

No. 52

THE KINGDOM OF CAMBODIA
MINISTRY OF AGRICULTURE,
FORESTRY AND FISHERIES

JAPAN INTERNATIONAL
COOPERATION AGENCY
(JICA)

**MASTER PLAN STUDY ON
THE INTEGRATED AGRICULTURAL AND RURAL
DEVELOPMENT PROJECT
IN THE SUBURBS OF PHNOM PENH**

EXECUTIVE SUMMARY

February, 1995

NIPPON KOEI CO., LTD.

A F A
J R
95 - 12

THE KINGDOM OF CAMBODIA MINISTRY OF AGRICULTURE,

MASTER PLAN STUDY ON THE INTEGRATED AGRICULTURAL

February 1995



JICA LIBRARY



1119838(9)

27733

THE KINGDOM OF CAMBODIA
MINISTRY OF AGRICULTURE,
FORESTRY AND FISHERIES

JAPAN INTERNATIONAL
COOPERATION AGENCY
(JICA)

**MASTER PLAN STUDY ON
THE INTEGRATED AGRICULTURAL AND RURAL
DEVELOPMENT PROJECT
IN THE SUBURBS OF PHNOM PENH**

EXECUTIVE SUMMARY

February, 1995

NIPPON KOEI CO., LTD.

国際協力事業団

27733

LIST OF REPORTS

EXECUTIVE SUMMARY

VOLUME-I MAIN REPORT - MASTER PLAN STUDY-

VOLUME-II MAIN REPORT - FEASIBILITY STUDY-

VOLUME-III ANNEXES

- Annex I Hydrometeorology
- Annex II Soils and Land Use
- Annex III Geology and Embankment Materials
- Annex IV Agriculture and Agricultural Economy
- Annex V Irrigation and Drainage
- Annex VI Rural Infrastructure
- Annex VII Socio-economy and Life Improvement
- Annex VIII Environmental Aspects
- Annex IX Cost Estimate

VOLUME-IV DRAWINGS

PREFACE

In response to a request from the Royal Government of the Kingdom of Cambodia, the Government of Japan decided to conduct a Master Plan Study on the Integrated Agricultural and Rural Development Project in the Suburbs of Phnom Penh and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Kingdom of Cambodia a study team headed by Mr. Shinichi Yano, Nippon Koei Co., Ltd., three times from October 1993 to December 1994.

The team held discussions with the officials concerned of the Royal Government of the Kingdom of Cambodia, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Royal Government of the Kingdom of Cambodia for their close cooperation extended to the team.

February, 1995



Kimio Fujita
President

Japan International Cooperation Agency

February, 1995

Mr. Kimio Fujita
President,
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Sir,

We have the pleasure of submitting the study report for the Master Plan Study on the Integrated Agricultural and Rural Development Project in the Suburbs of Phnom Penh, in accordance with the Scope of Work agreed upon between the Ministry of Agriculture and the Japan International Cooperation Agency (JICA).

The study was carried out for a total period of 17 months from October 1993 to February 1995. The master plan for the integrated agricultural and rural development was basically formulated with principal aim of increase of agricultural production and improvement of rural life conditions, paying attention to environment conservation in the study area which consists of Kandal Stung Area in Kandal Province and Tonle Bati Area in Takeo Province, totalled 16,000 ha.

The basic development plans of the project consist of six aspects ; (1) protection from flood damage, (2) irrigation and drainage improvement, (3) agricultural production promotion, (4) improvement of rural life condition, (5) agricultural and rural infrastructure development, and (6) strengthening of the agricultural support institute and service systems, and these aspects are interlinked each other to achieve the main targets of the plan. We would recommend that the project will be soon implemented in line with the conclusions presented in this report.

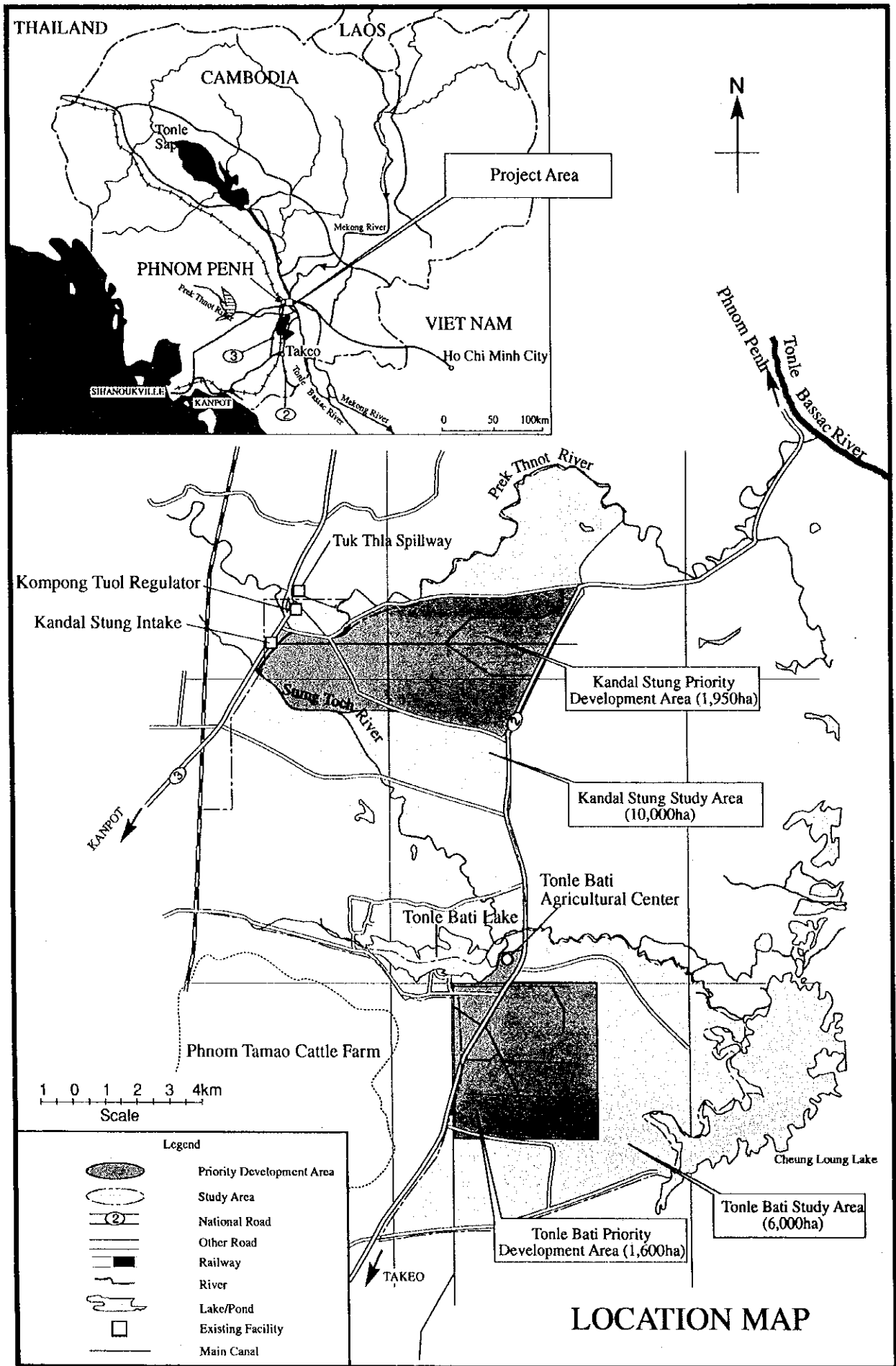
We wish to express our deep appreciation and gratitude to the personnel concerned of your and other Agencies, your Cambodia Office, the Embassy of Japan in the Kingdom of Cambodia, and the Authorities concerned of the Royal Government of the Kingdom of Cambodia as well as various NGOs for the courtesies and cooperation extended to us during our field surveys and studies.

