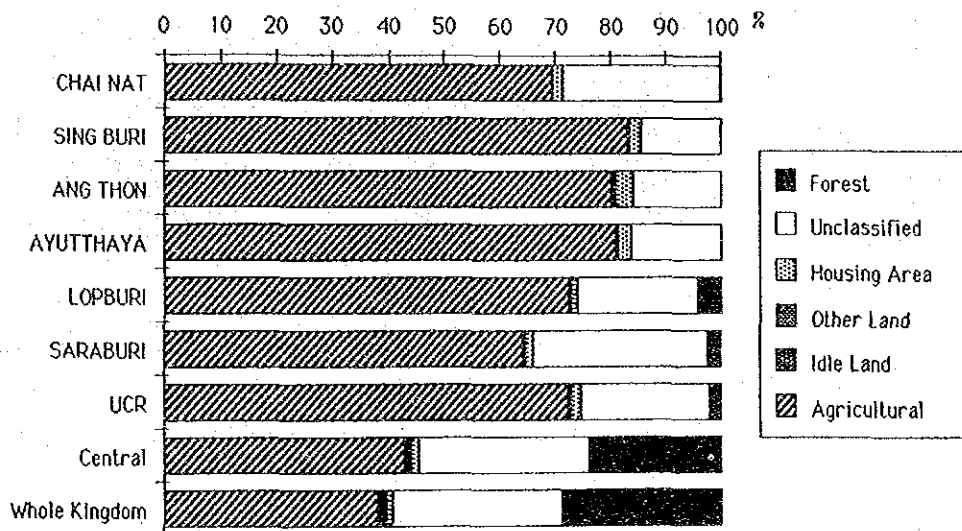


Fig. 1.1 Land Use Composition 1986

A large portion of cultivated land is used for paddy. In Sing Buri, Ang Thong and Ayutthaya, more than 95% of cultivated land is classified as paddy. 84% is paddy in Chai Nat because of its terrace area in the western edge of the Changwat. In Lop Buri and Sara Buri, less than 50% of the cultivated land is used for paddy. A

large portion of land for field crops exists, because the large terrace area is cultivated for field crops in these Changwats (Table 1.1).

Table 1.1 Agricultural Land Utilization 1987/1988

Unit: %

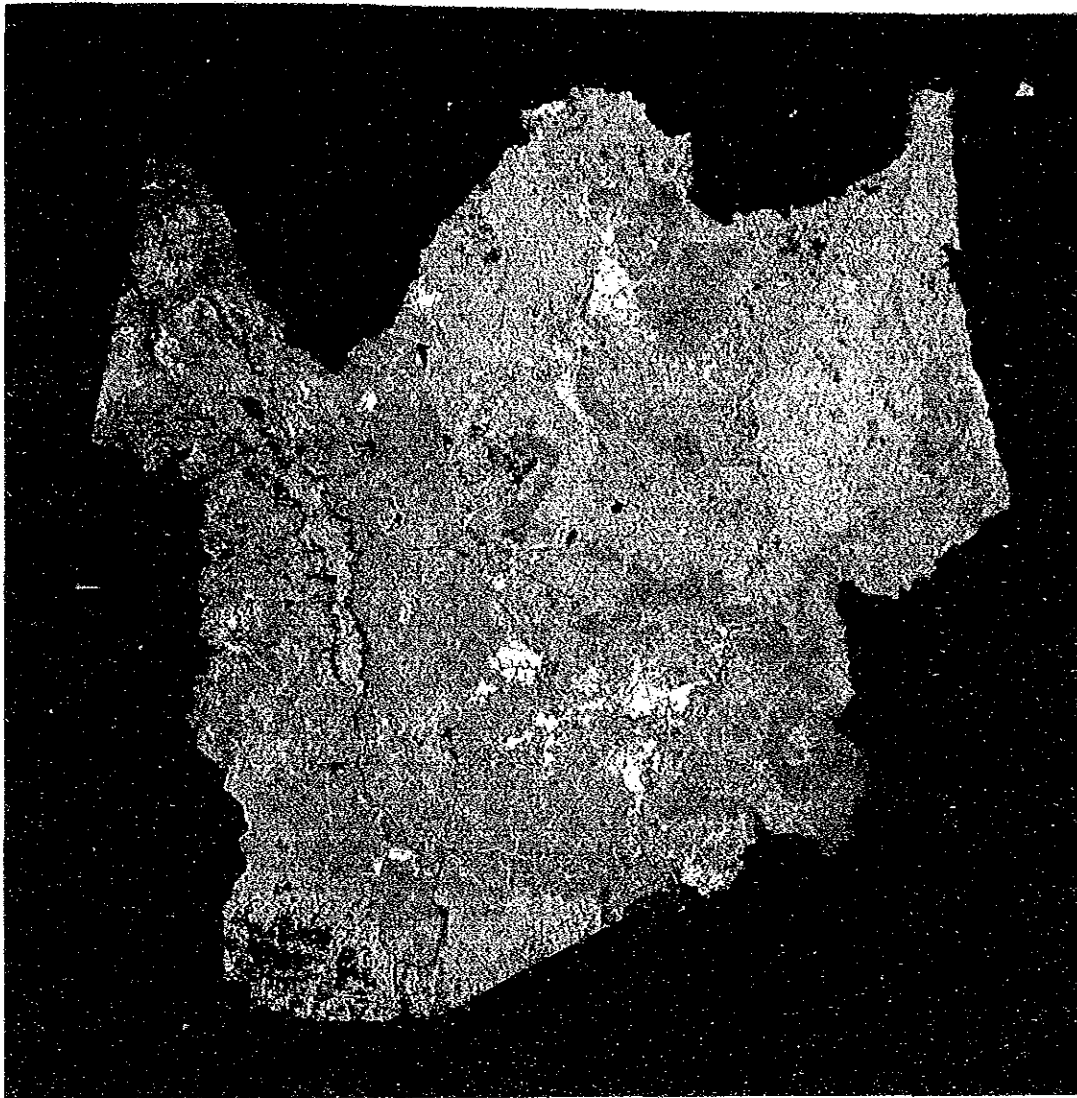
	Paddy	Field Crop	Fruit	Veg.&Flow	Grass	Total
CHAI NAT	84.83	11.67	3.27	0.10	0.12	100
SING BURI	93.00	2.14	4.66	0.17	0.03	100
ANG THONG	94.42	1.34	3.68	0.57		100
AYUTTHAYA	95.86	1.11	2.67	0.36	0.02	100
LOP BURI	40.97	56.50	1.52	0.15	0.86	100
SARABURI	50.37	42.80	3.12	0.09	3.62	100
UCR	64.88	31.30	2.59	0.19	1.03	100
Central	53.98	34.26	10.32	0.73	0.70	100
Whole Kingdom	61.02	26.36	11.43	0.44	0.75	100

Source: Agricultural Statistics of Thailand 1987/88

Paddy land in the UCR is 7% of the Whole Kingdom, while the total area of the UCR is 3% of the national total. The rice productivity in the UCR is highest in the Kingdom. Approximately, 12% of rice is produced in the UCR.

This high productivity is identified in comparison with those in other regions, that is, although 50% of paddy land exists in the Northeast Region, its production share is 32.2%. Majority of the rice field in the Northeast is rainfed paddy. On the other hand, 23% of paddy field is in the North Region which produces 27% of rice.

Fig. 1.2 shows the LANDSAT image of the UCR which indicates the types of ground cover. It clearly shows that the type of land use is different between delta and upland areas. Yellow and brown indicate paddy, pink indicates upland crops, blue indicates tree crops and dark pink indicates forest area. Land utilization in the UCR in comparison with other regions of the Kingdom is shown in Table 1.2.



LEGEND

Item	Color
1. Low Land Rice	Yellow
2. Active Rice	Orange
3. Field Crop-1	Light Pink
4. Field Crop-2	Green
5. Vegetation	Light Blue
6. Forest	Pink
7. Mining Area	Purple
8. Burnt Area, Moist Soil	Blue
9. Bare Soil-1	White
10. Bare Soil-2	Brown
11. Surface Water	Black

Fig. 1.2 Land Coverage Distribution Map

Table 1.2 Land Use 1986 (Unit : 1,000 rai)

Region and Area Name	Total	Forest	Farm Holding Land								Unclassified
			Housing Area	Paddy	Field Crop	Fruit	Veg.&Flower	Grass	Idle Land	Other Land	
Chainat	1,543.6	5.4	28.3	908.6	125.0	35.1	1.1	1.3	0.9	1.0	436.9
Sing Buri	514.0	0.0	11.6	397.5	9.1	19.9	0.7	0.1	0.3	1.3	73.4
Ang Thong	605.2	0.0	20.3	457.3	6.5	17.8	2.8	0.0	3.7	1.2	95.7
Ayutthaya	1,597.9	0.0	41.5	1,237.8	14.3	34.4	4.6	0.2	0.9	4.7	259.4
Lop Buri	3,874.8	171.9	42.7	1,146.0	1,580.6	42.4	4.1	24.2	7.6	6.0	849.2
Saraburi	2,235.3	56.3	38.2	721.4	612.9	44.6	1.3	51.8	1.6	6.2	701.0
UCR	10,370.9	233.7	182.6	4,868.6	2,348.5	194.2	14.5	77.6	14.9	20.6	2,415.7
Eastern	22,814.1	4,991.9	234.5	4,625.6	3,797.6	1,491.6	24.4	47.0	293.4	159.5	7,148.6
Western	26,644.0	10,266.0	242.8	3,597.0	3,128.2	705.8	72.4	67.0	164.7	86.4	8,313.8
BHR	5,109.3	12.9	100.2	1,904.5	242.0	476.1	91.8	3.4	22.9	63.2	2,192.4
Central	64,938.3	15,504.4	760.1	14,995.7	9,516.4	2,867.7	203.1	195.0	495.9	329.6	20,070.4
North-Eastern	105,534.0	14,813.4	1,120.3	37,445.0	13,039.1	947.1	161.6	530.6	2,172.0	779.8	34,525.0
Northern	106,027.7	51,849.4	768.9	16,932.0	9,365.7	1,122.1	131.5	60.5	433.3	166.3	25,178.0
Southern	44,197.0	9,487.6	423.9	4,660.8	154.3	8,973.5	41.6	101.0	456.6	274.1	19,423.6
Whole Kingdom	320,696.9	91,654.8	3,073.2	74,233.4	32,075.5	13,910.3	537.9	907.1	3,557.8	1,549.8	99,197.0

Source : "Agricultural Statistics of Thailand Crop Year 1987/88"
Center for Agricultural Statistics Office of Agricultural Economics, Ministry of Agriculture & Co-operatives

Table 1.3 Average Farm Size and Number of Farm in 1986

	Farm Size (rai)	Growth Rate * (%)	Number of Farm	Growth Rate * (%)	Land Tenure (% of Owner)	Growth Rate (%)
Chainat	26.3	-0.2	41,867	-0.3	57.3	-5.4
Sing Buri	19.5	-0.6	22,647	0.6	75.2	1.6
Ang Thong	20.9	2.4	24,422	-15.3	64.6	-1.8
Ayutthaya	32.5	-0.5	41,146	-0.4	38.9	-8.6
Lop Buri	39.6	-0.2	72,026	0.0	68.0	0.3
Saraburi	36.6	-0.9	40,346	0.0	47.7	-8.3
UCR	31.8	-0.1	242,454	-0.4	57.7	-3.4
Central	32.5	0.1	903,849	0.4	63.7	-1.4
Whole Kingdom	26.3	-0.4	4,940,616	1.7	79.2	0.0

Note : * : Annual Growth Rate 1981-86
Source : Agricultural Statistics

Table 1.4 Area and Number of Holding by Size of Holding in 1983

	Holdings			Area		
	< 9.9 rai	10-39.9	> 40 rai	< 9.9 rai	10-39.9	> 40 rai
Chainat	25.5	56.3	18.2	5.4	51.1	43.5
Sing Buri	31.9	55.9	12.1	7.7	58.9	33.4
Ang Thong	36.9	56.3	6.8	10.0	68.3	21.7
Ayutthaya	21.1	55.7	23.1	3.2	46.8	49.9
Lop Buri	13.6	54.3	32.1	1.9	34.0	64.1
Saraburi	17.0	56.4	26.6	2.7	41.8	55.5
UCR	22.0	55.6	22.3	3.7	44.4	51.9
Central	25.5	53.8	20.7	4.7	43.8	51.5
Whole Kingdom	27.0	57.8	15.2	6.4	53.2	40.4

Source : 1983 Intercensal Survey

Table 1.5 Irrigated Area in 1981 and 1986

		Unit : 1,000 rai	
		1981	1986
Chainat	Irrigated Area	694.2	740.1
	Agr. Land	1,101.7	1,069.8
	Ratio (%)	63.0	69.2
Sing Buri	Irrigated Area	424.0	424.0
	Agr. Land	431.3	427.3
	Ratio (%)	98.3	99.2
Ang Thong	Irrigated Area	506.4	507.4
	Agr. Land	517.3	484.3
	Ratio (%)	97.9	104.8
Ayutthaya	Irrigated Area	1,235.4	1,234.8
	Agr. Land	1,372.2	1,291.1
	Ratio (%)	90.0	95.6
Lop Buri	Irrigated Area	472.1	545.1
	Agr. Land	2,785.1	2,773.1
	Ratio (%)	17.0	19.7
Saraburi	Irrigated Area	329.2	351.2
	Agr. Land	1,438.8	1,380.2
	Ratio (%)	22.9	25.4
UCR	Irrigated Area	3,661.2	3,802.6
	Agr. Land	7,646.5	7,425.9
	Ratio (%)	47.9	51.2
Central	Irrigated Area	11,419.4	12,254.2
	Agr. Land	26,777.0	27,582.9
	Ratio (%)	42.6	44.4
Whole Kingdom	Irrigated Area	19,821.6	19,821.6
	Agr. Land	113,381.2	113,381.2
	Ratio (%)	17.5	17.5

Source : "Agricultural Statistics of Thailand, 1982/83 & 1987/88"
 Note : Ang thong 1986 exceed 100 % , due to different information source

1.2 Farm Size and Farm Holding Size

Average farm size in the UCR in 1986 is 32 rai which is much larger than that of the Whole Kingdom, 26 rai. The average size in Lop Buri and Sara Buri, where upland crop cultivation is dominant, is much larger than that of the UCR's average; while Sing Buri, where rice cultivation is dominant and paddy yield is the highest in the UCR, is the smallest: being only 61% of the UCR's average.