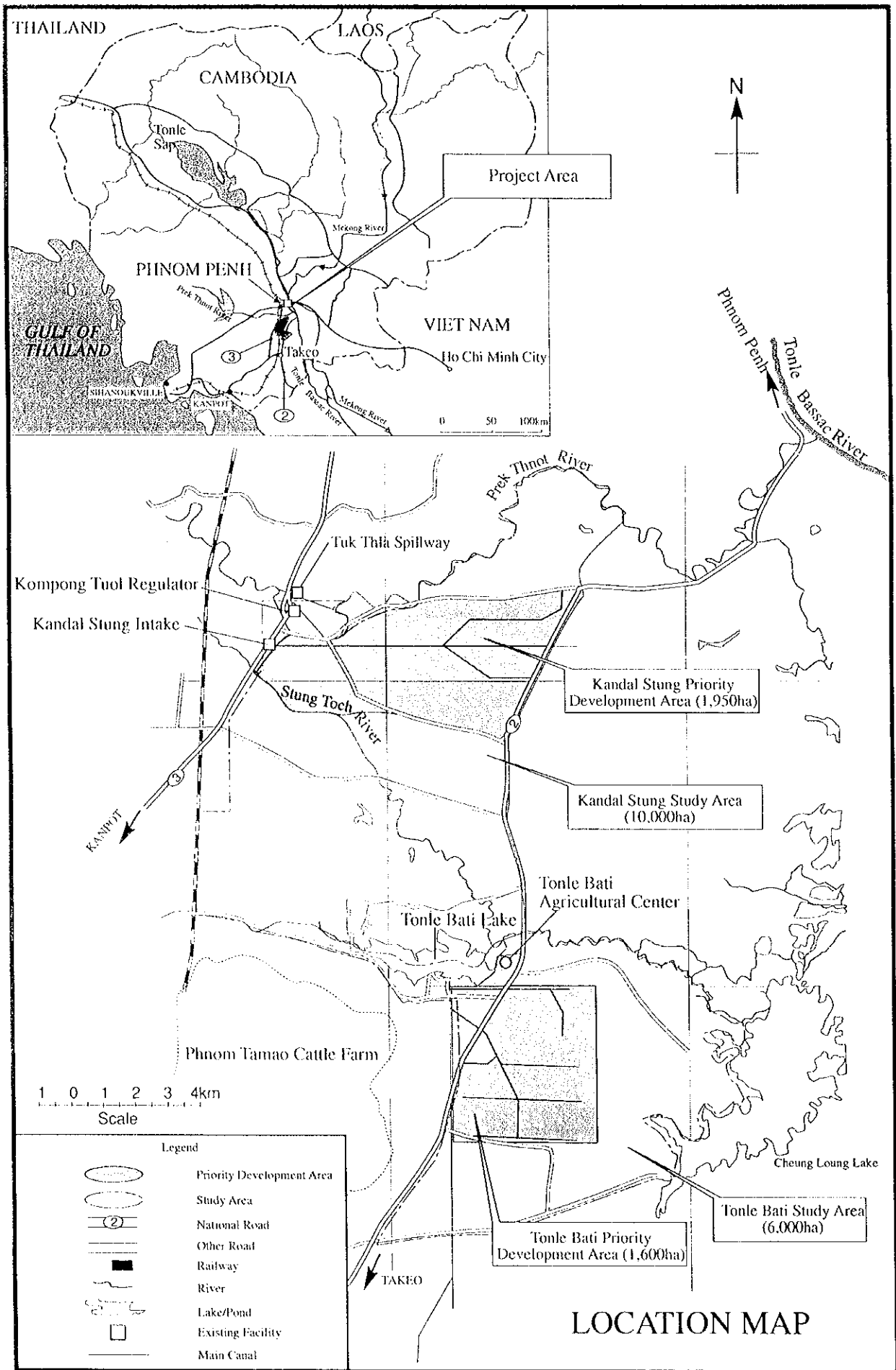
Very truly yours,



Shinichi YANO

Team leader of the Study Team for the Master Plan Study on
the Integrated Agricultural and Rural Development Project in
the Suburbs of Phnom Penh





**MASTER PLAN STUDY ON
THE INTEGRATED AGRICULTURAL AND RURAL
DEVELOPMENT PROJECT
IN THE SUBURBS OF PHNOM PENH**

EXECUTIVE SUMMARY

Contents

	<u>Page</u>
LOCATION MAP	
1. INTRODUCTION	1
2. BACKGROUND	2
3. THE STUDY AREA	4
4. PROSPECTIVE AGRICULTURAL AND RURAL DEVELOPMENT	8
5. RECOMMENDATION	17

List of Tables

Table 1 Summary of Project Cost	T-1
---------------------------------------	-----

List of Figures

Fig. 1	Present Cropping Pattern	F-1
Fig. 2	Proposed Organization of Agricultural Development Centre	F-2
Fig. 3	General Layout of Rehabilitation of Kompong Toul Irrigation Intake	F-3
Fig. 4	Canal Layout of Kandal Stung Irrigation Project	F-4
Fig. 5	Canal Layout of Tonle Bati Irrigation Project	F-5
Fig. 6	General Plan for Improvement of Rural Road Network	F-6
Fig. 7	General Plan for Improvement of Rural Water Supply Facility in Kandal Stung Priority Development Area	F-7
Fig. 8	General Plan for Improvement of Rural Water Supply Facility in Tonle Bati Priority Development Area	F-8
Fig. 9	General Plan for Improvement of Other Rural Infrastructure Facilities in Kandal Stung Priority Development Area	F-9
Fig. 10	General Plan for Improvement of Other Rural Infrastructure Facilities in Tonle Bati Priority Development Area	F-10
Fig. 11	Implementation Schedule of Priority Development Project	F-11

EXECUTIVE SUMMARY

1. INTRODUCTION

01. This Report is prepared in accordance with the Scope of Work agreed upon between the Ministry of Agriculture, Forestry and Fisheries (MAFF) and the Japan International Cooperation Agency (JICA) in January 1993. It presents the results of the Master Plan Study on the Integrated Agricultural and Rural Development Project in the Suburbs of Phnom Penh and the subsequent Feasibility Study on the priority development area identified through the Master Plan Study. The objectives of the Master Plan Study are to formulate an integrated agricultural and rural development plan to achieve substantial and sustainable improvement in the living conditions of the inhabitants in the area. Focus is on the water resources in the Prek Thnot River basin, agricultural resources, social and agricultural infrastructures, and rural living improvement. The Feasibility Study for the selected priority area was carried out based on the physical, agricultural and socio-economic conditions in the development area.

02. The agricultural sector is recognized as the top priority sector in the national reconstruction program. For the purpose of increasing agricultural productivity and thus improving living standards, the Government has been taking effective measures in the sector such as granting land ownership, introduction of a free market, and the decontrol of product prices in order to provide more incentives to producers. The supporting infrastructure including irrigation and drainage facilities, and rural roads needs to be improved and expanded and the delivery of basic support services needs to be strengthened.

03. MAFF has overall responsibility for coordinating agricultural development activities. The most relevant departments in MAFF for agriculture and rural development are the Department of Agricultural Hydraulics and Hydro-meteorology (DOAHH), the Department of Agronomy (DOA), the Central Company of Agricultural Materials (CCAM), and the Land Titling Department (LTD). The Secretariat of Rural Development is responsible for the supervision and management of rural development, having a target of achieving at the same socio-economic level as that of other Southeast Asian countries by the year 2000.

04. The construction works of the dam and power station of the Prek Thnot Multipurpose Project were started in 1969 and have been suspended since 1974 due to the civil wars. A re-appraisal of the Project was carried out in 1991, and it was identified that about 4,200 ha under "without-dam" conditions, 34,000 ha if irrigation priority is given, and 27,000 ha if hydropower generation is given priority, would be respectively irrigable.

05. In view of the high priority given to the implementation of irrigation improvement as well as the integrated rural development in the suburbs of Phnom Penh, the Government of the Kingdom of Cambodia requested the Government of Japan (GOJ) to undertake an overall master plan and the feasibility study on the priority development scheme identified. In response, JICA sent a preparatory study team in January 1993 and agreed on the Scope of Work for the Master Plan Study on the Integrated Agricultural and Rural Development Project in the Suburbs of Phnom Penh. This Study was carried out during the period from October 1993 through March 1995 based on the said Scope of Work.

2. BACKGROUND

06. Cambodia has an area of about 181,000 km². Forests cover about 12,300,000 ha or 68 % and are located mainly in the northeastern part and between the Tonle Sap Lake and the Dongrek mountains in the north. Farmlands occupy about 3,800,000 ha or 21 %, comprising 2,700,000 ha of paddy fields, 1,000,000 ha of upland crops, and 85,000 ha of rubber plantations. The cultivated areas are mainly concentrated in the lowland around the Tonle Sap Lake and on both sides of the Mekong River in the south of the country.

The population in 1991 was approximately 8.8 million, corresponding to 49 persons/km² in the whole country and 1,840 persons/km² in Phnom Penh. About 88 % of the total population lived in the rural areas, and females totalled about 54 %. The annual growth rate of the population during the period from 1980 to 1991 was 2.8 %. The total labour force in the country was estimated at 3.7 million of which the agricultural labour force was estimated to be about 2.6 million.

07. The Gross Domestic Product (GDP) in 1991 was 280 billion Riels (US\$ 127 million), and the agriculture sector occupied 46.9 % of real GDP. Rice accounted for 17.6 %, other crops and rubber 11.7 %, livestock 11.2 %, fishing 4.8 %, and forestry 1.5 %. GDP per capita was US\$ 223 equivalent and its recent annual growth rate was 19 %. Exports amounted to US\$ 51.3 million in 1991 and the principal exports were timber, rubber, soybeans, maize and fish/fish products. Imports totalled US\$ 345.7 million in 1991 and the main imports were food, fuel, fertilizers, raw materials, equipment and consumer goods.

08. The climate of Cambodia is suitable for year-round cultivation and the soils are generally suitable for agriculture if irrigation water is properly made available. Rice is the most important crop in the country. In 1991, rice accounted for about 23 % of agricultural production in terms of GDP. In 1991, 85-90 % of agricultural land was under rice cultivation totalling 1.8 million ha, and producing approximately 2.5 million tons of rice. Also, fish production has increased six times in 1991 from its 1980 level. Rubber production rose to about 30,000 tons in 1989 from practically zero in 1979.

09. Agriculture in Cambodia is mostly dominated by rainfed rice cultivation. Self sufficiency in foodstuffs, especially rice has been one of the main and most urgent targets of the Government. Although irrigation development can greatly increase cropping intensity and agricultural production, a lack of capital accumulation has long limited expansion of the irrigated area. The Government initially intends to promote a cost-effective and quick-responding small-scale developments to be used as model schemes in which sustainable and self-reliant agriculture can be achieved.

10. The Secretariat of Rural Development (SRD) recently published the "Programme for Rural Development". The SRD's target is to achieve the same level of social and economic well-being in Cambodia's rural population as is prevalent in other Southeast Asian countries by the year 2000. Rural development is required to be formulated in line with the SRD's programme to ensure self sufficiency, and to contribute to overcoming the existing disparity between rural and urban lifestyles.

11. Cambodia's First Five-Year Plan (FFYP) was inaugurated in 1985 to accomplish the nation's economic development covering the period from 1985 to 1990. The Second Five-Year Plan (SFYP) was prepared for the period from 1991 to 1995, in which 30 % of the total investment was allocated to the agricultural sector, followed by 25 % to the communication sector, as shown in the following table.

Sector	Total Investment millionRiel(1984 Price)	Distribution %
Agriculture	3,3318.9	30
Communication	2,765.8	25
Industry	1,106.3	10
Energy	1,659.4	15
Tourism	553.2	5
Others	1,659.4	15
Total	11,063.0	100

MAFF prepared a Five-Year Agricultural Development Plan titled "Situation and Objectives of Agricultural Development Policies" based on the SFYP, and further drafted the Two-Year Agricultural Development Plan for 1994 to 1995. The objectives of the Two-Year Plan are to urgently strengthen the national economy, particularly, implementation of rural infrastructure under the international cooperation for the economic development priorities.

3. THE STUDY AREA

12. The Study Area for agricultural development covers approximately 18,000 ha. The Kandal Stung area under the jurisdiction of the Kandal Stung District of Kandal Province, covers about 11,300 ha and the remainder is covered by the Tonle Bati area under the jurisdiction of the Tonle Bati District of Takeo Province. The present land use is summarized below:

Land Use Categories	Kandal Stung		Tonle Bati		Total	
	(ha)	(%)	(ha)	(%)	(ha)	(%)
1. Villages, Roads, etc.	1,500	13.2	400	5.8	1,900	10.4
2. Rainfed Wet Season Rice	7,300	64.6	5,100	73.9	12,400	68.1
3. Upland Crops	300	2.7	50	0.7	350	1.9
4. Cattle Grazing, Unused	2,200	19.5	1,350	19.6	3,550	19.5
Total	11,300	100	6,900	100	18,200	100

13. The alternating monsoon system controls the climate in the Study Area. The wet season, the Southwest monsoon, is from May to November when about 90 % of total rainfall occurs. The remaining months, the Northeast monsoon, are hot, dry and less humid with a potential of particularly high transpiration demands in March and April. Annual mean rainfall is 1,365 mm and the monthly temperatures range from 21 °C to 35 °C.

Runoff from December to April forms a small part of the annual total. From May through the remaining months of the wet season, floods can occur at any time in response to intense rainfall, but the highest floods tend to occur towards the end of the wet season, usually in September or October. The hydrograph declines rapidly at the end of the wet season and this is similar for all years. The annual runoff of the Prek Thnot River is 1,130 - 1,620 MCM. Probable flooding at the Prek Thnot dam site is 1,900 m³/sec in a 100-year return period and 3,900 m³/sec in a 1000-year return period. The annual sediment transported at the dam site is estimated to be 0.37 to 0.31 MCM.

14. The two areas sandwiched between the Stung Toch and Prek Thnot rivers and extending immediately south of the Tonle Bati River consist of active alluvial flood plains with recent and silty soils. The lands extending south of the Stung Toch River and southwest of the Tonle Bati River are older terraces where natural flooding no longer occurs. The proposed new dike and existing Kompong Tuol regulator site is located on an underlaid high permeable recent alluvium sand layer. These soils are loose and susceptible to piping. However, the less pervious layer having 3 to 5 m thickness extends between the recent alluvium sand and the old alluvium sand.

15. The main soils in the Study Area were classified into seven (7) soil units in accordance with the FAO system (FAO-UNESCO, 1974) and thirteen (13) land units were identified based on their formation on location, land form, soils, native vegetation and land use. Land suitability is assessed in terms of the ability to support three particular forms of land use - wet season lowland rice, dry season (irrigated) rice, and dry season (irrigated) upland crops. In the Study Area, 80 % of the total area is suitable for wet season rice, and 84 % is suitable for dry season rice, dry season horticulture, and upland crops.

16. The population of the Study Area is estimated at about 26,100 (4.6 persons/family) and about 15,500 (4.9 persons/family) persons, for Kandal Stung and Tonle Bati area, respectively. The proportion of female population is about 54 % in the Study Area. A quite vulnerable group in the area would be the Female Headed Households (FHHs) without adult male members, which account for about 20 % of families in the Study Area.

17. Both districts in the Study Area have a similar curative public health services structure, headed by a district hospital of about 100 beds, and each village (khum) has an infirmary or khum clinic assisted by a khum Health Committee. Public health services in both districts are

supported by foreign NGOs. However it can be concluded that the public health services in the Study Area, even with the assistance of NGOs, have got a long way to go in providing adequate services to the people, due to a shortage of staff. Some clinics have been damaged by war and are not functioning properly. There are several primary schools and some lower and higher secondary schools. The socio-economic survey results of the Study Area show that more than 90 % of children between 6 to 16 go to school. Classrooms are not sufficient to cope with the enrolled pupils.

18. Private land ownership has been granted and the registration of land titles in the Study Area is being prepared by MAFF. The average land holding size by household is 1.2 ha for Kandal Stung and 1.3 ha for the Tonle Bati areas. The agriculture in the Study Area is dominated by rice cultivation and most of the farm land is rainfed lowland rice fields with a rather low average unit yield of about 1.2 to 1.5 ton/ha. A typical pattern is rain-fed single cropping in the wet season. The early rice, medium rice and late rice cultivated during the rainy season in the Study Area is 600 ha, 8,700 ha, and 3,700 ha, respectively. The irrigated dry season rice cultivated in the area totals only about 30 ha. In addition to the rice cultivation, the farmers grow other crops such as vegetables, bananas, mango and guava in limited extent. Livestock raising is also very important farming activities in the Study Area. Most of farmers keep pig and poultry. The cattle is raised as the purpose of draught power for field preparation and cart.

19. Total production of rice, palm sugar and number of livestock raised in the Study Area in 1993 were as shown below:

Items	Kandal Stung Area	Tonle Bati Area	Total
Paddy (ton)	9,120	6,570	15,690
Sugar (ton)	1,000	190	1,190
Cattle (head)	16,240	9,530	25,770
Pig (head)	7,320	4,130	11,450
Poultry (head)	64,000	27,500	91,500

20. The Study Area's main economy base is rice cultivation, but the production is not sufficiently enough due mainly to an irrigation water deficit and a shortage of inputs and improved techniques. The farmers are at present earning income basically from rice cultivation, but the majority of farmers maintain their living supplemented by other incomes, livestock, sugar, wages, etc. The gross income of farm households in the Kandal Stung area is estimated at about 380 US\$ for farming and 220 US\$ for off-farm activities, totalling 600 US\$. Farm household income in the Tonle Bati area is estimated at about 300 US\$ for farming activities only. About 40 % of the gross income in the Kandal Stung area is derived from off-farm income, while more than 90 % of the gross farm income is derived from rice production in the Tonle Bati area. The study on farm budgets shows that the farm economy for typical farmers in both Kandal Stung and Tonle Bati areas remains at a subsistence level.

21. Agricultural support services are offered by MAFF at the central level, the Provincial Agricultural Office at the provincial level, and the District Agricultural Office at the district level. DOA in MAFF is responsible for the formulation of an experimental plan at the national level and for the monitoring of food production in the country through provincial agricultural offices. Agricultural extension work in the Study Area has been carried out under DOA, by the Tonle Bati Agricultural Development Centre (TBADC) in the Tonle Bati area and by the Kandal Stung Rural Development Centre (KSRDC) in the Kandal Stung area. The agricultural extension by KSRDC covers about 375 families in 12 villages. Most of the activities concentrate on community development through small scale agricultural credit. The main activities of TBADC are to distribute irrigation water to about 6,000 ha, in cooperation with the District Agricultural Office, and the distribution of farm inputs and extension work such as rural credit, operation of a demonstration plot to show farming techniques for fertilizer application and improved varieties, and community development. The activities of the centres are very limited due to a lack of qualified manpower, budget, and facilities.

22. The area and number of families covered by the small-scale rural credit scheme are still very limited due mainly to a shortage of funds and qualified manpower. The activities covered by the credit are mostly vegetable gardening, pig raising, and the operation of small shops in the villages. The Family Food Programme (FFP), sponsored by UNICEF and implemented with the assistance of the World Food Programme (WFP) and the Khmer Women Association, specifically targets poor families with children under five, FHHs, widows, etc.

23. During the Pol Pot regime 1975-79, an irrigation canal system was constructed in the Kandal Stung area. At first, the Prek Thnot By-pass Channel with the Tuk Thla Regulator was constructed at the National Road No. 3 crossing, together with a road dike, the Kompong Tuol Regulator, and a flood dike. Irrigation canals and their related structures were then constructed in the Kandal Stung area, following latitudinal and longitudinal grid lines, regardless of the topographic conditions.

The irrigation area envisaged in the Kandal Stung area is 3,100 ha, for which water is diverted from the right bank of the Prek Thnot River about 1 km south of the Kompong Tuol regulator. In 1987 to 1991, the rehabilitation of the irrigation facilities was executed by the Department of Hydrology and the joint effort of the Kandal Stung District and Kandal Province, under the assistance of MCC (Mennonite Central Committee). However, the National Road No. 3 dike between Kompong Tuol and Tuk Thla regulators was washed out several times by flood, each time being repaired. In August 1994, the road dike was further severely breached by flood. Therefore, the water supply to the Kandal Stung area has not been ensured since then. Under these circumstances, farmers are compelled to carry out farming by using various kinds of lifting irrigation, such as indigenous tools or small capacity engine-driven pumps.

24. During the period of 1975 - 1979, the canal system of the Tonle Bati Project, for the planned area of 6,000 ha was constructed, of which water was diverted from the Tonle Bati Lake. During 1987 - 1990, the irrigation system was rehabilitated by the Department of Hydrology with the assistance of WCC for an area of about 900 ha. However, irrigation facilities are presently not functioning well due to insufficient rehabilitation, insufficient water level/storage of the Tonle Bati Lake, and the lack of an effective O&M system. At the head of the main canal, an intake and pumping station were installed. The pumping station is used for supplying water in the dry season. The operation and maintenance of the facilities is made by the Bati District office.

25. In the Study Area, there are about 14.3 km of national roads (NR No.2 and No. 3) and about 14.9 km of provincial roads. The national roads are mostly paved with asphalt. The provincial roads in the Kandal Stung area are asphalt-paved but is severely damaged, so that only four-wheel driven cars can pass in the rainy season. District roads remain unpaved. Farm road networks are insufficient for efficient transport of farm inputs and outputs. In the rainy season, these roads are hardly passable by car due to mud or serious erosion.