Number of farms in the UCR decreased at 0.4% p.a. during the 1981-82 in contrast to the Whole Kingdom which increased at 1.7% p.a.. The number decreased rapidly especially in Ang Thong.

Owner-operate-farms account for 57.7% of the total number of farms in the UCR in 1986, which is much lower than that of the Central Region and Whole Kingdom: 63.7% and 79.2% respectively. The share in the UCR decreased at 3.4% p.a. during the 1981-86. The share in Lop Buri and Ayutthaya is much lower than that of the UCR and decreased rapidly during the same period. As a result, tenant farmers increased in the UCR, especially in Sara Buri and Ayutthaya.

According to Intercensal Survey in 1983, 22% of the holdings in the UCR are less than 9.9 rai in size, but they account for only 3.7% of the total cultivated area. On the other hand, about 22% of the holdings with the area of more than 40 rai of the size of holdings account for about 52% of the total cultivated area. Generally, the share of the holdings with more than 40 rai is high in the upland crop area and the share of those with less than 9.9 rai is high in the paddy area.

1.3 Irrigated Area

Irrigated agricultural land in the UCR accounts for more than 50% of the whole agricultural land. This is higher than the average of Central Region and Whole Kingdom which are 44% and 20% respectively. In Sing Buri, Ang Thong and Ayutthaya, more than 95% of agricultural land is irrigated.

On the other hand, Lop Buri and Sara Buri with the large portion of terrace and mountainous areas show lower percentages of irrigated land, which are 20% in Lop Buri and 25% in Sara Buri. 70% of agricultural land has been irrigated in Chai Nat. It is noted that these irrigated areas are those irrigated in the wet season.

Irrigated agricultural land in the dry season seem to be less than 20% of that in the wet season. Also, the irrigated areas in the dry season largely fluctuate because the rainfall fluctuation affects available water stored in the dams in upstream.

The most significant irrigation system in the UCR has been developed by the Chao Phraya Project which diverts water at Chai Nat to the Chao Phraya delta. Five main canals and rivers exist in the UCR and approximately 40% of the land is included in this project which is enclosed by the boundaries of Chai Nat Pasak Canal at east side and Makhamthao - Uthong Canal at west side.

The irrigation system in the UCR has a larger capacity than that for the water available in the dry season. Water allocation and efficient use of irrigation water in the dry season is the most important issue to intensify land use, because drought in the dry season has often constrained the agricultural production.

1.4 Land Use Intensity

In terms of land utilization, the UCR is almost fully utilized. Area expansion is limited as described previously. Under such a land constraint, in order to increase the productivity of land, intensification of land use is critical, and multiple cropping and introduction of higher value-added crops should be considered.

Table 1.6 shows the actual planted areas and the land being used for cropping. In the areas where the planted area exceeds the utilized area, activities of multi-cropping such as second rice and second crop in paddy field can be found. In some case, double cropping takes place in the field crop land.

Land use intensity, calculated based on Table 1.6, is shown in Table 1.7 in terms of the index of land use percentage. In general, agricultural land in the UCR is more intensively used than the Central Region and the Whole Kingdom. In Chai Nat and Sing Buri, second rice has been planted intensively, while in Ang Thong and Sara Buri, second field crops have been planted intensively in 1986.

Table 1.6 Land Use Intensity 1986 (1)

	UNIT : 1,000 rai							
	Planted Area			Land Utilization				
	Maj. Rice	2nd. Rice	Total Rice	Field Crop	Total	Paddy	Field Crop	Total
CHAI NAT	897	257	1,154	130	1,283	909	125	1,034
SING BURI	403	152	555	27	583	398	9	407
ANG THON	436	82	518	14	532	457	7	464
AUTTHAYA	1,037	200	1,237	17	1,254	1,238	14	1,252
LOP BURI	990	27	1,017	1,851	2,867	1,146	1,581	2,727
SARABURI	689	33	723	841	1,564	721	613	1,334
UCR	4,453	751	5,203	2,880	8,083	4,869	2,348	7,217
CENTRAL	12,210	2,841	15,051	9,693	24,744	14,996	9,516	24,512
WHOLE KINGDOM	57,943	3,628	61,571	31,671	93,242	74,233	32,076	106,309

Source : Agricultural Statistics of Thailand, 1987/88. (Data of 1986)

Table 1.7 Land Use Intensity 1986 (2)

	Unit : Percent		
	*Paddy	**Field Crop	***Total
Chainat	127.0	103.7	124.2
Sing Buri	139.7	299.1	143.3
Ang Thong	113.3	210.3	114.6
Agutthaya	99.9	120.0	100.2
Lop Buri	88.7	117.1	105.2
Saraburi	100.2	137.2	117.2
UCR	106.9	122.6	112.0
Central	100.4	101.9	100.9
Whole Kingdom	82.9	98.7	87.7

Source : "Agricultural Statistics of Thailand, 1987/1988"

Note : Intensity is calculated based on following "AREAS"

- * (Major rice + Secondary rice) / Paddy area
- ** Field crop planted area / Field crop area
- *** Major rice + Secondary rice + Field crop planted area / Paddy area + Field crop area

In some Changwats, especially in Ayutthaya and Lop Buri, major rice planted areas are considerably less than the land utilization areas. Abandoned paddy fields seem to exist due to shortage in labor and water.

1.5 Land Consolidation Project Areas

To increase productivity and efficiency in land use, land consolidation projects have been carried out.

The Land Consolidation Act was enacted in 1974 after good results of the land consolidation pilot projects. Based on this Act, the Central Land Consolidation Office was established in 1975. The project locations are shown in Fig. 1.3.

The land consolidation projects involve water works and coordinations among relevant government agencies such as Royal Irrigation Department (RID) and local government offices related to the land administration. This scheme has a great potential to expand its roles to manage water use and agricultural diversification.

In the UCR, many land consolidation projects have been carried out. A total area of land consolidation projects amounts to roughly 425 thousand rai with provision of the following facilities and arrangements.

- Minor irrigation system,
- Minor drainage system,
- Farm roads,
- Re-arrangement of farm holdings, and
- Clearance and leveling of land for water control.

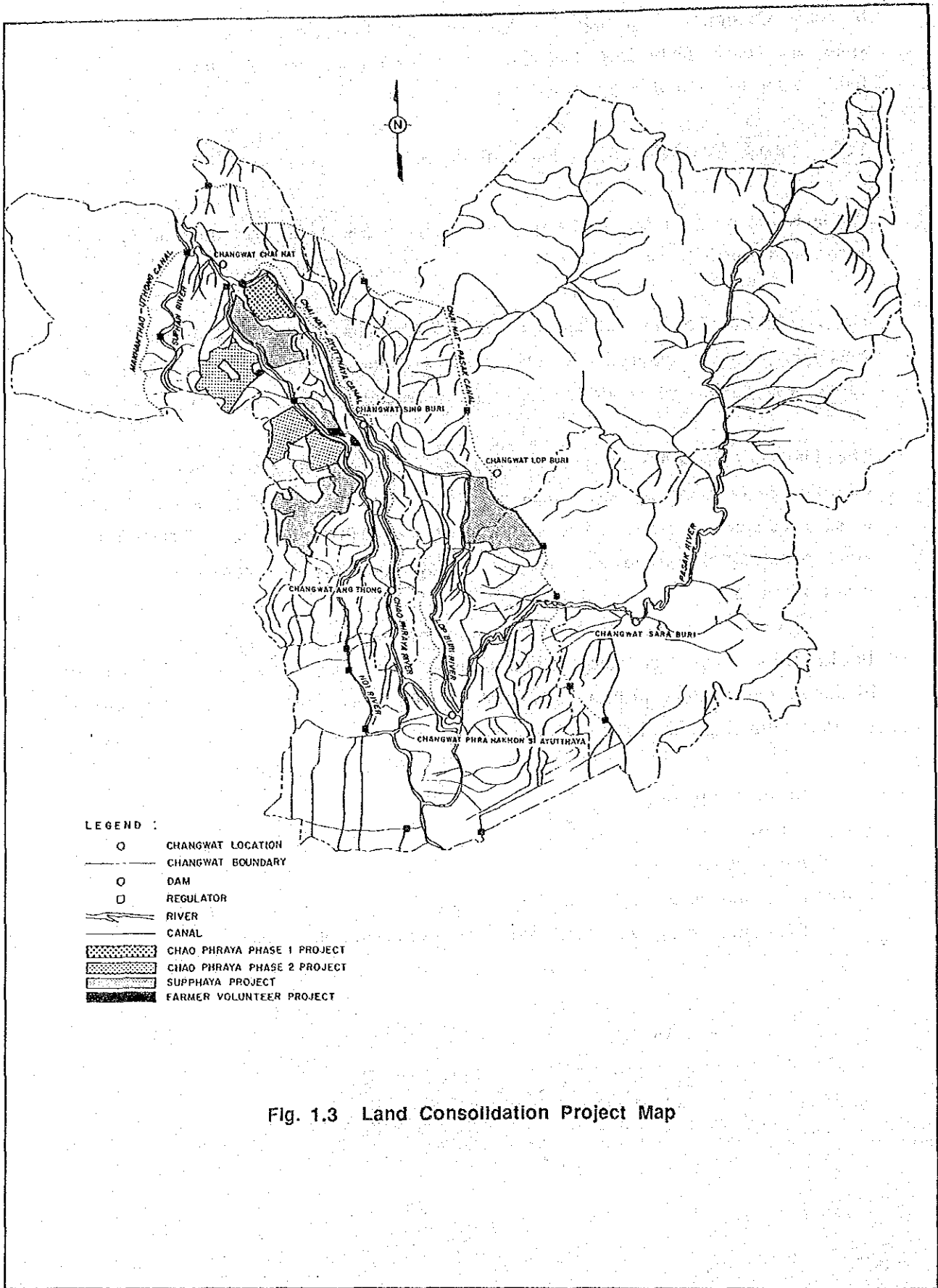


Fig. 1.3 Land Consolidation Project Map

2. LAND USE POTENTIALS AND CONSTRAINTS

2.1 Regional Land Use Potentials

Land use potentials have been studied and compiled as Land Use Potential Map and areas in each category are measured by Land Development Department of Ministry of Agriculture.

The land use potential is analyzed, based on climate, topography, hydrology, and soil conditions. Four categories of land use potentials (i.e., upland crops, paddy, tree crops and not-suitable land) are indicated. Regional comparison is shown in the tables of Appendix.

The regional land use potentials are described as follows.

2.1.1 Upland Crops

The area of land suited for upland crops is 67.4 million rai in the nation, which corresponds to 21 % of the total land area of the Kingdom.

The regional distribution of upland crop potential areas is 25 % in Central, 30 % in North, and 45 % in Northeast. The largest areas exist in the Northeast Region, however, most of the potential upland crop areas in the Northeast have a certain level of constraints. The distribution of the best suited area for upland crop is 7% in the Central, 8% in the North and 1 % in the Northeast. The most productive lands for upland crop exist in the Central and North Regions.

In the Central Region, more than 70 % of the best suited land for upland crops is found in the Western Region. In the UCR approximately one fourth of the land suited for upland crops is recognized as best suited.

In general the Central and the North Regions have high productive land for upland crops, while the Central Region and the Western Region have the highest potential for upland crop cultivation.

2.1.2 Paddy

The total area of the land suited for paddy is 84.2 million rai in the nation, which is equivalent to 26 % of the total land area of the Kingdom.

The regional distribution of paddy potential area is 25% in the Central, 20% in the North, 47 % in the Northeast and 8 % in the South. Largest area exist in the Northeast Region, however, most of the potential paddy area in the Northeast has a certain level of constraints. The best suited paddy areas are 11 % in the Central, 14 % in the North, 9 % in the Northeast and 2 % in the South; and therefore, 37 % of the paddy potential area is categorized as the best suited in the nation. The most productive land for paddy exists in the North Region followed by the Central region.

In the Central Region, more than 50 % of the best suited land for paddy is in the UCR, and this accounts for 16 % of the best suited land for paddy in the nation. In the UCR in particular, approximately 77 % of the land suited for paddy is recognized as the best suited.

In general the Central and the North Region have high productive land for paddy, and in the Central Region the UCR has highest potential for paddy.

2.1.3 Tree Crops

The area of the land suited for tree crops is 16.4 million rai, or 5% of the total land area in the nation, out of which the most of area, or 90% is in the South Region. The other 10% is in the Central Region.

The distribution of the best suited for tree crops area is 5 % in the Central and 18% in the South; therefore, 23% of the tree crops potential area is categorized as the best suited in the nation. The most productive land for tree crops is in the South Region as well.

In the Central Region, more than 60 % of the best suited land for tree crops is shared by the Eastern Region and 40 % by the Western Region. In general the South has high productive land for tree crops, followed by the Central Region especially the Eastern Region.

2.1.4 Not-Suitable

About 47 % of the total land in the Kingdom is categorized as not-suited land for cultivation. It accounts for 150.2 million rai with a distribution of 17 % in the Central, 46 % in the North, 22 % in the Northeast and 15 % in the South. The large portions of mountain areas are in the North Region and most of those areas are covered with forest which should be protected for water and soil conservation.

In the Central Region, 54 % of not-suited area is in the Western Region and 39 % is in the Eastern Region, because of existence of the mountainous forest. In the Upper Central Region, 12.5 % of the area is categorized as not-suited for cultivation.

In short, from regional land use potential mentioned above, it is clear that the Upper Central Region has the highest potentials for paddy compared with other Regions.

2.2 Land Suitability

An agricultural land suitability analysis was carried out by the Study Team, employing detailed soil map of each Changwat in the Central Region.

Categories to be applied in this analysis are selected to cope with the development strategy of the region, that is, crop diversification and intensification on paddy land and field crop land. The following four categories are considered :

Paddy area: the area which can grow only paddy without intensive drainage system development or soil improvement.