Groundwater is the main source for drinking and domestic purposes. At present, 161 dug wells and 90 tubewells have been installed under the programs of UNICEF and two foreign NGOs in the Kandal Stung area. In most of these wells, water is drawn with a well bucket. Tubewells are equipped with manual operated pumps. In the dry season many wells are dry forcing villagers to take water from other water sources. Generally they are faced with a severe shortage of domestic water.

Basically a commune clinic is provided for each commune. School facilities are inadequate. Some wooden buildings are in such bad condition that replacement or additional buildings are indispensable in improving the quality of education. There is no community centres in the Kandal Stung and the Tonle Bati areas.

Market facilities in the Study Area are satisfactory, however, their facilities and access to the market areas need to be improved. Rice mill facilities at present are mostly sufficient in quantity and quality.

26. The most striking feature in the Study Area is the absence of natural systems such as undisturbed forests or wetlands. Consequently, biological diversity is poor and there are no larger animals. River and canal banks are eroding and riverine vegetation which provides natural stability to river banks, has disappeared in many places. Although livestock are reared extensively, the integration of crops and animal husbandry has not taken place with any seriousness. Firewood is in short supply throughout the Study Area. Part of the domestic needs are supplied by the home gardens and nearby wet lands. In the Tonle Bati district, a part of the firewood demand is met by the Phnum Thamao forest reserve which is nearly denuded. Some localized groundwater indicates an excessive content of iron, causing unpleasant taste. The Ta Prohm Temple at Tonle Bati is a place of archaeological interest. It is near the Tonle Bati Lake, which is also a recreation area, very popular during holidays. The recreation area is in poor condition, with evidence of large scale erosion.

27. The major physical and socio-economic constraints in the Study Area are summarized below:

- | | |
|----------------------------------|---|
| (1) Soil Mechanical Condition | - Embankment materials surrounding the proposed dike site are considered to be undesirable due to their dispersive properties. |
| (2) Soils | - Soils in the older terrace geomorphic province, lying Southwest of the Study Area, have low fertility, requiring a large amount of farm inputs for effective production. |
| (3) Water Resources | - Inadequate timely water resources available in the dry season and through the early months of the wet season, and
- High potential for severe flooding both in terms of damage to irrigation facilities and by the inundation of cropped areas later in the wet season. |
| (4) Irrigation and Drainage | - Shortage of experienced engineers and technical staff in planning, design and implementation, and a lack of funds for rehabilitation /reconstruction and operation and maintenance.
- Inadequate design and implementation due to a lack of design standards and construction specifications, and
- Lack of a systematic operation of the irrigation system including O&M organization. |
| (5) Rural Infrastructures | - Insufficient number of rural water supply facilities and the drying-up of water sources in the dry season.
- Muddy rural roads in the rainy season making it difficult to maintain daily transportation access, and
- Inadequate provision of facilities for community organization development, and health care services. |
| (6) Agriculture and agro-economy | - Insufficient supply of certified seeds, and agricultural inputs.
- Lack of supporting services and improved techniques. |
| (7) Socio-economic Conditions | - Lack of sufficiently skilled Government staff, and
- Lack of credit opportunities at reasonable cost/interest rates. |
| (8) Environment | - River and canal bank erosion, and
- Shortage of firewood supply. |

4. PROSPECTIVE AGRICULTURAL AND RURAL DEVELOPMENT

28. In due consideration of the Government policy applied to the agricultural and rural development, as well as the present socio-economic conditions of the Study Area, it is presumed that the following are regarded as the ultimate objectives and development strategies of the integrated agricultural and rural development of the Study Area:

- (1) The objectives of the integrated rural development plan are to achieve substantial and sustainable improvement in the living conditions of the inhabitants of the Study Area.
- (2) To achieve the objectives of development, the strategy adopted is to increase farming output in the area through improvement and development of irrigation, drainage and rural infrastructure, together with suitable supporting services and schemes.

According to the development needs and the national development policy, the objectives for development of the whole area are described as follows :

- (1) To raise farmer's income level through the enhancement of agriculture, especially rice and livestock production, and by the effective utilization of land and water resources in the Study Area.
- (2) To contribute to regional and national needs to increase rice production with the aim of achieving self-sufficiency.
- (3) To raise the living standard and to improve rural people's life through increasing farm income and extending services.

To achieve the objectives mentioned above and solve the present problem, the following plan will be executed:

- (1) Irrigation and drainage facilities improvement,
- (2) Agricultural development,
- (3) Agricultural supporting services including farmers' organization,
- (4) Rural infrastructure development,
- (5) Rural life improvement,
- (6) Establishment of model area, and
- (7) Landscape improvement.

29. The available amount of water of the Prek Thnot River for irrigation development of the Study Area is as follows:

- (1) Run-of-River Water

The flow available for the Study Area is estimated to be the residual flow after sharing the gross irrigation demands of the irrigation schemes located/envisaged upstream of the Tuk Thla and Kompong Tuol regulators. The average monthly flow derived from the 10-year series of residual flow at Tuk Thla is shown below:

Average residual flow at Tuk Thla for the 10-year design period

	Jan.	Feb.	Mar.	Apr.	May	Jun	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Tuk Thla	8.0	5.3	4.5	6.4	33.0	79.0	140.9	199.0	318.6	433.7	147.9	69.2	1,446

(MCM)

- (2) With Prek Thnot Reservoir

The irrigation potential "with dam condition" is estimated at the range of 25,000 ha (maximum firm power) to 35,000 ha (irrigation priority) based on the double cropping plan.

30. The proposed cropping patterns are formulated for the "with and without Prek Thnot Reservoir conditions" as shown below.

Crops	With Prek Thnot Reservoir				Without Prek Thnot Reservoir			
	Wet season		Dry season		Wet season		Dry season	
	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)
Rice:	100	8,400	50	4,200	100	3,550	50	1,700
Early dry season rice			50	4,200			50	1,700
Early wet season rice	50	4,200			50	1,775		
Medium wet season rice	30	2,520			30	1,065		
Local varieties	20	1,680			20	710		
Maize & soybeans			38	3,192			15	510
Vegetables			12	1,008			15	510
Crop intensity/total area	100	8,400	100	8,400	100	3,550	80	2,720

31. It is necessary to introduce new high-yielding varieties or hybrid seed with the appropriate use of fertilizers and agro-chemicals (minimum use and environmentally sound chemicals) along with the provision of irrigation facilities and institutional support services. The present farming practices prevailing in the project area are basically applied. Taking into consideration the present circumstances, rapid introduction of full mechanization is not practicable in the area.

Regarding plant protection, farmers should choose and use the chemicals through consultation with the Agricultural Development Centres and their services. It is recommended to organize an integrated pest management system for the protection of the crops as well as the environmental conservation of the area. To promote livestock production, it is recommended to produce secondary crops for feed. It is also essential to promote disease control by the extension of veterinary services.

32. The target yield of crops at the full development stage is expected to be as follows:

crop	HYV rice	maize	soybeans	groundnuts	mungbeans	sesame
yield	4.0	3.0	2.0	1.5	1.0	1.2

The anticipated annual rice production in the area at the full development stage for the "with Prek Thnot Reservoir" condition is estimated at 59,240 tons, while that for "without Prek Thnot Reservoir" condition is estimated at 43,370 tons. As the present rice production is estimated at about 15,600 tons, the incremental rice production of the project is expected to be about 43,600 and 27,800 tons for the with and without alternatives, respectively.

Under "with Prek Thnot Reservoir" conditions, the expected production of secondary crops is estimated at about 9,600 tons of maize, 4,800 tons of soybeans, and about 10,000 tons of vegetables. Under "without Prek Thnot Reservoir" conditions, the production is expected at 1,500 tons of maize, 800 tons of soybeans, and 5,100 tons of vegetables. The anticipated annual production of livestock is estimated as the increased production of pigs which are very common in the Study Area. Under "with Prek Thnot Reservoir" conditions, the increased number of pig is about 17,200 heads, while "without Prek Thnot Reservoir" conditions, it is estimated at about 2,720 heads.

33. The area is located in the suburbs of Phnom Penh and is densely populated. It is anticipated that considerable rice demand will continue under these circumstances, and large demand for livestock products is also expected especially for the markets of Phnom Penh.

Under the "with Prek Thnot Reservoir" conditions, the anticipated agricultural benefit is estimated at about US\$ 13.1 million for the irrigation development area, and US\$ 0.7 million for the non irrigation development area. Under the "without Prek Thnot Reservoir" conditions, the anticipated agricultural benefit is estimated at about US\$ 4.1 million, for the irrigation development area, and US\$ 1.7 million for the non irrigation development area, totalling US\$ 5.8 million.

The economic incremental agricultural benefit for the irrigation development area under "without Prek Thnot Reservoir" conditions, is estimated at US\$ 2.1 million and US\$ 1.8 million for the Kandal Stung and the Tonle Bati areas, respectively, totalling about US\$ 3.9 million.

34. In the irrigation area under the "with or without Prek Thnot Reservoir" conditions, the net income of households would be sufficient to cover not only about 3 million Riel (US\$ 1,364) of annual living expenses, but also considerable capacity to pay. On the other hand, in the non irrigation area, the farmer's income would only be one fourth of the irrigated farmer's income, which is at a subsistence level, and therefore, requiring him to earn off-farm income.

35. The strengthening plan of the support services includes the activation of the existing TBADC and KSRDC covering about 11,300 ha. The operation plan of the centres is formulated taking into consideration the cooperation and coordination between each district office, the relevant research stations, development centres, and other projects. It is proposed that the agricultural supporting services at the initial stage in the project area will be carried out by the Agricultural Development Centres. And afterward, operation of the Agricultural Development Centres will be transferred to the management of each district office. The supporting services extended by the centres are as follows:

- Extension of agricultural techniques,
- Agricultural inputs and equipment supply, rural credit supply and agricultural insurance system,
- Assistance and guidance for operation and maintenance of irrigation and drainage facilities, and provided rural infrastructures, and
- Life improvement extension services

The proposed agricultural extension services will be provided mainly for food (rice) and other secondary crops, and livestock raising, mainly pigs, poultry, and cattle for draft power. The key points of emphasis in the agricultural extension are as follows:

- Supply of planting materials,
- Introduction of improved varieties,
- Demonstration and guidance of cultivation techniques,
- Extension of livestock production,
- Introduction of a vaccination service, and
- Monitoring and evaluation.