Paddy and Upland Crops: the area which can grow both paddy and various types of upland crop, depending upon the irrigation water availability.

Upland Crop area: the area which generally can grow only upland crops due to topography and moisture content of soil.

Not-Suited for Cropping: the area which is not suitable for cropping, and usually better to keep as forest land.

These areas were identified on the soil map and the area by category was measured by Amphoe. The suitability map is shown in Fig. 2.1. Land suitability by Changwat is summarized as shown in Table 2.1. The details by Amphoe is attached in Appendix of this paper.

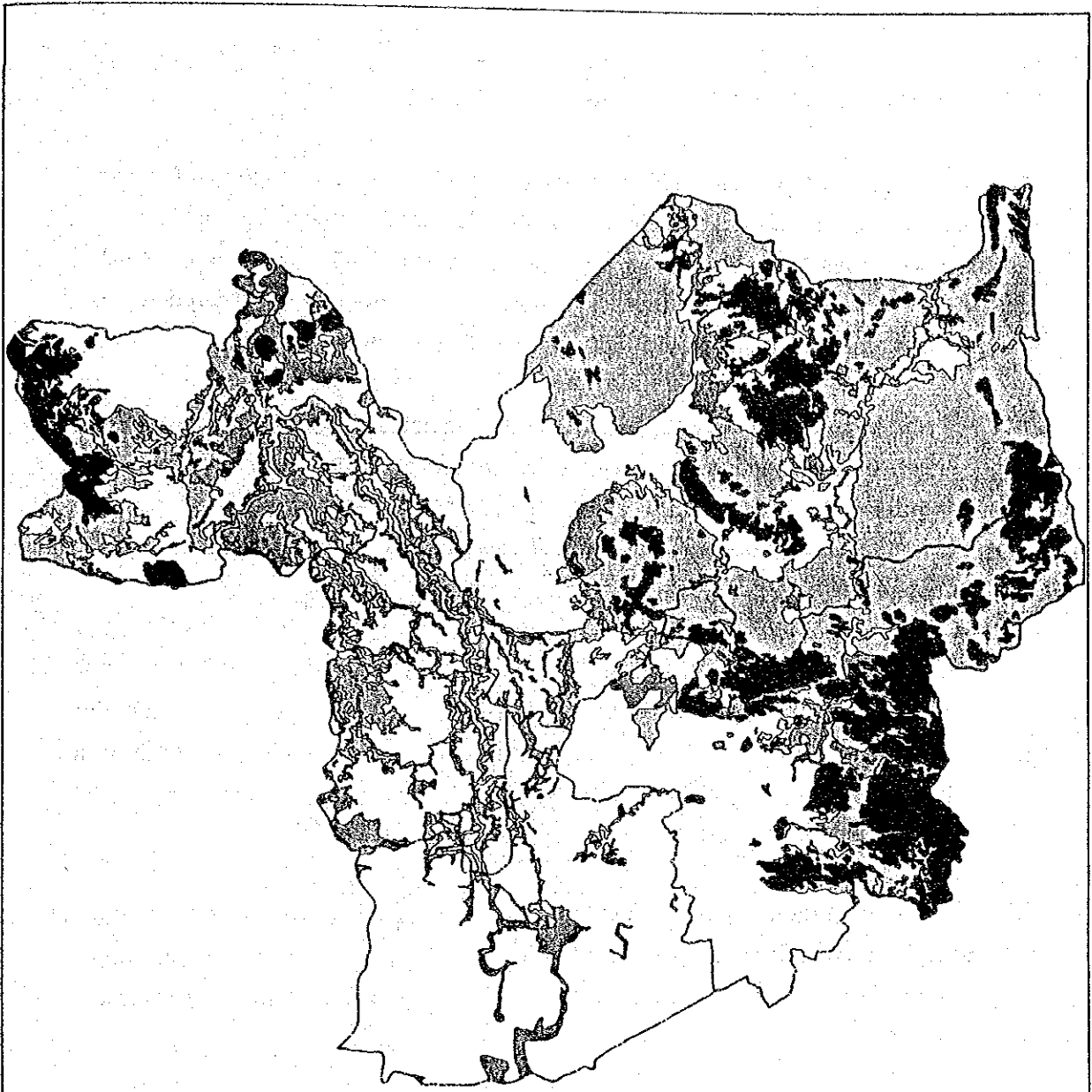
Table 2.1 Land Suitability

Name of Provinces and Districts	Area Total (1000Rai)	Paddy	Paddy & Upland Crop	Upland Crop	Not Suitable
CHAI NAT	1,543.6 (100%)	671.4 (43%)	358.9 (23%)	324.8 (21%)	188.4 (12%)
SING BURI	514.0 (100%)	291.8 (57%)	63.3 (12%)	158.9 (31%)	0.0 (0%)
ANG THONG	613.2 (100%)	382.6 (62%)	57.1 (9%)	173.4 (28%)	0.0 (0%)
PHRANAKHON SI AYUTTHAYA	1,592.3 (100%)	1,417.3 (89%)	20.0 (1%)	154.9 (10%)	0.0 (0%)
LOP BURI	3,874.8 (100%)	1,147.6 (30%)	2,089.5 (54%)	192.8 (5%)	444.9 (11%)
SARA BURI	2,235.3 (100%)	932.2 (42%)	566.7 (25%)	129.5 (6%)	606.9 (27%)
Upper Central Region Total	10,373.2 (100%)	4,843.1 (47%)	3,155.6 (30%)	1,134.3 (11%)	1,240.2 (12%)

Source : STUDY TEAM

NOTE : Data to be used are "DETAILED RECONNAISSANCE SOIL MAP OF CHAI NAT, SING BURI, ANG THONG, PHRANAKHON SI AYUTTHAYA, SARA BURI and LOP BURI".

Arable land in the UCR accounts for 88 % of the total area. The total paddy area cultivated in the UCR in 1987 was 4,767 thousand rai, which is almost same as the paddy suitable area. However, paddy areas cultivated in Chai Nat, Sing Buri and Ang Thong were 909 thousand rai, 398 thousand rai and 457 thousand rai respectively. The planted area was much more than the suitable area. Potential of crop diversification in these three Changwats is high.



LEGEND:





-  PADDY
-  PADDY AND UPLAND CROPS
-  UPLAND CROPS
-  NOT SUITED FOR CROPPING

Fig. 2.1 Crop Suitability Map

2.3 Water Saturation Period and Flood Area

The Soil Survey Map mentioned previously includes the information of water saturation period in the soil. This information is closely related to the soil suitability of paddy. At the same time, it is an indicator of magnitude of flood problems. In addition to the four categories, this information was applied for identification of flood areas and crop diversification potential.

Water saturation period is more than six months in a year: this type is found in the flood prone area, where floating rice planting is the traditional land use. Fish pond development is another possible development. For crop diversification, intensive drainage works are necessary.

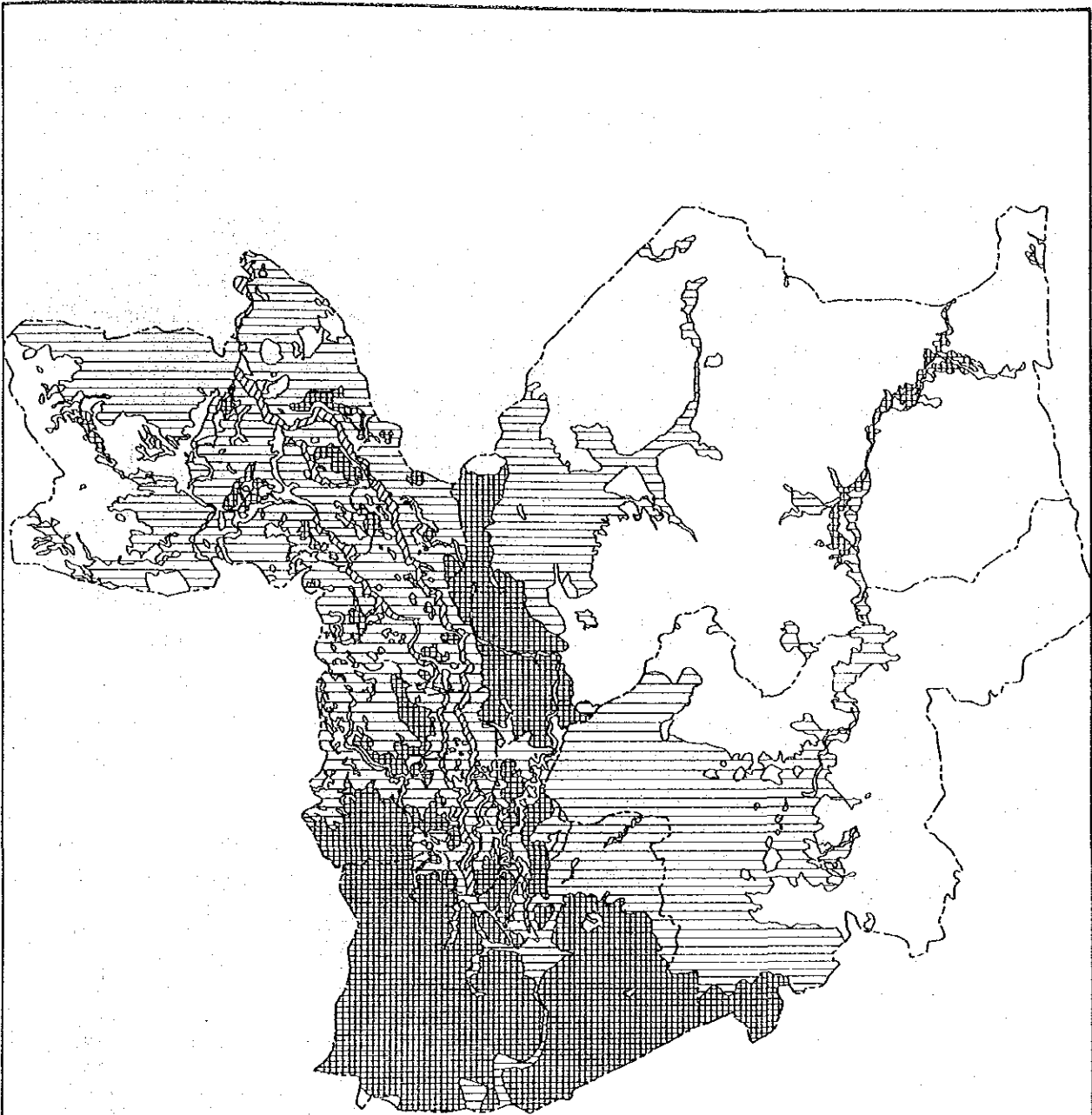
Water saturation period is three to six months: this type of soil can be found in the delta area without flood problems. In this type of area, major rice production, second rice and other crops can be cultivated, and high crop diversification is possible. Types of crops to be planted depend upon the availability of irrigation water.

Water saturation period is one to three months: this type of soil is generally found at the river bank or gently sloped-upland crop areas. Field crop diversification and intensification is possible, given proper irrigation facilities.

Water saturation period is less than one month: this type of soil is found in the areas of moderate to steep land with excessive drainage. Soil conservation and careful selection of crops are necessary.

Fig. 2.2 shows the distribution of the soil in the UCR by water saturation period mentioned above. Fig. 2.3 and Table 2.2 show the distribution of each type of soil by Changwat.

Large flood area in Ayutthaya is conspicuous. Lop Buri and Sara Buri have large areas for upland crops but appropriate soil conservation should be taken. In Chai Nat, Sing Buri, and Ang Thong, large portion of the land has potentials for crop diversification and intensification, however, irrigation water availability and water resource development should be considered.







- LEGEND :
-  MORE THAN 6 MONTH OR EQUAL
 -  6 MONTH TO 3 MONTH
 -  3 MONTH TO 1 MONTH
 -  LESS THAN 1 MONTH

Fig. 2.2 Water Saturation

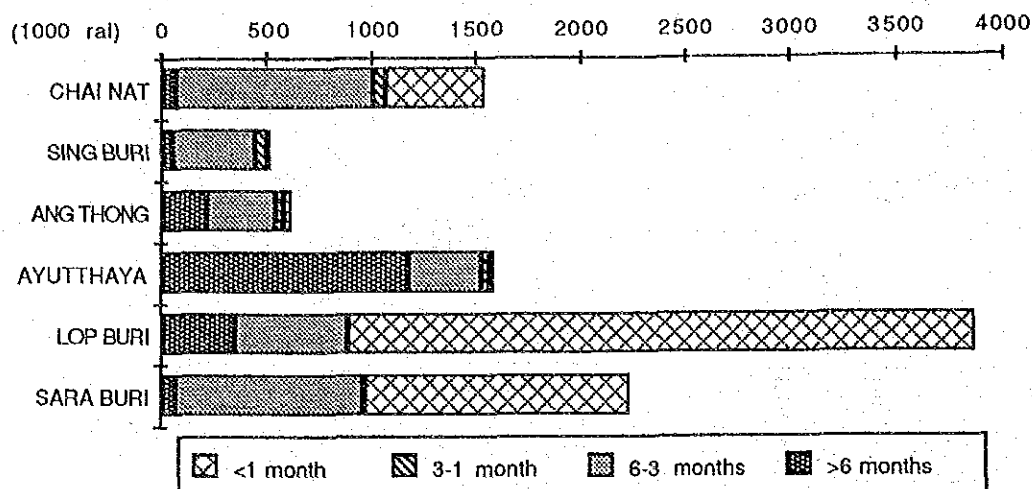


Fig. 2.3 Saturation Period

Table 2.2 Distribution of Saturation Period

Code No.	Name of Provinces and Districts	AREA TOTAL				
		(1000 Rai)	>6 months	6-3 months	3-1 month	<1 month
1 0 0	CHAI NAT	1543.6 (100%)	64.9 (4%)	942.8 (61%)	58.7 (4%)	477.1 (31%)
2 0 0	SING BURI	514.0 (100%)	53.0 (10%)	390.3 (76%)	62.4 (12%)	8.3 (2%)
3 0 0	ANG THONG	613.2 (100%)	210.2 (34%)	328.1 (54%)	45.4 (7%)	29.5 (5%)
4 0 0	PHRANAKHON SI AYUTTHAYA	1592.3 (100%)	1173.9 (74%)	363.4 (23%)	35.8 (2%)	19.1 (1%)
5 0 0	LOP BURI	3874.8 (100%)	350.5 (9%)	537.6 (14%)	0.7 (0%)	2986.0 (77%)
6 0 0	SARA BURI	2235.3 (100%)	62.6 (3%)	897.4 (40%)	14.3 (1%)	1261.0 (56%)
Upper Central Region Total		10,373.2 (100%)	1,915.1 (18%)	3,459.7 (33%)	217.4 (2%)	4,781.0 (46%)

Source : STUDY TEAM

NOTE : Data to be used are "DETAILED RECONNAISSANCE SOIL MAP OF CHAINAT, SING BURI, ANG THONG, PHRA NAKOHON SI AYUTTHAYA, SARA BURI and LOP BURI".

2.4 Ground Water Productivity

Ground water is an important water resource for industry and urban development, although a large amount of surface water available from the Chao Phraya River. Most of the surface water available from the Chao Phraya River has already been allocated for agricultural uses in the UCR. Even for agricultural uses, some areas can use the ground water in a small scale for high value added agriculture such as vegetable garden and fruits growing. Chai Nat, Sing Buri and Ang Thong have potential for agriculture diversification by using the ground water, because of the type of soil and potential of ground water. Fig. 2.4 shows the map of ground water potential.

2.5 Irrigation Network

The Upper Central Region is one of the most intensively irrigated area in Thailand, especially in the Chao Phraya Project area. The location and its network are described in Part I in this sector report. Fig. 2.5 shows the length of irrigation and drainage facilities in each Changwat. Longer canals and ditches are found in large Changwat such as Ayutthaya, Lop Buri and Sara Buri.

However, the intensity of irrigation facilities is higher in Sing Buri, Ang Thong and Chai Nat than those in Lop Buri and Sara Buri. Fig. 2.6 shows the density of the irrigation and drainage facilities.

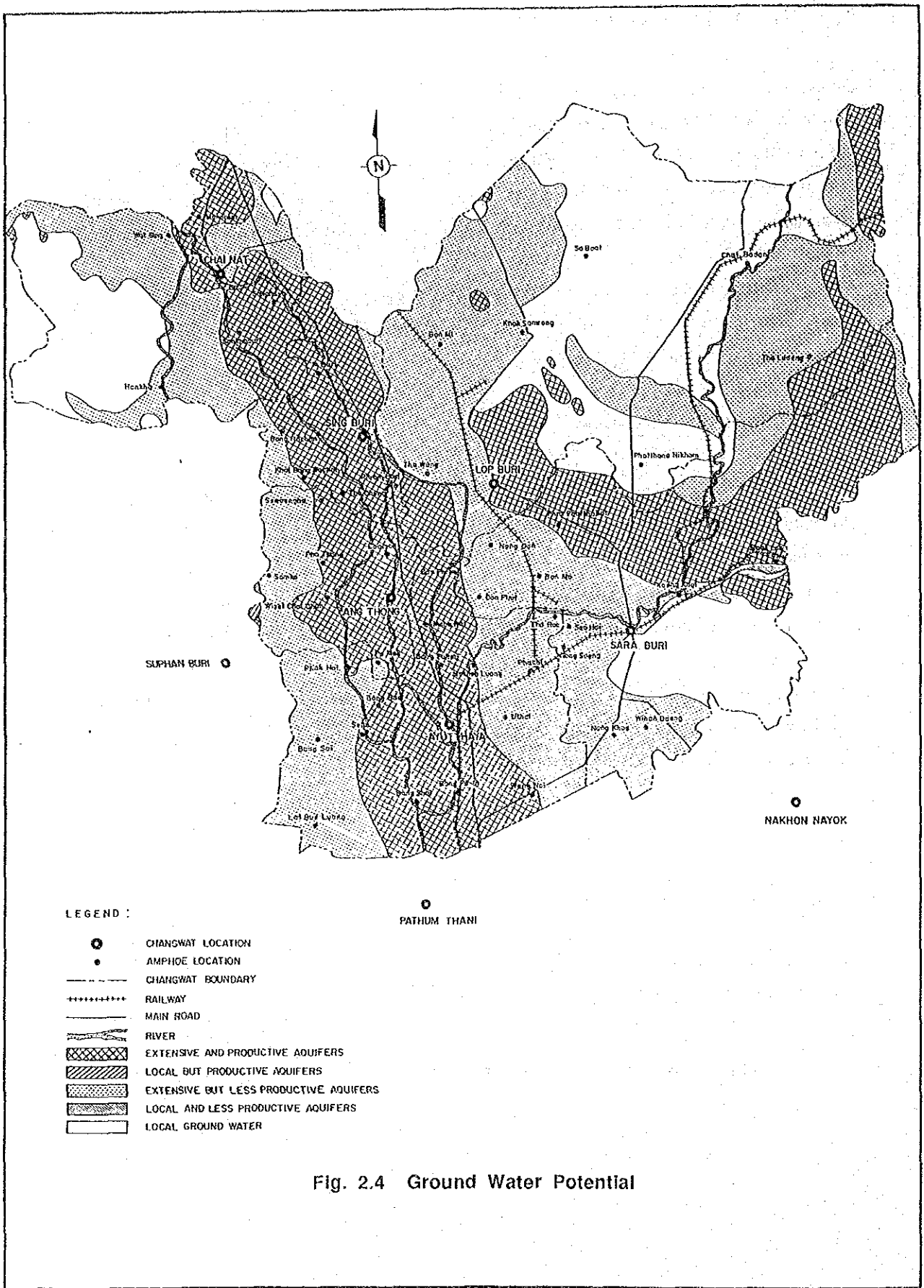


Fig. 2.4 Ground Water Potential

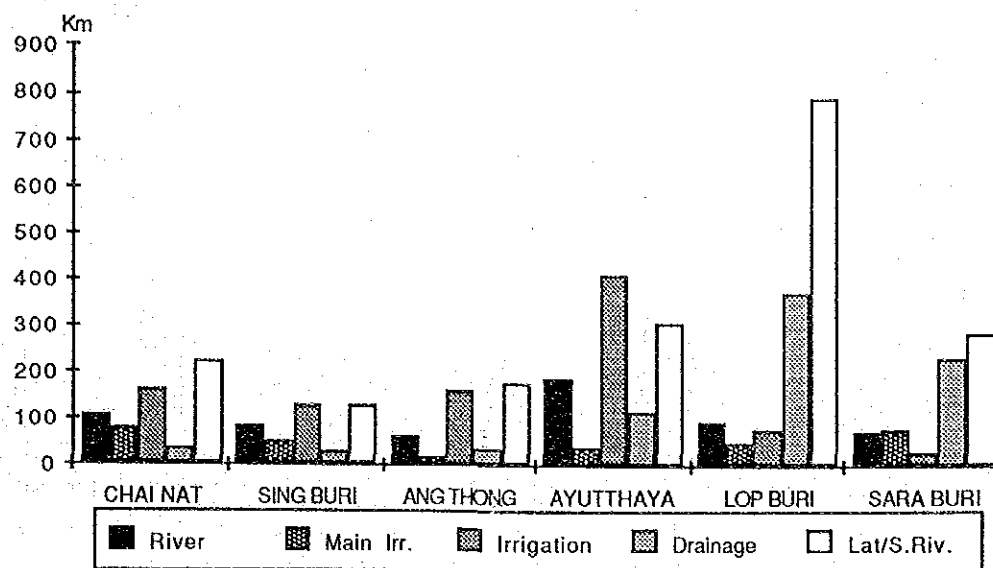


Fig. 2.5 Length of Irrigation & Drainage Facility

Table 2.3 Measured Irrigation Facilities (Kilometers)

Code No.	Name of Provinces and Districts	River	Main Irr.	Irrigation	Drainage	Lateral & Small river
1 0 0	CHAI NAT	108.33	79.20	164.99	34.53	226.11
2 0 0	SING BURI	84.06	54.33	128.37	28.86	126.98
3 0 0	ANG THONG	65.23	19.35	161.51	34.38	179.01
4 0 0	PHRANAKHON SI AYUTTHAYA	191.70	43.41	417.97	117.98	311.77
5 0 0	LOP BURI	95.98	50.16	81.91	381.49	806.51
6 0 0	SARA BURI	72.45	78.32	30.95	236.27	288.39

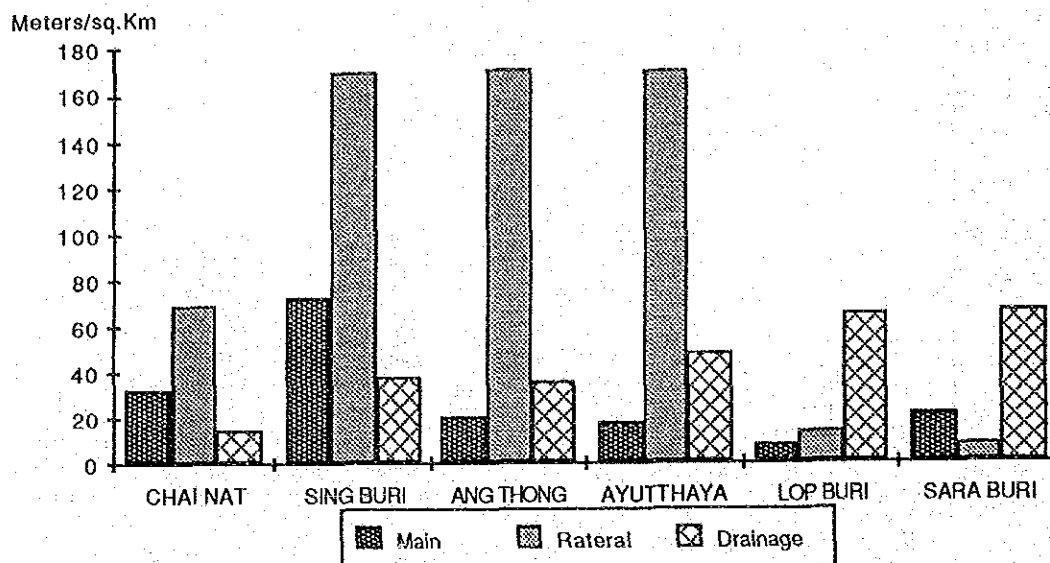


Fig. 2.6 Density of Irrigation and Drainage Facility

Table 2.4 Density of Irrigation Facilities (Meter Per sq. Kilometer)

Code No.	Name of Provinces and Districts	River	Main	Rateral	Drainage	Regulator	Dam(L) (No. of facility)
1 0 0	CHAI NAT	45	33	69	14	4	1
2 0 0	SING BURI	112	72	170	38	1	
3 0 0	ANG THONG	69	20	171	36		
4 0 0	PHRANAKHON SI AYUTTHAYA	78	18	170	48	5	
5 0 0	LOP BURI	16	9	14	65	1	
6 0 0	SARA BURI	20	22	9	66	3	1

3. ISSUES ON LAND USE MANAGEMENT

3.1 General

Fig. 3.1 shows the problems and issues of the land development and management in the past. These problems are conspicuous especially in the newly developed agricultural land. Water is another important issue related to land use and agricultural development and it is discussed in Part I of this report.