36. The area suitable for irrigation development in Kandal Stung area is 4,200 ha. The irrigable areas are estimated on the basis of the water balance simulation shown below.

- (1) Without Prek Thnot Reservoir Case
1,950 ha of the Kandal Stung area will be served by the Kompong Tuol regulator site, with an irrigation dependable level of 4 out of 5 years. The year 1968 is the basic design year according to the simulation.
- (2) With Prek Thnot Reservoir Case
The run-of-river water of the Prek Thnot will ensure irrigation for 1,950 ha. The remaining area of 1,750 ha (4,200 ha less 1,950 ha and the Saba reservoir area of 500 ha) could be implemented only after the realization of the Prek Thnot reservoir as an extension area.

The Saba reservoir irrigation area of 500 ha lies between the Stung Toch River and Tonle Bati Lake. The Saba Lake does not have a significant catchment area for water storage, requiring a supplemental water supply from the Prek Thnot River. The cost required for the irrigation and drainage system, mostly consisting of the construction of the Saba dam and a connection canal, is high compared with the area it services, implying low priority for development of this scheme.

In case that the irrigable area of 1,950 ha under the run-of-river water of the Prek Thnot River is developed as the first stage and the remaining area is developed as the second stage, the general features of the proposed project works of the irrigation and drainage system are as follows:

Description		First Stage Work	Second Stage Work
Main canal			
- Improvement of main canal	(km)	5.3	0
Lateral			
- Improvement of existing lateral	(km)	8.2	0
- Construction of lateral	(km)	4.0	18.3
Tertiary canal			
- Improvement construction of tertiary canal	(km)	56.8	65.5
Quaternary canal system	(ha)	1,950	1,750
Saba Scheme			
- Saba dam	(nos)	-	1
- Connection canal	(km)	-	4.5
- Lateral canal	(km)	-	8.0
- Tertiary canal	(km)	-	11.0
- Quaternary canal system	(km)	-	500
Drainage works			
- Major drainage canals	(km)	18.1	20.9
- with related structures	(km)	64.6	74.5

37. The area suitable for irrigation development in the Tonle Bati area is 4,200 ha. The irrigable areas are estimated on the basis of the water balance simulation as shown below.

(1) Without Prek Thnot Reservoir Case

- Without Kok Tel reservoir case

The water balance simulation of this case indicates that this plan could ensure irrigation to an area of 1,600 ha. Run-of-river water of the Prek Thnot River, however, reduces sharply from December, showing a minimum in March. The supply from the Prek Thnot River through the connection canal could not be expected during some dry seasons. In the later stage of the second cropping and the beginning of the first cropping, January through May, the lake water level reduces necessitating pumping-up irrigation for the dry season irrigation area.

- With Kok Tel reservoir case

On the other hand, in this case, gravity irrigation will be ensured throughout the year for an area of 1,600 ha.

(2) With Prek Thnot Reservoir Case

The irrigation Plan of this case will ensure sufficient irrigation of the whole area of 4,200 ha, without the Kok Tel reservoir.

In the case of the "with Kok Tel reservoir" under "Prek Thnot reservoir condition", gravity irrigation can be ensured for the area of 1,600 ha. This means the Kok Tel dam will contribute greatly reducing the O&M works. However, in case the Prek Thnot dam is realized quickly, the dam will not be economically justified. The implementation of the Kok Tel dam is largely dependent upon the time span of the Prek Thnot dam construction.

The implementation schedule of the Prek Thnot Multipurpose Project is not formulated at the present time, and it is not clear whether the Prek Thnot reservoir will become operational soon or later. In this situation, it is recommended that the irrigation development of the Tonle Bati area is implemented firstly, without the Kok Tel dam, by augmenting water through the connection canal.

In case the irrigable area of 1,600 ha using supplementary water from the Prek Thnot river without the Kok Tel reservoir, is developed as the first phase and the remaining area is developed as the second phase, the general features of the proposed project works of the irrigation and drainage system will be as follows:

Description		First Stage Work	Second Stage Work
Main Canal			
- Improvement of main canal	(km)	8.3	-
- Construction of main canal	(km)	-	-
Lateral			
- Improvement of existing Lateral	(km)	6.9	-
- Construction of Lateral	(km)	3.1	6.3
Tertiary Canal			
- Improvement of existing tertiary canal	(km)	15.0	-
- Construction of tertiary canal	(km)	33.1	78.2
Quaternary canal system	(ha)	1,600	2,600
Improvement of Tonle Bati Lake Related Strucs.	(nos)	3	-
Improvement of Connection Canal			
- Connection canal	(km)	4.6	-
- Stung Toch Regulator	(nos)	1	-
- Stung Toch Dike	(km)	1.0	-
- Kandal Stung Regulator	(nos)	1	-
Improvement of Drainage canals and structures			
- Main Drain	(km)	10.4	16.9
- Secondary Drain	(km)	13.7	22.3
- Tertiary	(km)	41.8	66.6

37. Improvement of the Tuk Thla and Kompong Tuol regulators are a prerequisite in the development of the Kandal Stung and Tonle Bati areas. The improvement plan is described below.

- a) Design flood without the dam : 1,900 m³/sec (100-year return period)
- b) Required intake water level : EL 11.50 m for water intake
- c) Allowable maximum flood water level : EL 13.00 m

After the careful study on five alternative cases of the intake system, it is proposed to adopt the plan to improve the existing Tuk Thla Regulator, replace the existing Kompong Tuol Regulator, and construct the new Overflow Type Spillway. The major improvement works are shown below.

- Tuk Thla Regulator : Replacement of gates (6m x 3m x 5 sets)
- Kompong Tuol Regulator : Replacement of the existing regulator (gate: 6m x 8 m x 5 sets, bridge: width = 15 m)
- Spillway : Overflow type, 400 m in length
- Route National No. 3 : Total width 15 m, asphalt pavement width 9 m
- Flood Dike Upstream : Length about 5 km, top dike width 4 m
- Telecommunication system : Main, branch and two site stations

38. The overall water management of the Prek Thnot River will be carried out by MAFF. The responsibility for operation and maintenance of the irrigation and drainage systems will be divided into two types of administrative bodies, i.e., a Project operation body, responsible for the head regulator to the lateral systems, and water users groups responsible for the tertiary irrigation and drainage systems.

The Water Management Division in the DOAHH will be responsible for the operation, maintenance, and management of the head regulators and localized reservoirs in order to ensure the equitable water management and safe operation of the large facilities. The local govern-

ments concerned will be responsible for the operation, maintenance and management of the main canal up to the lateral systems. To co-ordinate smooth operation and maintenance of the irrigation system and water management of the Project, the provincial and district irrigation committees will be organized at provincial and district government levels. They are made up of representatives of the provincial or district government offices.

The O&M section will prepare a seasonal water distribution schedule including rotational blocks for dry and rainy season cropping, respectively. It will submit the prepared irrigation schedule to the chairman of the Irrigation Committee for its approval.

39. The improvement of provincial, district and farm roads will be made using asphalt or gravel-metall. In order to stabilize the supply of domestic water, additional tubewells are proposed to be provided where existing wells are insufficient. Regarding health services facilities, it is proposed to improve the existing Khum clinics whose facilities have severely deteriorated and to construct new clinics in place of those destroyed during the Pol Pot regime. The following table shows the proposed improvement of the social infrastructures.

Facilities		Unit			
Road	Trunk	Provincial	(km)	14.9	Asphalt pave.
		District	(km)	15.9	Gravel pave.
Farm or rural	Tubewell	Depth more than 50 m	(nos)	67	Gravel pave.
		Depth less than 50 m	(nos)	196	
Khum clinic	Kandal Stung		(nos)	4	384 m ²
		Tonle Bati	(nos)	4	384 m ²
School class room			(nos)	58	
Community hall			(nos)	18	

40. To improve support services for life improvement is need to strengthen the support services by reactivating and improving the Agricultural Development Centres and to carry out most of the relevant services and programmes in cooperation with the agricultural support services. To improve household management is need to educate and also offer practical training on the importance of clothing for safety and health, and offer training on basic accounts and record keeping of income and expenses.

Community development is the most important for improving the conditions of the people in the area. The proposed measures for this development are the promotion of people's participation at the planning stage of programs, and organizing grass root communities including water users' associations, small farmers' credit groups, life improvement leading groups, and FHH /women's group.

41. Special consideration should be paid to health and sanitation among the environmental issues envisaged along with agricultural development in the Study Area. The rural people at present depend on fish and small aquatic animals in the rivers, canals and ponds for their protein supply. In order to minimize the adverse impacts to the environment and to enjoy sustainable improved agricultural production, special attention should be paid to chemical application for pest control, and environmental conservation pest control techniques such as an integrated pest management system should be established.

42. The project cost consists of construction cost, procurement of machinery, land acquisition cost, engineering and administration cost and contingency. The total cost is estimated to be US\$ 101.3 million. The cost required for implementation of the first stage works will be about US\$ 67 million.

43. The Integrated Agricultural and Rural Development Project herein formulated includes various schemes for development and consolidation of infrastructure as well as the reinforcement and/or activation of supporting functions. In order to effectively implement the various

components, and taking into account the technical and managerial capacity of the staff concerned, the implementation of the schemes should be well designed in stages. It can be divided into the following two stages:

(1) Priority development

The first stage development aims to establish a model area as a technical and implementing base which will be used as a core to demonstrate the effects of the integrated agricultural and rural development and to be a base for future expansion of the whole area. The selection of the priority development areas for model development were made according to the physical and socio-economic conditions of the Study Areas. As a result of this comparison, 1,950 ha in the Kandal Stung area and 1,600 ha in the Tonle Bati area were selected as priority development areas, where reliable irrigation could be ensured under "without Prek Thnot reservoir" conditions.

The existing headwork facilities (Tuk Thla and Kompong Tuol regulators, National Road No. 3 dike, and a intake structure) have been repeatedly damaged by flooding of the Prek Thnot River, resulting in long term malfunctioning of the irrigation water supply from the Prek Thnot and serious drought damage in the command area. The National Road No. 3 dike connecting between Phnom Penh and Kampot has been continuously washed out by floods, hampering road traffic severely. The insufficient flow capacity of the flood regulator gates has resulted in flooding of the downstream farm land during large floods, causing losses in agricultural production and damages to public facilities. In view of above, it is strongly recommended the priority development scheme to be further divided into two implementation phases, the first being the urgent rehabilitation and improvement of the headworks and the rehabilitation of the existing irrigation and drainage facilities and rural infrastructures in the second phase. The implementation of the rehabilitation of the existing headworks will result in the following positive effects and benefits:

- An increase in irrigation area and crop production
About 8,000 ha of cultivated land will be stably irrigated through the existing canal. Increased yield as well as the prevention of damages to agricultural production by flood and drought are expected.
- The improvement of the condition of National Road No.3
About 500,000 households living in Phnom Penh city and three major provinces, Kandal, Takeo, and Kampot will benefit from improved transportation.
- Mitigation of inundation damages to the downstream area of the intakes
About 5,000 households in the downstream area of the intake will be protected from floods.
- Improvement of living environment.
- The creation of tourism resources and employment opportunities from the reservoir to be constructed in front of the intake.

(2) Second Stage Development

The remaining area will be covered in the second stage development. Based on the accumulated results and institutional set-up created during the first stage development, the second stage could successfully be implemented. The commencement of the irrigation works will be subject to the time schedule of the Prek Thnot multipurpose dam.

44. The implementation of the first stage will be concentrated in the Kandal Stung area of 1,950 ha and the Tonle Bati area of 1,600 ha. The implementation program will include the following:

(1) Agricultural development

- Improvement and strengthening of agricultural support services, and

- Establishment of a Rural Development Centre, including a demonstration farm
- (2) Development of irrigation and drainage development
 - Urgent improvement of the Tuk Thla and Kompong Tuol regulators,
 - Improvement of irrigation and drainage facilities of the Kandal Stung Irrigation Project of 1,950 ha,
 - Improvement of irrigation and drainage facilities of the Tonle Bati Irrigation Project of 1,600 ha
 - (3) Development of rural infrastructures
 - Improvement of rural road network,
 - Construction of rural water supply facilities,
 - Improvement of village clinics,
 - Improvement of school buildings, and
 - Construction of community halls
 - (4) Measures for rural life improvement
 - (5) Support services to women's group
 - (6) Measures for environment problems

45. The main agricultural impact will be the increase in agricultural production through improved irrigation, inputs and extension services. These crop production increases will bring about not only the upgrading of rural living standards in the Study Area but also the improvement of nutrition in and around Phnom Penh. Incremental crop production is summarized below :

Crops	(Unit : ton)	
	Without Dam*	With Dam*
Rice	27,952	43,642
Maize	1,530	9,576
Soybeans	765	4,788
Vegetables	5,100	10,080

Remarks ; Dam* means the planned Prek Thnot dam

Livestock production will also increase after the proposed development. A certain portion of incremental coarse grains could be fed to livestock, which can be regarded as a form of value-added farm activities. The increased livestock production will contribute not only to the increase in farmers' cash income but also to the improvement of nutrition in and around the Project area. The incremental production of livestock is estimated or units of pigs:

Description	(Unit : heads)	
	Without Dam*	With Dam*
Incremental Livestock (Pigs equ.)	2,720	17,200
Increment per Typical Family	0.8	2.6

Remarks ; Dam* means the planned Prek Thnot dam

Farmers in the Study Area as well as in other agricultural areas, especially in the suburbs of Phnom Penh, will become familiar with modern irrigation farming practices and value-added livestock raising. The incentive for adopting improved irrigation farming practices will be greatly enhanced. Enthusiasm generated from this success may even shorten the development period of other projects.

The improvement of the rural water supply, roads, community facilities, clinics, etc., will contribute to the development of the project area, and the living standard of the people will be greatly improved. The increase of the net farm income will provide motives for improving the living standards of the farmers as well as the rural economic development. In addition, the

farmers' increased purchasing power will activate the stagnated rural markets. Employment opportunities for unskilled labourers will be generated during the construction period. Employees will be able to gain more experience and skills in the various working fields. The accumulation of experience and skills will be very useful for the O&M work of the farmers.

A preliminary evaluation of the proposed agricultural development plan under the "without-Reservoir" condition (priority development area of 3,550 ha) has been made in order to confirm the viability of the plans, in view of the uncertain implementation programme of the second stage development area of 4,850 ha ("with Prek Thnot Reservoir" condition), and the fact that the calculated EIRR is 12 %. It is understood that the proposed plan will be highly viable from an economic point of view.

46. It is concluded that the priority project is justified, because the projects will significantly contribute to the economic development of the Study Area as well as to rural life improvement, in addition to the numerous direct and indirect benefits already described. It is strongly recommended to implement the priority development scheme as early as possible.

47. The integrated rural development herein conceived includes various components ranging widely in both soft and hard-ware technologies. It is therefore suggested that the Royal Government of the Kingdom of Cambodia particularly MAFF shall organize the project implementing agency together with a coordinating system for its efficient implementation. In this context, it is proposed to establish a Project Steering Committee, a Project Development Office, etc. The operation and management of the Agricultural Development Centre are recommended to be carried out in close contact and cooperation with other Government organizations and NGOs.

5. RECOMMENDATION

48. As explained and suggested before, the proposed integrated rural development plan in the Priority Development Area is justified to be technically feasible and economically viable, and the implementation of the plan would substantially contribute to economically, and socially to the beneficiaries in and around the development areas. Along with the development of the priority area, it is strongly proposed to carry out a feasibility study and subsequent implementation of the remaining development area after the Prek Thnot Multipurpose Dam Development Project will be sure to be implemented. The following points are particularly recommended to be taken into account for the smooth and successful implementation of the Integrated Agricultural and Rural Development Project.

- (1) Due to decisive long term damage to the irrigation intake system, farmers have been irrigating the lands to a very limited extent by using small pumps. Early rehabilitation and improvement of the Kompong Toul and Tuk Thla regulators prior to any other development schemes is most essential.
- (2) It is suggested that MAFF will organize a coordination system under the Ministry and in cooperation with the relevant agencies concerned, including a Project Management Committee, and a Project Office.
- (3) Farmers' participation in the Project, particularly strengthening the farmer's intention for agricultural development.
- (4) The establishment of an irrigation association and sufficient technical guidance on irrigation water management and O&M by the Government organization, in order to smoothly manage operation and maintenance of the existing irrigation facilities.
- (5) The early establishment of a telecommunication system on river basin water management in order to minimize flood damage and for the effective irrigation water use of the Prek Thnot River.
- (6) The establishment of a demonstration farm which would exhibit modernized irrigation farming and demonstrate to the surrounding areas for extension.
- (7) Training of the Government staff and the leading farmers related to the Project, on the techniques and management of improved farming in Cambodia and abroad.

Tables

Table 1 Summary of Project Cost

(Unit : 1,000 US\$)

Construction Work Items	F/C	L/C	Total
I. CONSTRUCTION COST			
1 Irrigation and Drainage Systems			
1).Improvement of Tuk Thla			
and Kompong Tuol Regulators	12,277	4,483	16,760
2).Irrigation and drainage system			
- Kandal Stung System	5,201	2,549	7,751
- Tonle Bati System	10,281	3,692	13,972
Sub-Total	27,759	10,724	38,483
2 On-Farm Development			
- Kandal Stung Area	0	1,299	1,299
- Tonle Bati Area	0	901	901
Sub-Total	0	2,200	2,200
3 Social / Rural Infrastructures			
1). Rural Development Center	1,450	1,139	2,589
2). Rural Road Network	3,397	3,136	6,533
3).Rural Water Supply Facilities	706	364	1,070
4).Village Clinic	71	71	142
5).School Building	460	460	920
6).Community hall	631	631	1,262
Sub-Total	6,715	5,801	12,516
Total (Item - I)	34,474	18,725	53,199
II. Procurement of O/M.Equipment	950	50	1,000
III.Engineering / Administration (12%)	4,251	2,253	6,504
IV.Land Acquisition	0	30	30
Total (Item - II,III,IV)	5,201	2,333	7,534
V. Physical Contingency (10%)	3,967	2,106	6,073
Total (Item - I+II+III+IV+V)	43,642	23,164	66,806