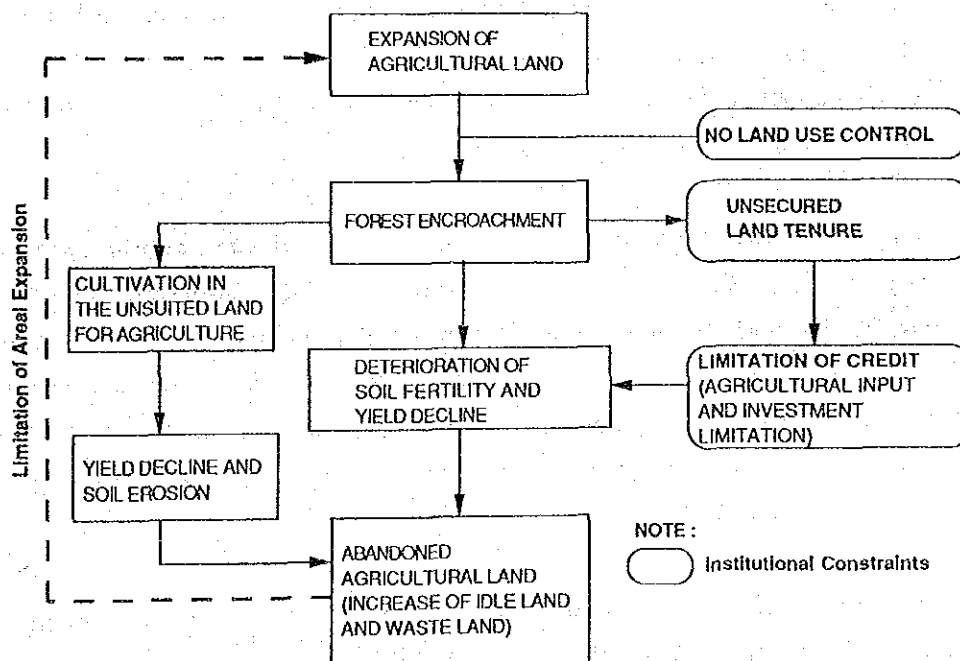


Fig. 3.1 Problem Structure of Agricultural Land Management

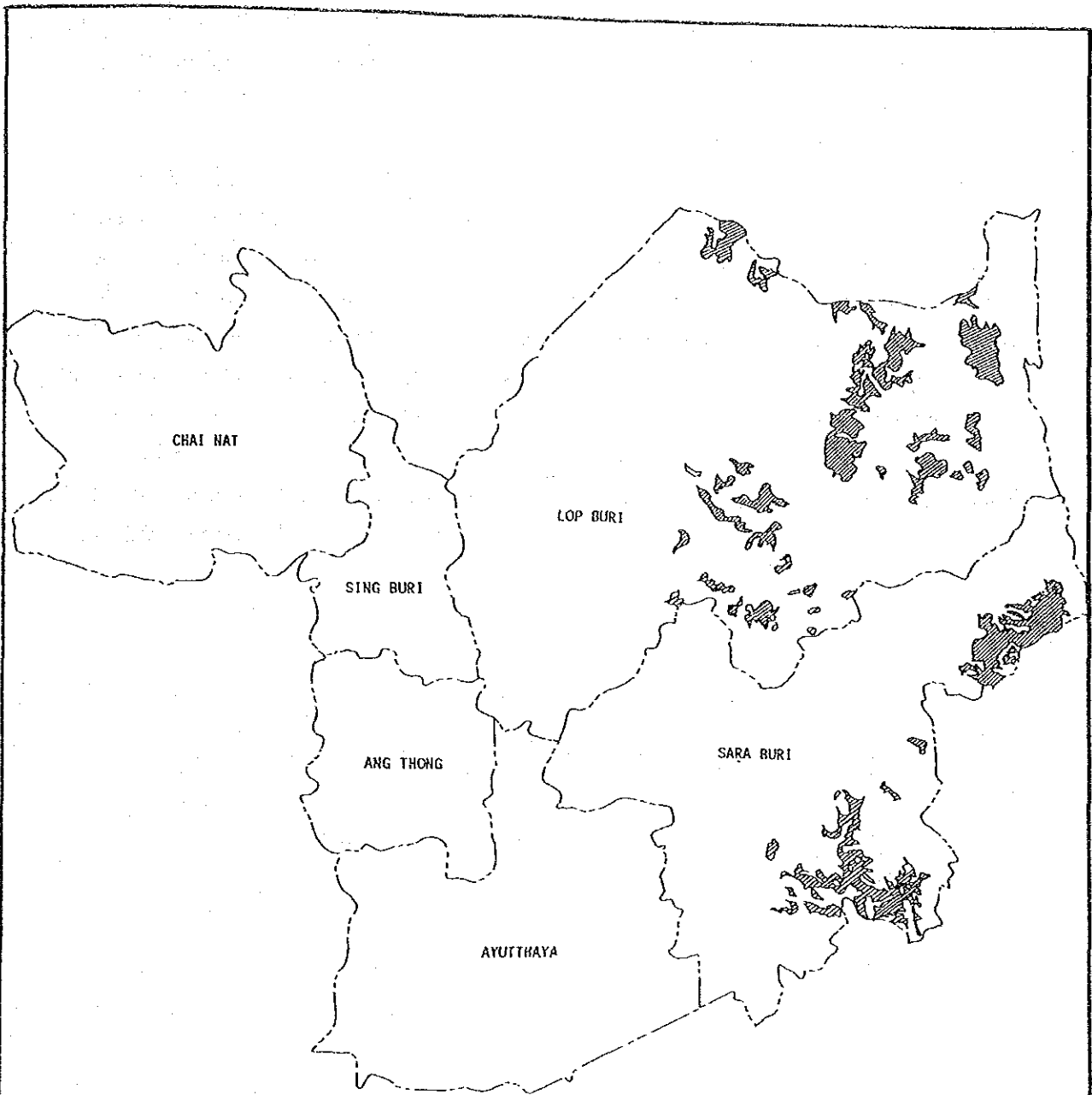
3.2 Yield Decline and Forest Land Encroachment

It is generally known that agricultural production growth in Thailand in the past was mainly due to area expansion. This has been the case for most major crops such as rice, maize, cassava, rubber and soybean. In fact, out of these crops, only rice production shows a positive yield growth rate of 0.6% per annum, while others exhibit negative growth rates in yield during 1975-1980 (World Bank, 1982).

Planted areas have expanded at an annual rate of 3.6% during 1960-70, 4.4% during 1970-75 and 4.1% during 1975-79. During the same periods, farm holding areas have expanded at the rate of 4.1%, 3.4%, and 1.2%, respectively (World Bank, 1982). Most of the expanded areas were used for cultivation of upland crops such as maize, cassava, and sorghum. This expansion of cultivated areas has taken place associated with decreases of forest land in the nation. From 1963 to 1978, the area of forest land decreased from 167.4 million rai to 76.6 million rai, or 52.1% to 23.8% of the total land area. This led to the limitation of areal expansion in the nation and resulted in serious deterioration of soil fertility. Hence, natural resource management is one of the most critical issues for the nation as a whole to maintain the economic and social fundamentals.

Due to sensitive natural environment in the tropical climate, conservation of soil and improvement of the agricultural environment (for stabilizing the agricultural production) is most important especially in the area located near the foot of mountains and upland areas. In such areas, erosion problems occur easily, if proper soil conservation measures are not taken. In the study area, erosion problems have taken place in some upland areas. Fig. 3.2 shows the distribution of erosion areas in the UCR.

The problem on forest area encroachment is occurring in the UCR. According to the Agricultural Statistical Year Book in 1988/1987, there is 234 thousand rai of forest land in the UCR. On the other hand, LANDSAT analysis carried out by the Study Team identified 991 thousand rai of primary and secondary forest area and 8 thousand rai of mining area. The area classified as not-suitable for cultivation is 1,240 thousand rai (all of which should be forest areas) and unclassified land is 2,416 thousand rai in the UCR. From these data there is at least 241 thousand rai of



LEGEND : Existing Erosion Area & Potential Erosion Area

Fig. 3.2 Erosion Area in the UCR

Source : The Study Team/Soil Map LDD

farm land encroached into the forest area and almost 1 million rai of disturbed forest. This problem is found especially in Lop Buri and Sara Buri.

3.3 Land Tenure Document

Security of land tenure is one of the most significant factors for improvement of agriculture productivity and crop diversification. To receive financial support from any organizations or agencies, the secured land title is required. Investment of facility improvement, diversification of crops, especially for tree crops requires long-term finance for growing the plant till first harvest, as well as introduction of new agricultural technics and inputs.

Table 3.1 shows the land tenure in the UCR. This table is compiled using the Rural Data Base in 1987. This table indicates number of villages where most villagers have the land title by category.

Table 3.1 Land Tenure in the UCR

Amphe Name	Unit : Number of Villages			Total Villages
	Most Villagers have land title of :			
	Temporary right	certificate of use	title deed	
CHAINAT	50 (14%)	178 (50%)	125 (35%)	353 (100%)
SINGBURI	16 (6%)	43 (16%)	218 (79%)	277 (100%)
ANGITHONG	11 (3%)	41 (10%)	373 (88%)	425 (100%)
AYUTTHAYA	77 (7%)	23 (2%)	1069 (91%)	1169 (100%)
LOPBURI	206 (21%)	368 (38%)	398 (41%)	972 (100%)
SARABURI	114 (14%)	198 (24%)	520 (63%)	832 (100%)

Source : Rural Data Base 1987.

From this table, it can generally be found that Changwats located in the Chao Phraya Project area such as Sing Buri, Ang thong and Ayutthaya have more secure land title than Lop buri and Sara Buri which is outside the project area. Since the upland crop areas in the UCR were developed later than paddy areas in the Chao Phraya Project area, issuance of land titles may be under process.

3.4 Zoning and Land Use Control

A land use pattern consistent with the land use potentials and concordant with environmental sound activities is the most desirable for not only minimal environmental impact but also realization of maximum productivity from land resources. Guiding and controlling the land use in accordance to the land potential and eliminating unnecessary environment deterioration should be implemented with appropriate measures as follows :

3.4.1 National Level

At a national level, a zoning system for land use control is indispensable to manage the natural environment. Land Development Department is responsible to prepare the land use potential map based on the natural conditions such as soil, geography, and vegetation. This can provide useful and technical information for determining preservation areas, conservation areas and development areas based on the natural conditions.

Preservation and conservation are the most important for natural environmental. Royal Forest Department is responsible for management of the designated forest areas. Activities allowed in these areas are restricted.

Main activities in this area are:

- National park with recreational and educational program
- Agro-forestry project (mulberry and sericulture, bamboo planting, cashewnut plantation, forage tree plantation, livestock etc.) Proper guidance and support for people living in these areas should be provided in the context of this policy.

Development areas include the land rehabilitation area which is classified as idle land or waste land. In many cases, idle land and waste land are found in potentially developed land for agricultural activities but not cultivated due to insufficient provision of inputs such as investment, labour and technology. This type of land usually has a soil deterioration problem.

No land use control laws or regulations have been imposed at the national level except town planning areas and specific areas. Land located outside the town planning areas should be used in a proper manner.

3.4.2 Regional and Urban Area

Changwat Plan is provided for each Changwat, however no legislative and regulatory authority has been given to the plan. General town plans are prepared by Town and Country Planning Department in accordance with the city planning law established in 1975. The city boundary designated by the plan is usually much larger than the municipality or sanitary district areas. Therefore, some agricultural land is included inside of the city boundary.

3.5 Land Consolidation

Land consolidation projects have been carried out in the UCR, and most of the project areas are located in the Chao Phraya Project Area. The land consolidation program provides full utilization of agricultural infrastructure and secured land title with financial support. This program improves the agricultural productivity to a considerable extent. Application of this program to upland crop areas of the UCR will improve the productivity and agricultural environment. The program is described as follows.

1) Type of Land Consolidation

Intensive Type : Land readjustment and full utilization of irrigation facilities are included. The project area must have enough depth of top soil for leveling work. The original plot should not be too small and not flooded area.

Extensive Type : The form of farm plot remains as it is. Only ditch and dike construction is included. Flood areas can apply for this type only.

2) Project Area

Agriculture areas where irrigation water is available in dry season (lateral or sub lateral has already been completed) are designated as the project areas. In case of application to the upland area, small and medium scale water resource development or pond irrigation scheme should be included in the program.

Land holding per household should be an appropriate size. The land consolidation law regulates the rate of area-deduction by the development to be not more than 7% of the farm land. Land holding in the project area should not include a large portion of rental farm land, and more than 50% of farmers in the designated project area should agree with the project.

3) Project components

The project includes construction of ditches and dikes for irrigation, drainage systems, roads or paths for transportation, ground leveling, soil maintenance and planning of production and distribution of agricultural products. Exchanging or transferring rights of the land are also included.

4) Treatment of Land Title

After completion of the project, the title deed is issued to each plot owners without any administrative expense.

5) Financial Arrangement

50% of the construction costs is paid by farmers. The Bank for Agriculture and Agriculture Cooperative collects the money as an installment.

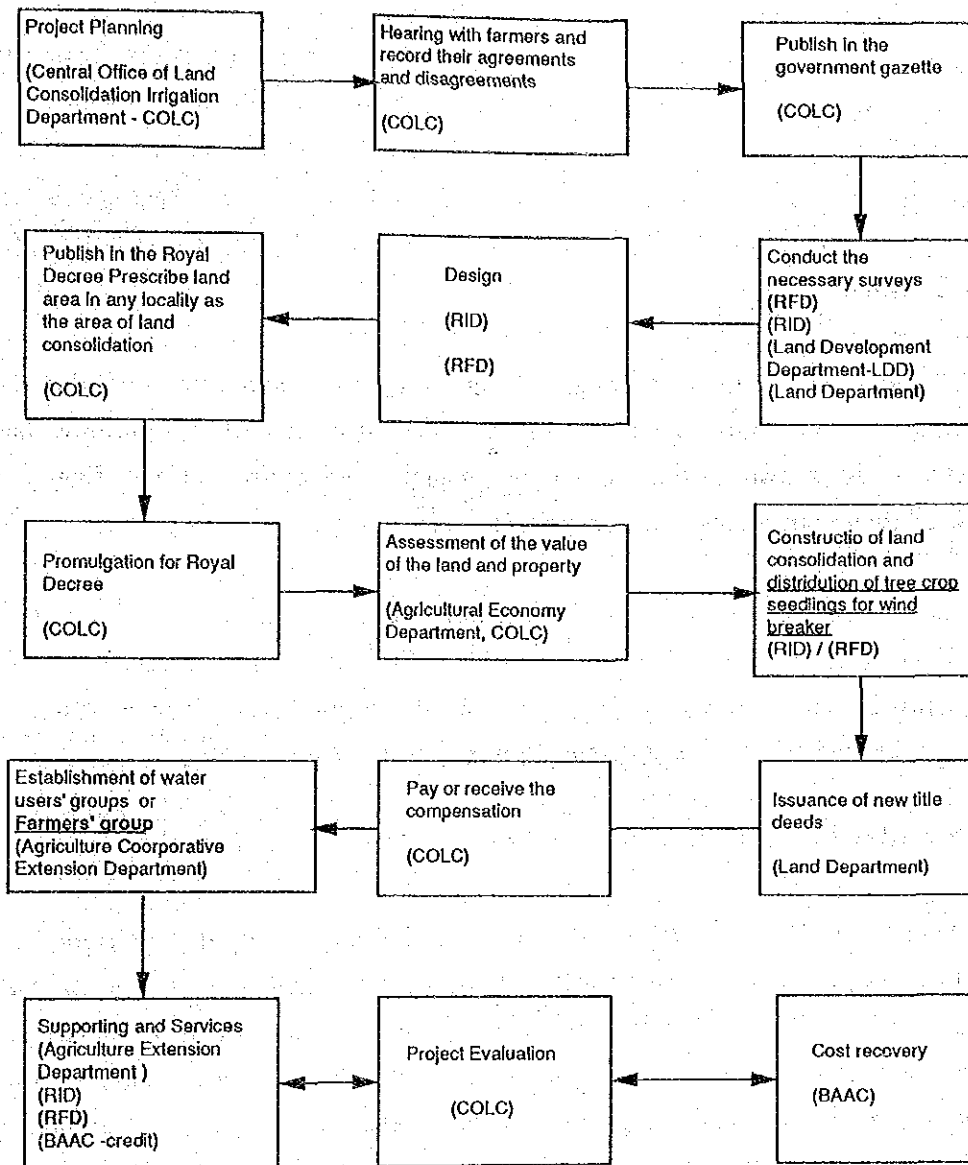
6) Administrative Procedure

An administrative procedure is shown in Appendix of this report.