Figures

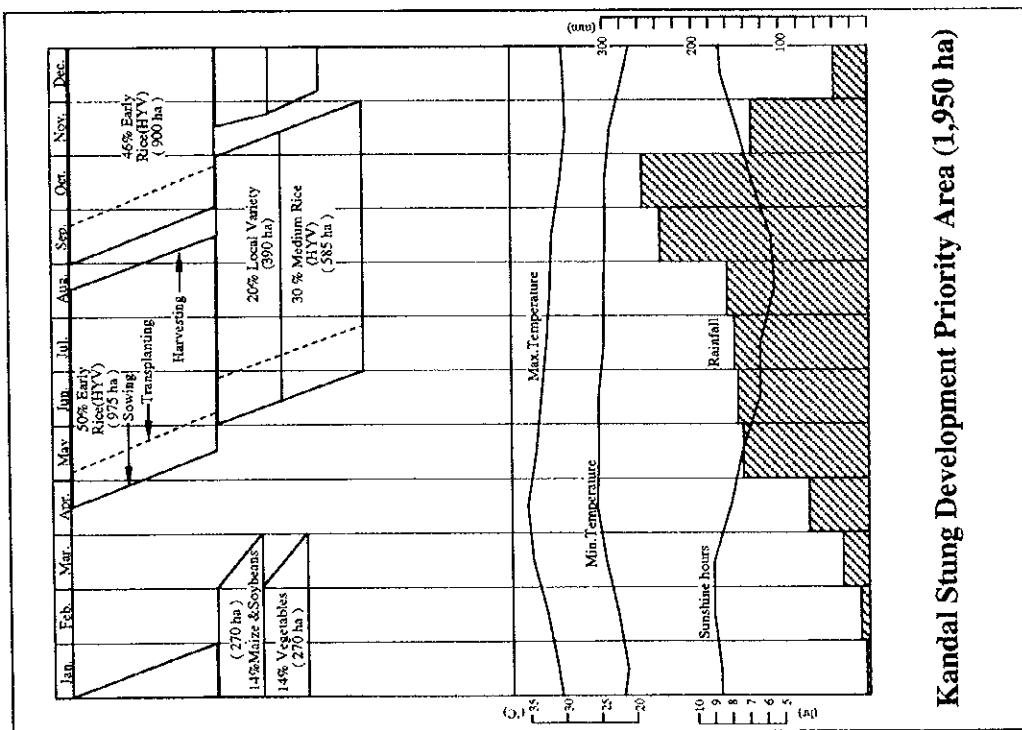
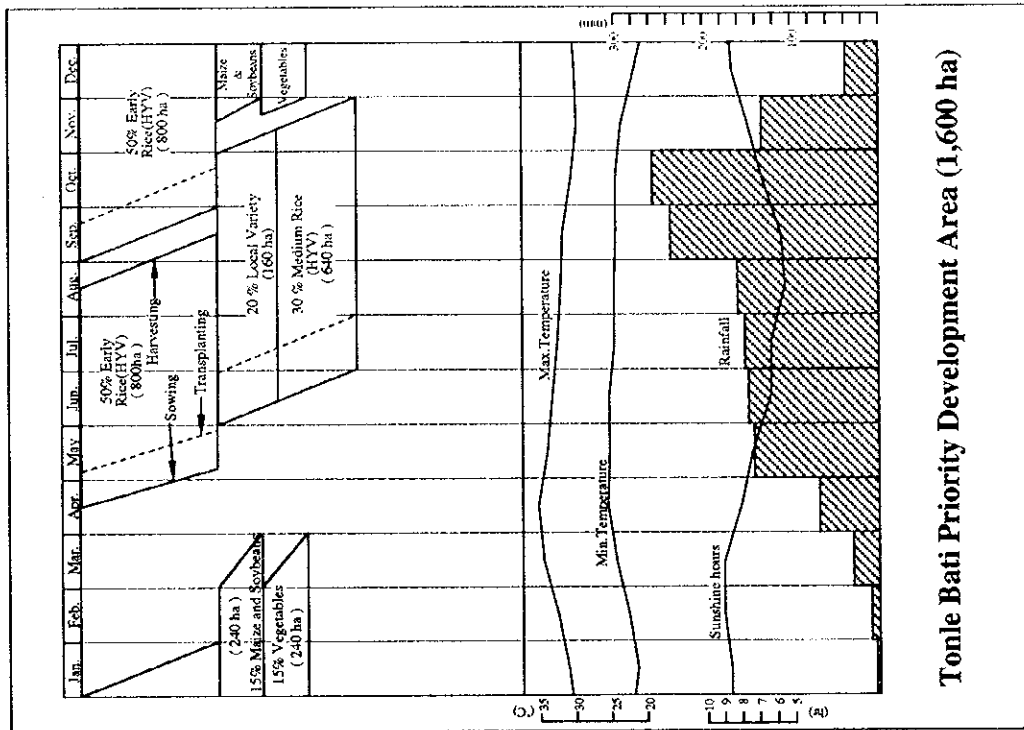
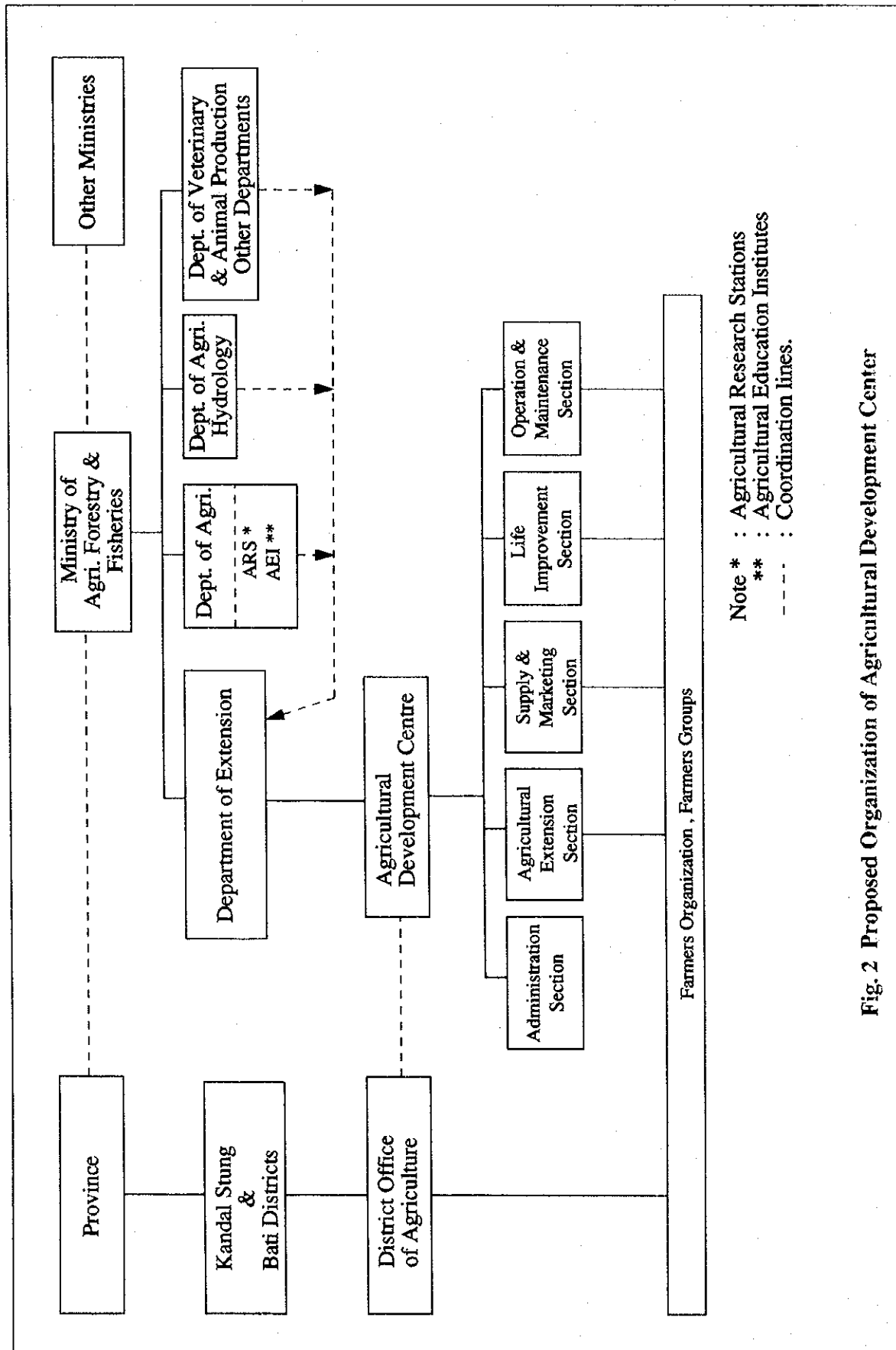


Fig. 1 Proposed Cropping Pattern



Note * : Agricultural Research Stations
 ** : Agricultural Education Institutes
 - - - - : Coordination lines.