Related Agencies are as follows:

- Central Office of Land Consolidation;
- Royal Irrigation Department;
- Agriculture Cooperative, Extension Department;
- Land Department (MOI);
- Agriculture Extension Department; and
- Bank for Agriculture and Agriculture Cooperatives

Fig. 3.3 shows the land consolidation procedures. Since the land consolidation programs have been carried out mainly in paddy areas, some modification of the procedure will be necessary for its application to field crops areas in the future.



Note : () indicate the responsible agencies for execution of the task
 (RFD) indicate the newly involved responsible agency and organization

Fig. 3.3 The Land Consolidation Procedures (At Present)

4. LAND USE MANAGEMENT STRATEGIES AND PROGRAMS

4.1 General

Fig. 4.1 shows the proposed programs and projects concerning agricultural land management. This corresponds to the problem structure of agricultural land management, as shown in the preceding chapter. As shown in the figure, the following three programs are proposed:

- 1) Land Use Zoning for land use guidance and control.
- 2) Land Consolidation Programs especially in the upland areas.
- 3) Agro-forestry Programs to recover land resources in erosion and encroached areas designated "Forest Preservation Area."

4.2 Land Use Zoning

Establishment of "Central Office for Land Use Management" is necessary to coordinate the land development of various agencies and preparation of the land use guidelines. The guidelines include agricultural development, industrial location and types, urban development, and preservation requirements, in conjunction with the national development strategies, taking into account natural environment and social and cultural aspects.

Land use zoning shall consist of three major areas (zones) : (1) Preservation area, (2) Conservation area, and (3) Development area.

4.2.1 Preservation Area

Preservation area shall be designated to preserve the environment as it is, or rehabilitate the environment as it should be. Major roles and functions of this area are to foster water resources, preservation of valuable flora and fauna,

prevention of natural disaster and soil erosion. In some culturally important area, preservation of landscape or its environment should be considered.

In the UCR, the area of 1.24 million rai should be designated as preservation area. At present this includes 250 thousand rai of primary forest, 750 thousand rai of secondary forest and 240 thousand rai of forest land encroached by farmers. These areas are not suitable for cultivation and permanent settlement, and should not be allowed for people to use for intensive agricultural activities.

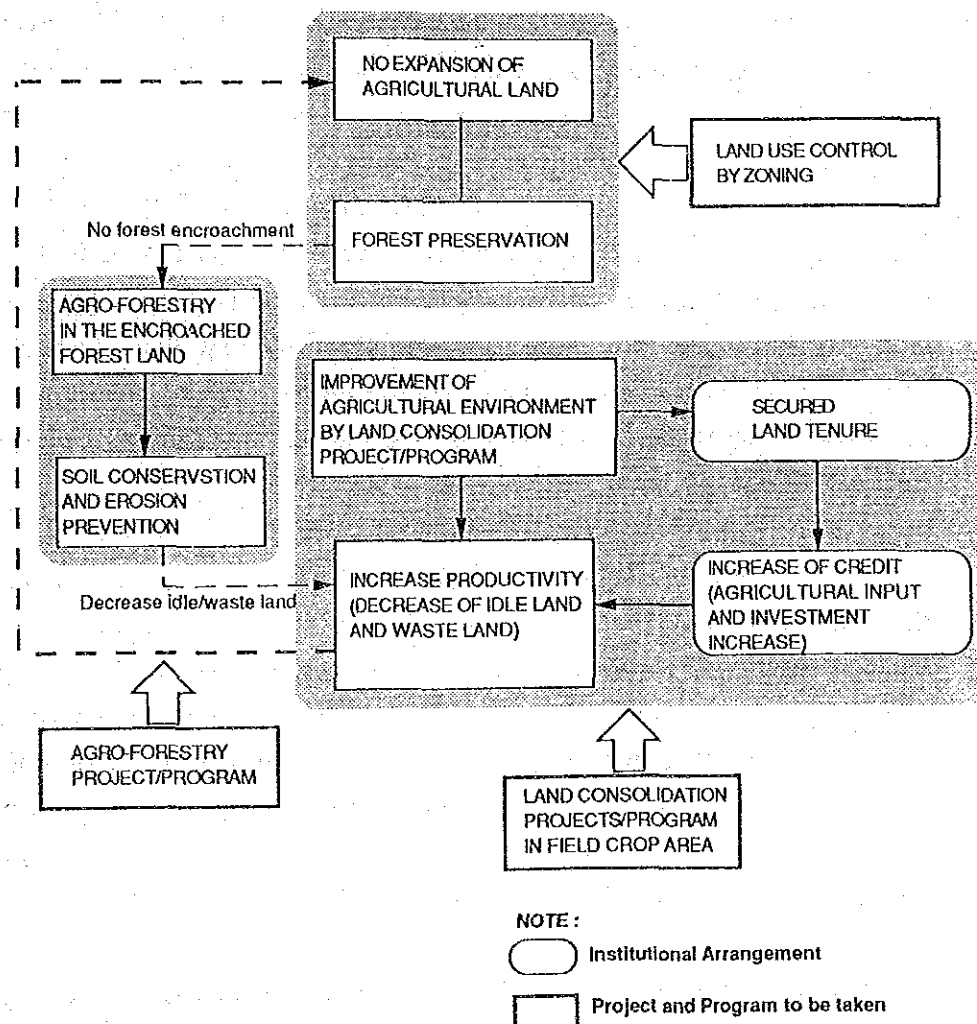


Fig. 4.1 Proposed Programs and Projects on Agricultural Land Management

4.2.2 Conservation Area

Conservation area is the area which has development potentials but is environmentally sensitive area. Agriculture in this area has constraints for full utilization and intensive cultivation. Agglomeration of industrial activities and urbanization will easily cause the environmental deterioration. Therefore, definite measures have to be taken to use the land so as not to bring environmental deterioration and flood problems.

Major concerns in this area are soil conservation for prevention of erosion, maintenance of its flood retention function and conservation of the surrounding environment for historical and archaeological assets. Development guidelines in the UCR are proposed as follows.

1) Agriculture

Conservation areas shall be designated in the upland crop area and the delta area. Soil erosion has already taken place at a part of the upland area in the UCR as described in the previous chapter. These areas should be designated as conservation area. Agro-forestry type agriculture development shall be encouraged to rehabilitate the soil and prevent the soil erosion.

The southern part of the Chao Phraya Delta in the UCR is functioning as a flood retention basin for the down stream of the river especially for Bangkok Metropolitan Area. This area should be designated as conservation area. The major crop is floating rice in these areas. Paddy and fish pond development with minimum impacts on the flood retention function is recommended.

2) Urban and Industry

Location of large scale industries and urban development should be discouraged. However, a number of industries which have already located in this area (Delta Area) should equip proper waste water and solid waste treatment plants so as to meet with the environmental standard.

Types of industries to be located in the future are strongly recommended to be pollution free. The flood retention capacity should be kept at present level in the delta area of the UCR. Instead of a polder system, a cut-and-fill method for site preparation is recommended. Some types of urban development should be also limited and a large-scale industrial area is not recommended. Special attention should be paid to equip waste water treatment plants and solid waste disposal systems in the urban area.

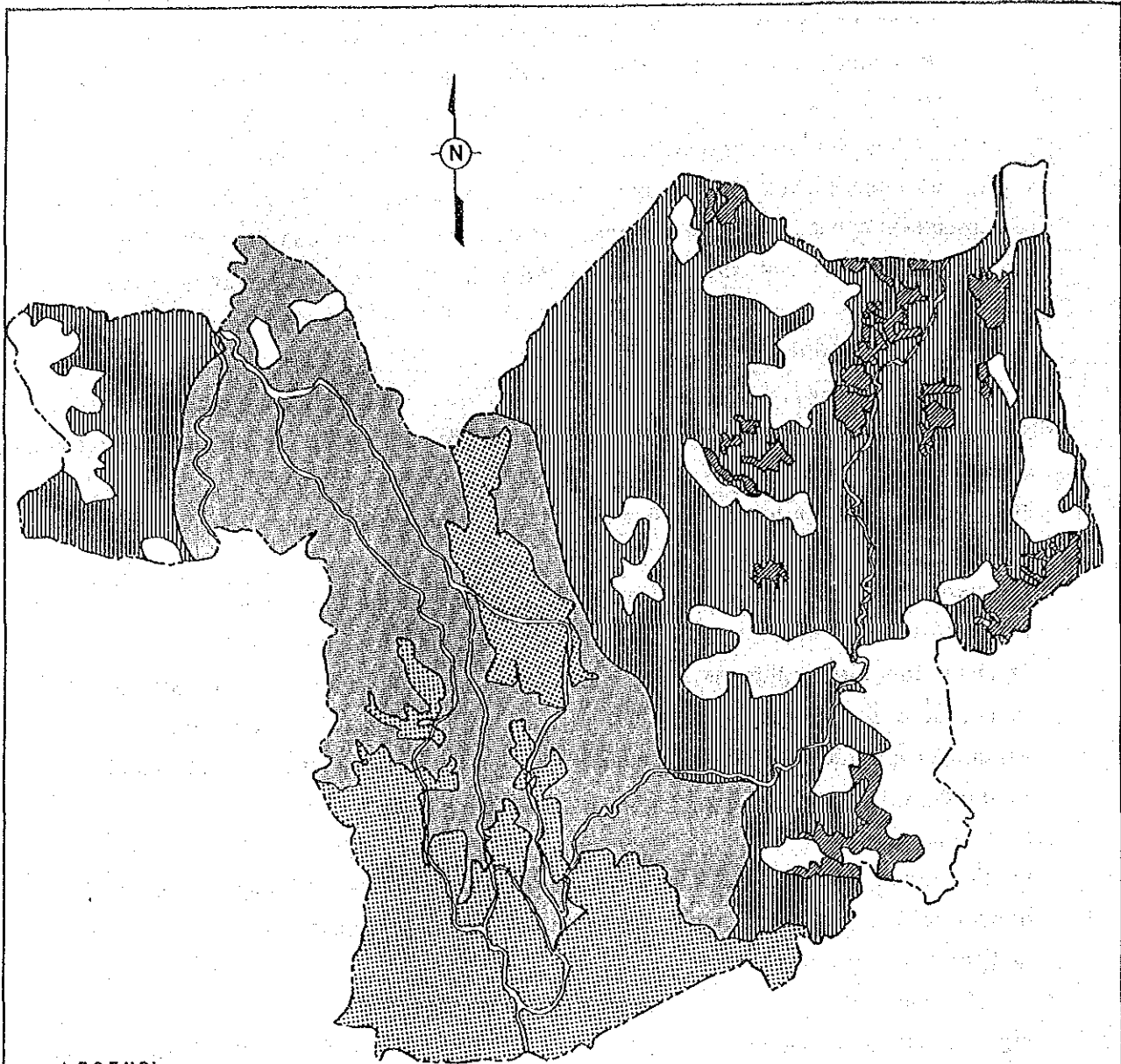
4.2.3 Development Area

Development may be induced in this area. Distinct zoning of urban development area and agricultural development area is necessary for efficient utilization of resources and minimizing the environmental deterioration.

Diversification and intensification of agriculture should be induced in the agricultural development zone. Provision of infrastructures and supporting services for full utilization of natural resources are required. Resource-based independent type industries are recommended to be located in this zone, and uncontrolled industrial land encroachment into the agricultural land should be avoided.

In the urban and industrial zone, location of industries and supporting service industries are promoted with provision of necessary infrastructures and institutional supports.

Fig. 4.2 shows a map of proposed agricultural land use zoning in the UCR, and Fig. 4.3 indicates the areal distribution of each zone. This map is prepared based upon the conditions of soil, flood potential and existing irrigation system. Location of industries and urban development areas should be determined in line with this zoning map.



LEGEND:

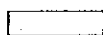



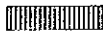
-  PRESERVATION AREA
-  CONSERVATION AREA (DELTA)
-  CONSERVATION AREA (UPLAND)
-  DEVELOPMENT AREA (DELTA)
-  DEVELOPMENT AREA (UPLAND)

Fig. 4.2 Agricultural Land Use Zoning

SOURCE: THE UCR STUDY TEAM

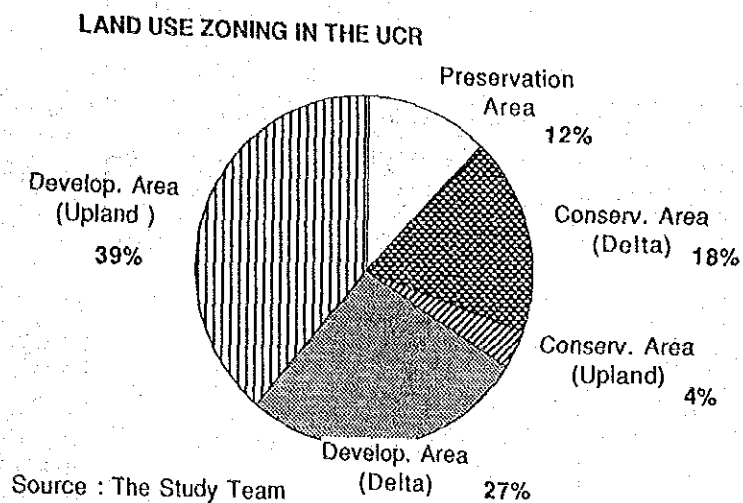


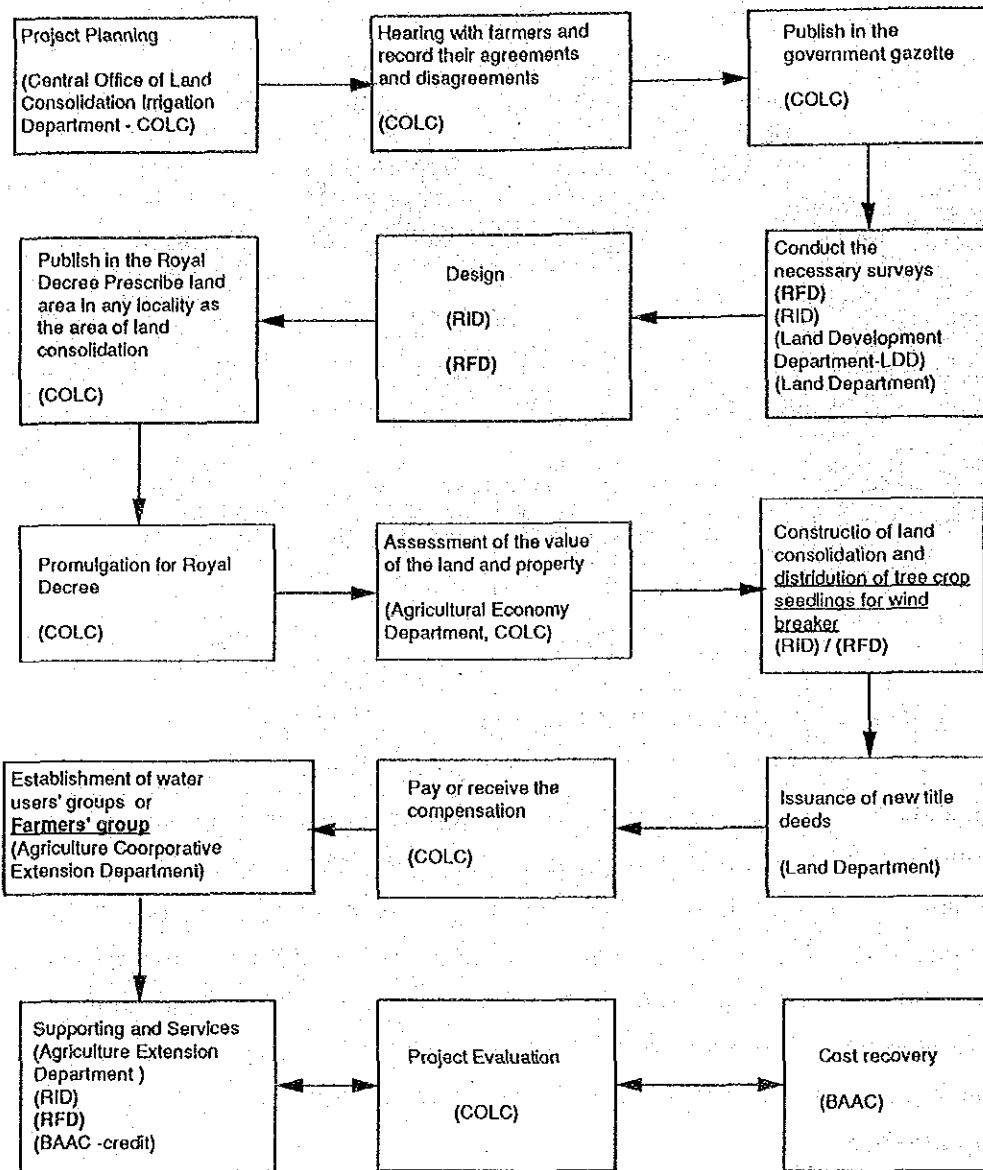
Fig. 4.3 Land Use Zoning In the UCR

4.3 Land Consolidation Program

Application of the land consolidation to field crop areas will improve the agricultural environment in the upland area in the UCR. One of the most important factors to improve the agricultural environment in the field crop areas is introduction of tree crops. Wind breaker and shade trees in conjunction with small- and medium-scale water resources development or pond construction are most important. In order to facilitate the land consolidation projects for the upland areas, involvement of the Royal Forestry Department (RFD) is indispensable.

Required wind breakers area is estimated to be 300 thousand rai in the UCR which corresponds to 10% of the field crop cultivation areas. It is estimated that more than 10 million pices of tree sheedlings per annum for 20 years are necessary to meet this requirement. Cooperation with tree crop shedding supply programs by the RFD is necessary.

Fig. 4.4 shows the proposed Land Consolidation Procedures. This is modification of the current procedures of the Central Office for Land Consolidation, RFD is incorporated into this proposed scheme for execution of the program.



Note : () indicate the responsible agencies for execution of the task
 (RFD) indicate the newly involved responsible agency and organization

Fig. 4.4 Proposed Land Consolidation Procedures

4.4 Agro-forestry Program

For the upland conservation area and encroached preservation area, an agro-forestry program is proposed. There exist 370 thousand rai of field crop area facing the erosion problem. In this area, agro-forestry program should be carried out by the Central Office for Land Consolidation as a part of upland area land consolidation program. Moreover, it is estimated that approximately 240 thousand rai of forest reserve area has been encroached by farmers. This area must be preserved as well. The agro-forestry program in coordination with the reforestation program being carried out by RFD will improve the function of the forest preservation area.

4.5 Future Land Utilization in the UCR

Land utilization in the future is estimated in accordance with the land use management strategies and programs as described above. Table 4.1 shows the existing land utilization, the future land utilization and areal changes in each category. Fig. 4.5 shows a composition of each land use category. "Other area" includes areas for infrastructure, urban and industries, and other farm holding land. It is noted that in the existing agricultural land utilization, "other area" includes approximately 750 thousand rai of secondary forest, and "forest area" includes primary forest only. On the other hand, "forest preservation area" in future includes this secondary forest as well.

Land Utilization changes implies that the intensity of agricultural diversification will increase in the UCR.

Table 4.1 Land Utilization Change In the UCR

LAND UTILIZATION 1988							UNIT : 1000 Rai
Area Name	CHAI NAT	SING BURI	ANG THONG	AYUTTHAYA	LOP BURI	SARA BURI	Total
Forest	5	0	0	0	172	56	234
Paddy	909	399	457	1,238	1,146	721	4,869
Field Crop	125	9	7	14	1,581	613	2,348
Tree crop & vegetable	36	21	21	39	47	46	209
Other area *	468	87	121	307	930	799	2,713
Total	1,544	514	605	1,598	3,875	2,235	10,373

* Including grass land, idle land and unclassified land (Agricultural Year Book 1987/88, MOA)

FUTURE LAND UTILIZATION 2010							UNIT : 1000 Rai
Area Name	CHAI NAT	SING BURI	ANG THONG	AYUTTHAYA	LOP BURI	SARA BURI	Total
Forest preservation area :	188	0	0	0	445	607	1,240
Pady	365	248	325	1,205	521	440	3,104
Field Crops	457	94	95	65	1,649	609	2,968
Agro-forestry area :	0	0	0	0	179	118	296
Tree crops & vegetable	226	70	76	65	375	209	1,021
Other area	306	102	118	257	706	254	1,743
Total	1,544	514	613	1,592	3,875	2,235	10,373

LAND USE CHANGE IN THE FUTURE							UNIT : 1000 Rai
Area Name	CHAI NAT	SING BURI	ANG THONG	AYUTTHAYA	LOP BURI	SARA BURI	Total
Forest preservation area :	183	0	0	0	273	551	1,007
Pady	-543	-149	-132	-33	-625	-282	-1,764
Field Crops	332	84	88	51	69	-4	620
Agro-forestry area :	0	0	0	0	179	118	296
Tree crops & vegetable	190	49	55	26	328	163	812
Other area	-162	16	-3	-49	-224	-545	-970
Total	0	0	8	-6	0	0	0

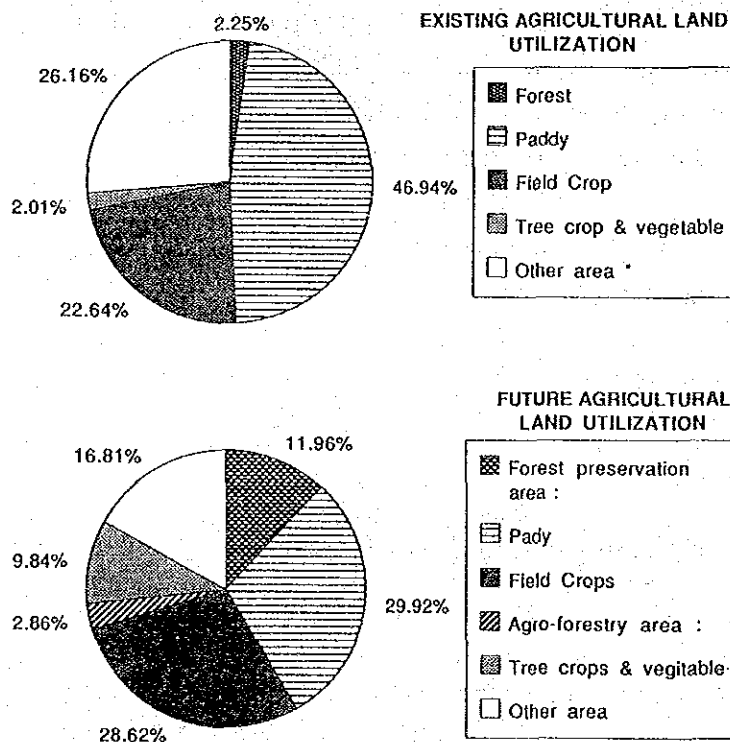


Fig. 4.5 Land Utilization Change In the UCR

PART I V

AGRICULTURAL DEVELOPMENT

1. UCR IN THE NATIONAL AGRICULTURE

The agriculture sector, including livestock, fishery and forestry, of the UCR contributed about a third of total value added of the region in 1986 (see Table 1.1). The importance of agriculture sector in the UCR economy is much larger than that of the Whole Kingdom (22.3%) and Central Region (5.6%). However, its relative magnitude decreased slightly from 33% in 1981 to 31% in 1986.

At the same period agricultural output of the UCR grew at an average annual rate of 2.7%, which is higher than that of the Central Region and the Whole Kingdom: 0.3% and 2.1% respectively. Main contributor of the growth was a crop subsector, accounting for 85% of the UCR's agricultural GRP.

Table 1.1 Agricultural GNP and GRP

	Agr. GRP (1986) at 1972 Price (Unit: Million B)	Share		Annual Growth Rate(1982-86) (% p.a.)	Share of Subsector			
		1981 (%)	1986 (%)		Crop (%)	Livestock (%)	Fishery (%)	Forestry (%)
CHAI NAT	988.9	44.2	45.4	2.2	89.9	8.2	1.8	0.0
SING BURI	445.1	39.2	31.0	- 0.4	88.5	10.0	1.6	0.0
ANG THONG	508.0	35.7	33.8	1.8	80.6	17.1	2.3	0.0
AYUTTHAYA	932.4	23.6	28.3	8.6	83.5	11.0	5.5	0.0
LOP BURI	1,377.8	43.7	36.4	- 0.2	85.6	12.9	1.5	0.0
SARA BURI	1,123.7	22.8	21.0	4.5	81.7	17.8	0.3	0.2
UCR	5,375.9	33.2	30.7	2.7	85.0	12.9	2.1	0.0
CENTRAL	10,685.0	7.0	5.6	0.3	71.6	14.0	14.4	0.0
WHOLE KINGDOM	86,215.6	25.0	22.3	2.1	75.5	13.3	8.1	3.1

Source: HESDB

2. PRESENT SITUATION, CONSTRAINTS AND POTENTIALS

2.1 Production and Planted Area

2.1.1 Major Crops

The UCR has enjoyed high productivity of rice because of its natural advantage. Rice is by far the most widespread crop in the UCR in 1987/88, covering 64% of total planted area of the UCR, accounting for 8.8% of total planted area and contributing 11.7% of total production of the Whole Kingdom (see Table 2.1).

During the period 1982/83 to 87/88, rice production increased at a rate of 2.8%. The increase in this period is a result of increased productivity rather than increased area planted: 2.9% p.a. and -0.1% p.a. respectively (see Table 2.2). Rice production in the area, however, fluctuated during the period because of rice price depression in the international market. Yield of rice in rainy season was far below the yield in dry season; 55% of dry season (see Table 2.1). According to Rice Research Institute, same varieties such as Rd 7, 23 and 27, are cultivated during dry and rainy seasons. Natural environment for rice cultivation in rainy season, however, is very different from that in dry season because of flood. Therefore, pest, disease and water control are difficult in rainy season.

Rice cultivation is dominant in Changwat Chai Nat, Sing Buri, Ang Thong and Ayutthaya, covering more than 90% of total planted area of each province. The predominance of rice cultivation is determined by natural conditions of these province such as soil. In these provinces, second rice planted area accounts for more than 20% of major rice planted area; especially in Ang Thong and Sing Buri, the percentage reaches 40.5% and 33.2% respectively. Sing Buri recorded the highest average rice productivity of both major and second rice. Especially major rice productivity is much higher than that of other provinces in the UCR and the whole Kingdom.

Table 2.1 Planted Area Production and Yield (1987/88)

		Major Rice	Second Rice	Total Rice	Maiz	Cassava	Sugar Cane	Mungbean	Sorghum	Soybean	Groundnuts	Cotton
CHAI NAT	Planted Area (1,000rai)	906.2	238.5	1,144.7	18.8	59.5	12.0	7.7	5.4	3.1	3.2	0.1
	Harvested Area (1,000rai)	883.2	237.1	1,120.3	15.1	55.0	11.4	7.6	4.8	2.3	3.1	0.1
	Production (1,000tons)	347.1	150.2	497.3	4.2	134.0	81.2	0.7	0.9	0.4	0.9	0.0
	Yield (Kgs per rai)	393	634	444	280	2436	7165	89	193	154	272	217
SING BURI	Planted Area (1,000rai)	378.7	125.6	504.3			9.1	7.9		3.3	4.4	
	Harvested Area (1,000rai)	338.6	125.6	464.3			8.8	7.5		2.5	4.4	
	Production (1,000tons)	164.7	86.9	251.7			113.4	0.8		0.4	1.2	
	Yield (Kgs per rai)	486	692	542			12852	109		163	269	
ANG THON	Planted Area (1,000rai)	432.1	175.1	607.2			6.9	9.9		0.5		
	Harvested Area (1,000rai)	427.8	174.8	602.5			6.9	9.4		0.5		
	Production (1,000tons)	153.4	120.2	273.6			83.2	1.0		0.1		
	Yield (Kgs per rai)	359	688	454			11971	110		156		
AYUTHAYA	Planted Area (1,000rai)	994.0	208.3	1,202.3				11.2				
	Harvested Area (1,000rai)	890.8	208.2	1,099.0				9.9				
	Production (1,000tons)	300.2	142.8	443.0				0.9				
	Yield (Kgs per rai)	337	686	403				87				
LOP BURI	Planted Area (1,000rai)	952.4	97.6	1,050.0	1,135.0	69.0	60.0	170.5	441.9	78.3	7.7	32.4
	Harvested Area (1,000rai)	946.6	97.3	1,044.1	828.6	66.1	56.0	161.6	388.0	70.7	7.5	31.1
	Production (1,000tons)	325.7	63.1	388.8	263.5	163.9	450.4	16.2	75.1	12.5	1.7	6.9
	Yield (Kgs per rai)	344	648	372	318	2480	8047	100	194	176	224	222
SARABURI	Planted Area (1,000rai)	615.1	47.6	662.7	532.4	41.4	45.8	70.6	45.1	59.0	7.9	11.9
	Harvested Area (1,000rai)	611.7	47.6	659.3	415.2	38.5	42.1	64.1	41.0	47.1	7.1	11.7
	Production (1,000tons)	228.2	29.7	257.9	137.9	87.2	333.8	7.0	10.4	6.8	1.8	2.9
	Yield (Kgs per rai)	373	624	391	332	2267	7930	109	253	144	252	245
UCR	Planted Area (1,000rai)	4,276.6	892.7	5,171.3	1,686.2	169.9	133.9	277.9	492.4	144.2	23.1	44.4
	Harvested Area (1,000rai)	4,098.9	890.6	4,989.5	1,258.9	159.6	125.2	209.1	433.8	123.2	22.1	42.9
	Production (1,000tons)	1,510.3	593.0	2,112.3	405.6	365.1	1,062.0	26.6	86.4	20.1	5.5	9.8
	Yield (Kgs per rai)	371	666	423	322	2,413	8,481	102	199	163	249	228
CENTRAL	Planted Area (1,000rai)	11,752.9	3,136.4	14,889.3	3,015.2	3,232.6	2,518.3	325.7	532.1	243.1	102.1	143.4
	Harvested Area (1,000rai)	11,385.5	3,116.0	14,501.5	2,409.2	3,173.8	2,457.4	306.8	469.0	212.1	98.5	140.4
	Production (1,000tons)	4,126.4	2,007.6	6,134.0	824.6	7,803.6	16,503.2	31.4	94.2	35.4	22.7	27.8
	Yield (Kgs per rai)	362	644	423	342	2459	7530	102	201	167	230	198
WHOLE KINGDOM	Planted Area (1,000rai)	53,910.0	4,563.9	58,473.9	10,941.0	9,819.4	3,663.6	2,899.9	1,105.3	2,260.4	762.6	412.3
	Harvested Area (1,000rai)	52,263.3	4,504.9	56,768.2	8,484.2	9,667.6	3,566.5	2,734.9	997.6	1,895.9	736.8	396.5
	Production (1,000tons)	15,271.5	2,770.5	18,042.1	2,780.9	22,307.0	27,191.2	267.3	191.6	337.7	161.5	74.3
	Yield (Kgs per rai)	292	615	316	328	2307	7624	98	192	178	219	187

Source: Agricultural Statistics of Thailand

Table 2.2 Annual Growth Rate of Planted Area Production and Yield (1982/83-1987/88)

		Major Rice	Second Rice	Total Rice	Maiz	Cassava	Sugar Cane	Mungbean	Sorghum	Soybean	Groundnuts	Cotton	Total Planted area
CHAI NAT	Planted Area	1.2%	2.1%	1.4%	-1.9%	0.4%	-16.8%	-12.2%	-1.5%	25.3%	7.8%		0.9%
	Harvested Area	2.5%	2.1%	2.4%	8.9%	6.0%	-17.6%	-11.1%	-3.5%	18.6%	8.9%		2.1%
	Production	3.3%	4.5%	3.7%	-1.3%	-0.9%	-13.5%	-9.5%	-0.1%	26.0%	10.4%		
	Yield	0.8%	2.4%	1.2%	-9.4%	-1.6%	5.1%	1.7%	3.6%	6.4%	1.4%		
SING BURI	Planted Area	-3.8%	0.1%	-2.9%			24.4%	-0.1%		23.9%			-2.4%
	Harvested Area	-5.6%	0.1%	-4.2%			23.8%	-1.2%		23.9%			-3.7%
	Production	-3.2%	2.6%	-1.4%			34.6%	6.2%		39.7%			
	Yield	2.5%	2.5%	2.9%			8.7%	7.5%		12.7%			
ANG THON	Planted Area	-1.4%	-2.1%	-1.6%			13.3%	0.8%					-1.4%
	Harvested Area	-1.5%	-2.1%	-1.7%			13.4%	-0.3%					-1.5%
	Production	2.6%	2.6%	2.7%			18.3%	12.9%					
	Yield	4.2%	4.9%	4.4%			4.3%	13.3%					
AYUTHAYA	Planted Area	-4.1%	-2.0%	-3.8%				2.6%					-3.7%
	Harvested Area	-5.6%	-1.9%	-4.9%				0.1%					-4.9%
	Production	-2.2%	3.8%	-0.5%				2.0%					
	Yield	3.6%	5.8%	4.7%				1.9%					
LOP BURI	Planted Area	4.5%	10.2%	4.9%	-3.0%	36.3%	39.7%	-12.2%	-5.8%	10.7%	6.3%	-20.6%	-1.3%
	Harvested Area	4.5%	10.1%	5.0%	-2.8%	46.0%	32.7%	-11.9%	-8.1%	9.6%	7.3%	-20.5%	-1.3%
	Production	7.2%	14.3%	8.2%	-8.7%	42.0%	40.1%	-8.0%	-5.5%	13.2%	4.0%	-18.7%	
	Yield	2.5%	3.8%	3.0%	-6.1%	-2.8%	1.7%	4.3%	2.9%	3.2%	-3.1%	2.3%	
SARABURI	Planted Area	2.8%	25.6%	3.8%	-3.9%	2.9%		2.7%	-21.2%	14.9%	-13.2%	-9.8%	-0.5%
	Harvested Area	2.7%	25.6%	3.7%	-6.5%	15.5%		1.5%	-22.7%	10.4%	-13.4%	-8.4%	-2.2%
	Production	3.6%	27.3%	5.2%	-8.2%	1.6%		0.1%	-18.0%	4.7%	-5.7%	-6.0%	
	Yield	0.9%	1.4%	1.5%	0.2%	-12.0%		4.1%	6.1%	-5.1%	8.8%	2.6%	
UCR	Planted Area	-0.1%	1.2%	0.1%	-3.3%	9.3%	22.6%	-8.4%	-8.1%	13.2%	-1.8%	-18.3%	-1.3%
	Harvested Area	-0.4%	1.2%	-0.1%	-4.8%	18.0%	21.1%	-8.4%	-10.3%	10.6%	-1.1%	-18.1%	-1.8%
	Production	1.9%	5.1%	2.8%	-9.5%	9.1%	27.7%	-4.1%	-7.6%	10.5%	4.0%	-15.9%	
	Yield	2.3%	3.6%	2.9%	-3.9%	-7.5%	5.4%	4.7%	3.0%	-0.1%	5.2%	2.6%	
CENTRAL	Planted Area	-0.9%	-0.2%	-0.7%	3.1%	0.4%	0.7%	-8.6%	-7.8%	14.6%	0.3%	-12.0%	-0.4%
	Harvested Area	-0.1%	-0.1%	-0.1%	4.2%	7.4%	0.4%	-8.6%	-9.9%	12.2%	0.2%	-10.4%	0.8%
	Production	0.2%	2.7%	1.0%	-0.4%	1.5%	2.7%	-4.7%	-7.2%	13.5%	2.6%	-9.8%	
	Yield	0.2%	2.8%	1.0%	-4.4%	-5.6%	2.3%	4.2%	2.9%	1.2%	2.3%	0.7%	
WHOLE KINGDOM	Planted Area	-0.8%	2.9%	-0.6%	0.8%	2.9%	0.1%	-0.9%	-6.3%	23.8%	0.0%	-10.4%	0.2%
	Harvested Area	0.1%	2.9%	0.3%	0.8%	8.7%	-0.2%	-0.3%	-7.5%	24.6%	0.1%	-9.9%	1.2%
	Production	0.7%	5.7%	1.3%	-1.5%	3.3%	2.2%	-1.0%	-4.1%	24.4%	2.1%	-9.4%	
	Yield	0.6%	2.7%	1.0%	-2.3%	-5.0%	2.4%	-0.6%	3.7%	-0.2%	2.0%	0.5%	

Source: Agricultural Statistics of Thailand

Maize is the second widespread crop in the UCR, covering 20.7% of total planted area in 1987/88. Maize production of the UCR contributed 14.6% of maize production of the Whole Kingdom and 49.2% of that of the Central Region. However, planted area, production and yield of maize in the area decreased during 1982/83-1987/88. Main provinces of maize production in the UCR are Lop Buri and Sara Buri, together contributing 99% of total maize production in the UCR. Another point of maize cultivation is that the ratio of planted area to harvested area is low (74.6%) compared with other regions and other crops in the UCR (see Table 2.3).

Of the main crops, cassava, sugarcane and soybean show rapid expansion of planted areas in the UCR during 1982/83-1987/88.

Of these main field crops, production of forage crop such as maize, cassava, sorgham and soybean is dominant. These products have played an important role in supporting livestock and feed factories.

Table 2.3 Ratio of Harvested Area Per Planted Area

	Major Rice	Second Rice	Maize	Field Crop
CHAI NAT	100.0	100.0	80.3	95.8
SING BURI	99.5	100.0	-	93.7
ANG THONG	99.8	100.0	-	88.0
AYUTTHAYA	98.5	100.0	-	80.9
LOP BURI	95.2	100.0	73.0	83.7
SARA BURI	99.9	100.0	78.0	87.1
UCR	98.5	100.0	74.6	88.3
CENTRAL	95.6	100.0	79.9	95.1
WHOLE KINGDOM	92.9	100.0	77.5	95.5

Source: Agricultural Statistics of Thailand

2.1.2 Other Crops

1) Vegetables

Vegetable production in the UCR contributed 1.7% of total crop GRP in 1986 while the planted area accounts for only 0.3% of total planted area in the UCR. It shows that per area productivity of vegetable is high compared with other crops. During the period 1981-86 vegetable production in value added and planted area decreased at an average annual rate of -16% and -24% respectively. Of the vegetable planted areas only garlic and baby corn increased during the same period. Bird pepper, long bean and short cucumber, which are the most popular varieties of vegetable for cultivation in the Whole Kingdom, are also the most wide spread vegetable production in the UCR. Main vegetable planted area is Lop Buri, which accounts for 31% of the total planted area in the UCR.

Table 2.4 Vegetable Planted Area (1986/87)

	Planted Area (rai)	Growth* Rate (%)	Share of Main Vegetable Planted Area		
			Crop (%)	Crop (%)	Crop (%)
Chai Nat	4765	-10.0	Baby Corn(22)	Long Bean(14)	Short Cucumber(12)
Sing Buri	1646	-38.0	Long Bean(28)	Short Cucumber(20)	Baby Corn(9)
Ang Thong	1764	-28.0	Long Bean(33)	Short Cucumber(19)	Bird Pepper(13)
Ayutthaya	3052	- 7.6	Long Bean(26)	Short Cucumber(24)	Chilli(20)
Lop Buri	6899	-23.8	Long Bean(14)	Bird Pepper(11)	Baby Corn(11)
Sara Buri	3959	-29.4	Bird Pepper(63)	Garlic(15)	Long Bean(8)
UCR	22085	-24.3	Bird Pepper(19)	Long Bean(17)	Short Cucumber(12)
Central	59416	-15.2	Chinese Kale(14)	Long Bean(13)	Short Cucumber(10)
Whole Kingdom	1687330	- 3.7	Bird Pepper(16)	Garlic(11)	Chilli(7)

* Annual Growth Rate 1981/82 - 1986/87

Source : Agricultural Extension Office

2) Fruit Production

Fruit production in the UCR contributed 6.4% of the total crop GRP in 1986. During the period 1981-86 fruit production and planted area increased at an average annual rate of 0.9% and 4.1%, respectively. Especially the planted area in Lopburi expanded significantly at a rate of 20.3% per annum.

However, the area of Ang Thong decreased by -6.0% per annum. Of the planted area, the area of unmaturing fruit tree and unharvested area per planted area reaches about 30%, and this means that production is expected to increase in the near future. Main products are mango, coconut and klue namwa, covering 56% of total fruit planted area. These crops are most prevailing in Thailand.

Sara Buri is a main fruit production area in the UCR, which accounts for 33% of the total fruit planted area of the UCR.

Fruits which expanded their planted area significantly in the UCR during the 1981-86 are cashew nut (26%), jack fruit (11%), klue namwa (9%), pomelo (8%), sugar apple (8%) and mango (7%). Cashew nut expanded mainly in Lop Buri; jack fruit in Lop Buri and Chai Nat; klue namwa in Ayutthaya, Lop Buri and Sing Buri; pomelo in Ayutthaya, Sing Buri and Ang Thong; sugar apple in Lop Buri; and mango in Lop Buri, Chai Nat and Sing Buri.

Table 2.5 Fruit Planted Area

	Planted Area (rai)	Growth* Rate (%)	Share of Main Fruit Planted Area		
			Crop (%)	Crop (%)	Crop (%)
Chai Nat	30950	5.5	Mango(25)	Coconut(19)	Klue Namwa(16)
Sing Buri	21932	6.5	Mango(30)	Klue Namwa(29)	Coconut(16)
Ang Thong	29318	-6.0	Coconut(37)	Mango(32)	Klue Namwa(11)
Ayutthaya	45310	4.6	Mango(29)	Klue Namwa(27)	Coconut(16)
Lop Buri	36270	20.3	Sugar Apple(18)	Mango(16)	Coconut(13)
Sara Buri	80633	3.1	Mango(24)	Tangerine(23)	Coconut(21)
UCR	244413	4.1	Mango(25)	Coconut(20)	Klue Namwa(16)
Central	539074	2.1	Tangerine(30)	Coconut(18)	Mango(18)
Whole Kingdom	7500153	-2.3	Coconut(38)	Mango(14)	Klue Namwa(12)

* 1981/82 - 1986/87

Source : Agricultural Extension Office