Fig. 2 Proposed Organization of Agricultural Development Center

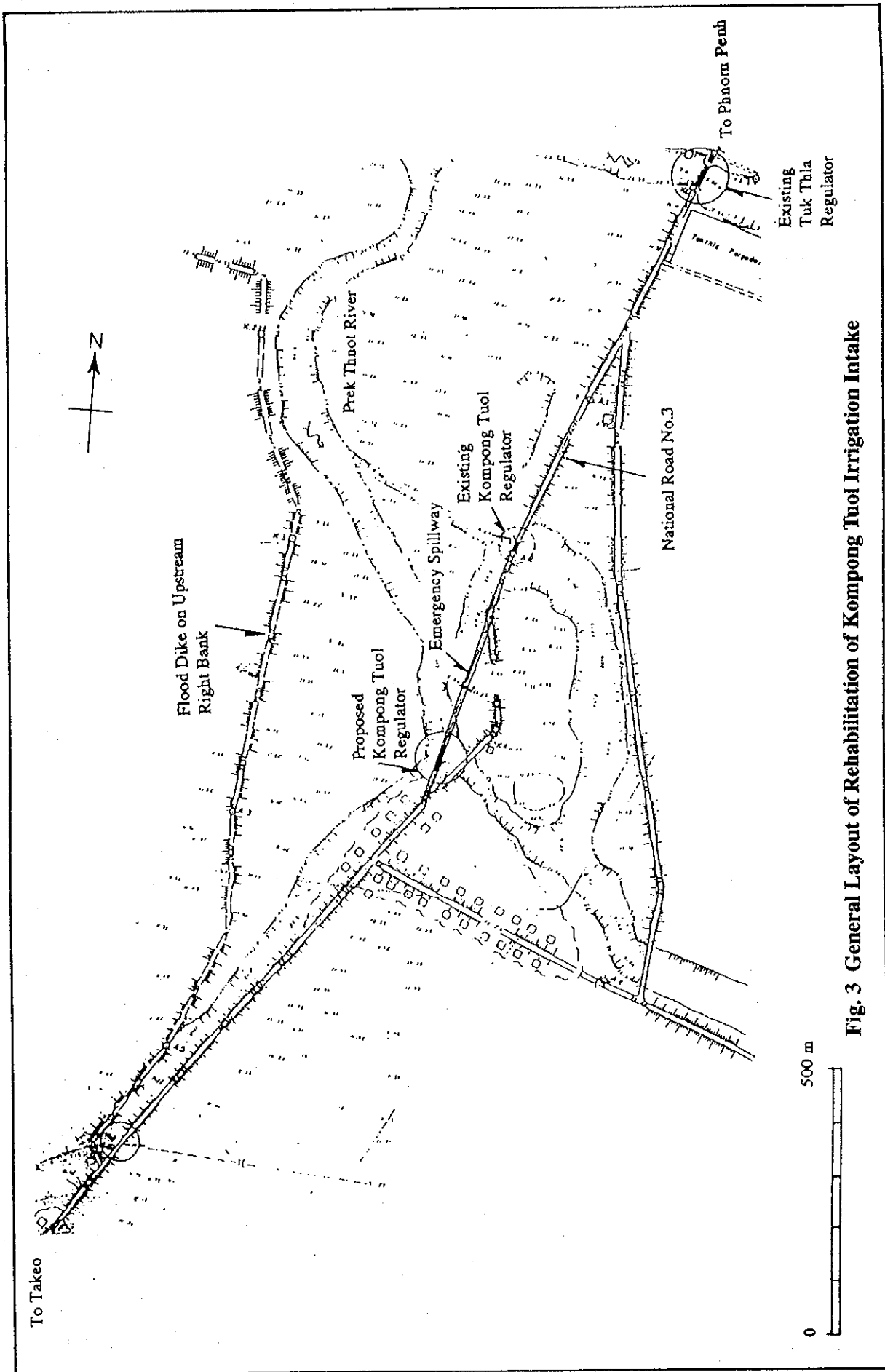


Fig. 3 General Layout of Rehabilitation of Kompong Tuol Irrigation Intake

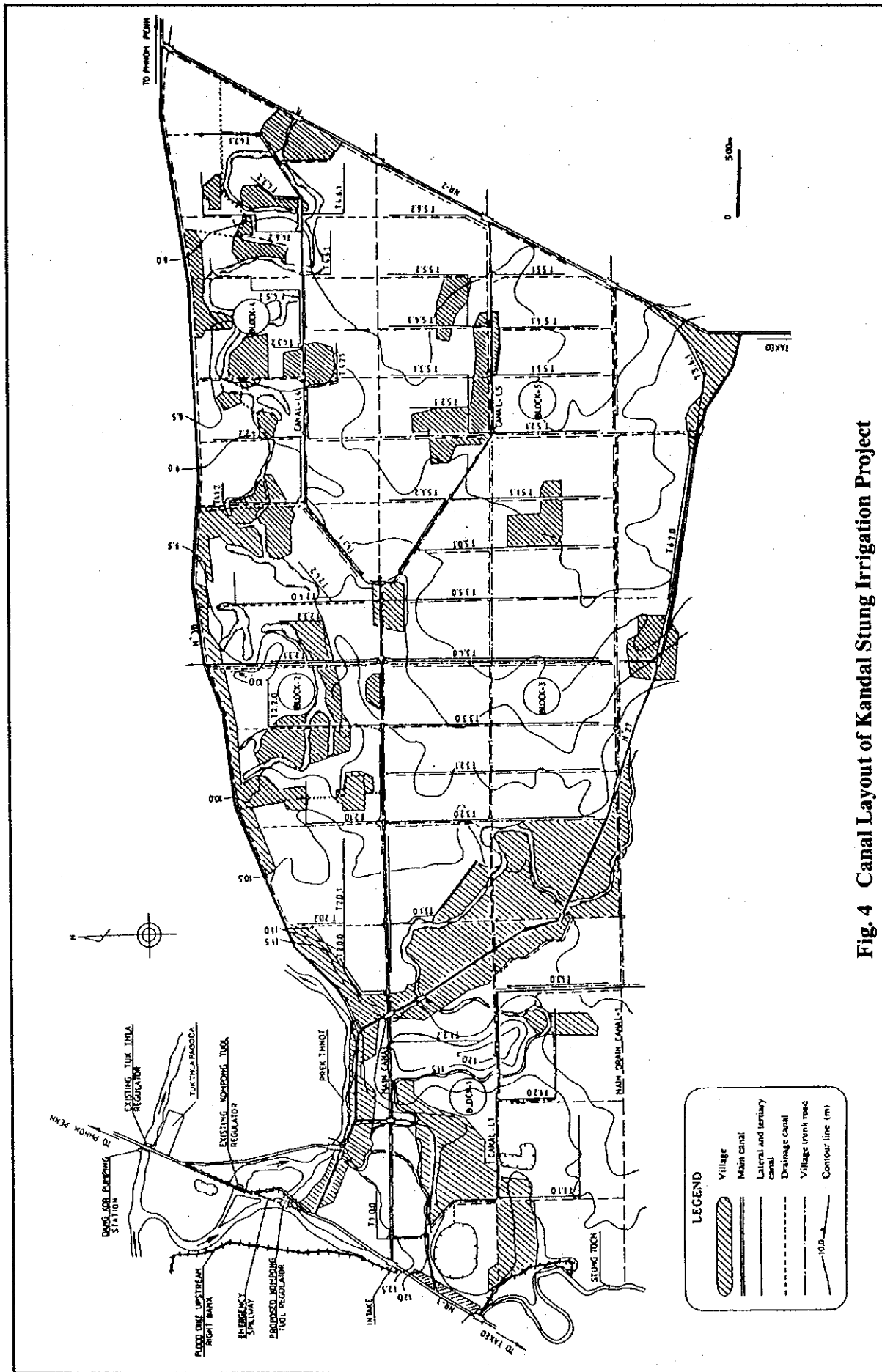


Fig. 4 Canal Layout of Kandal Stung Irrigation Project

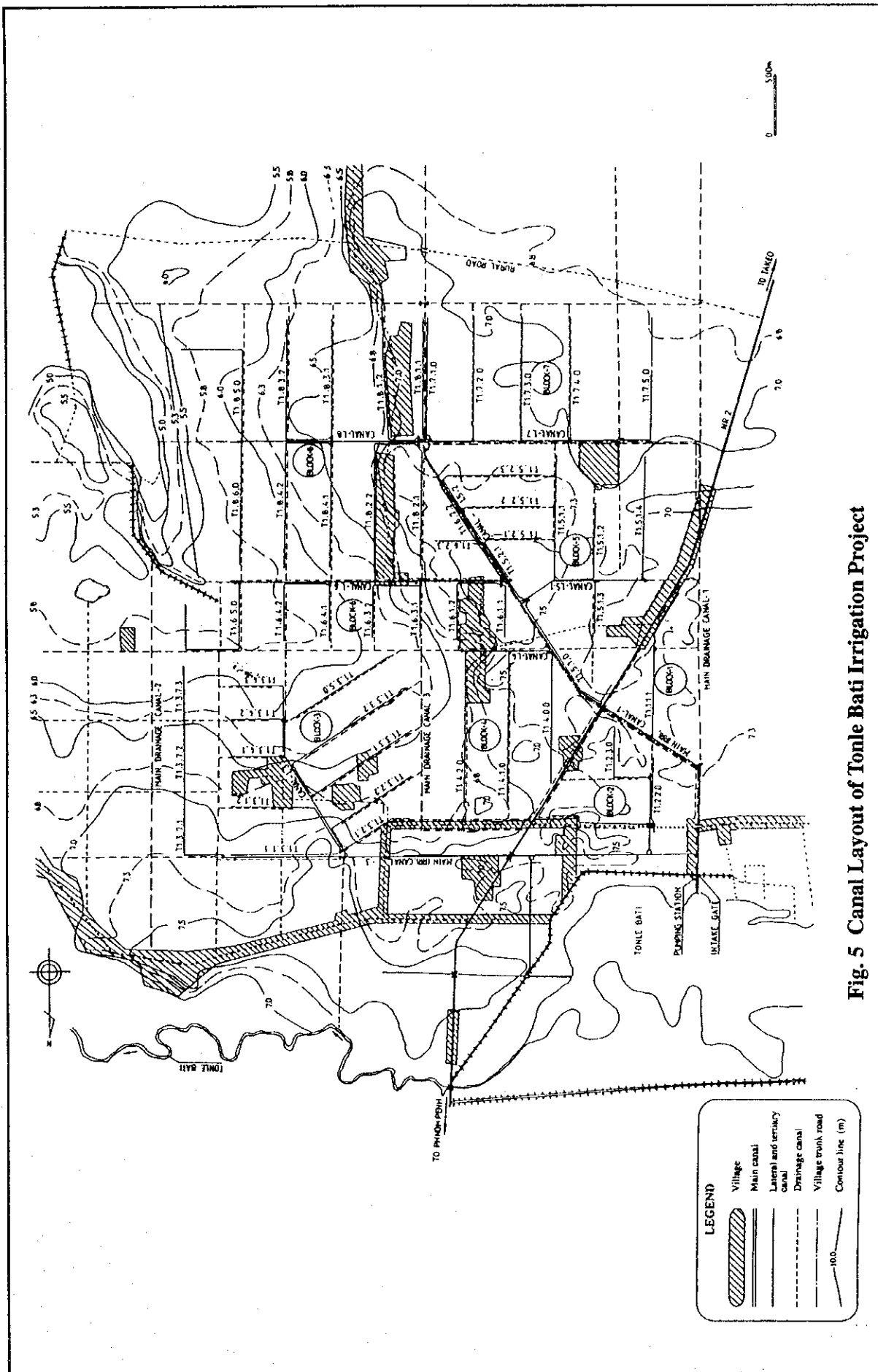
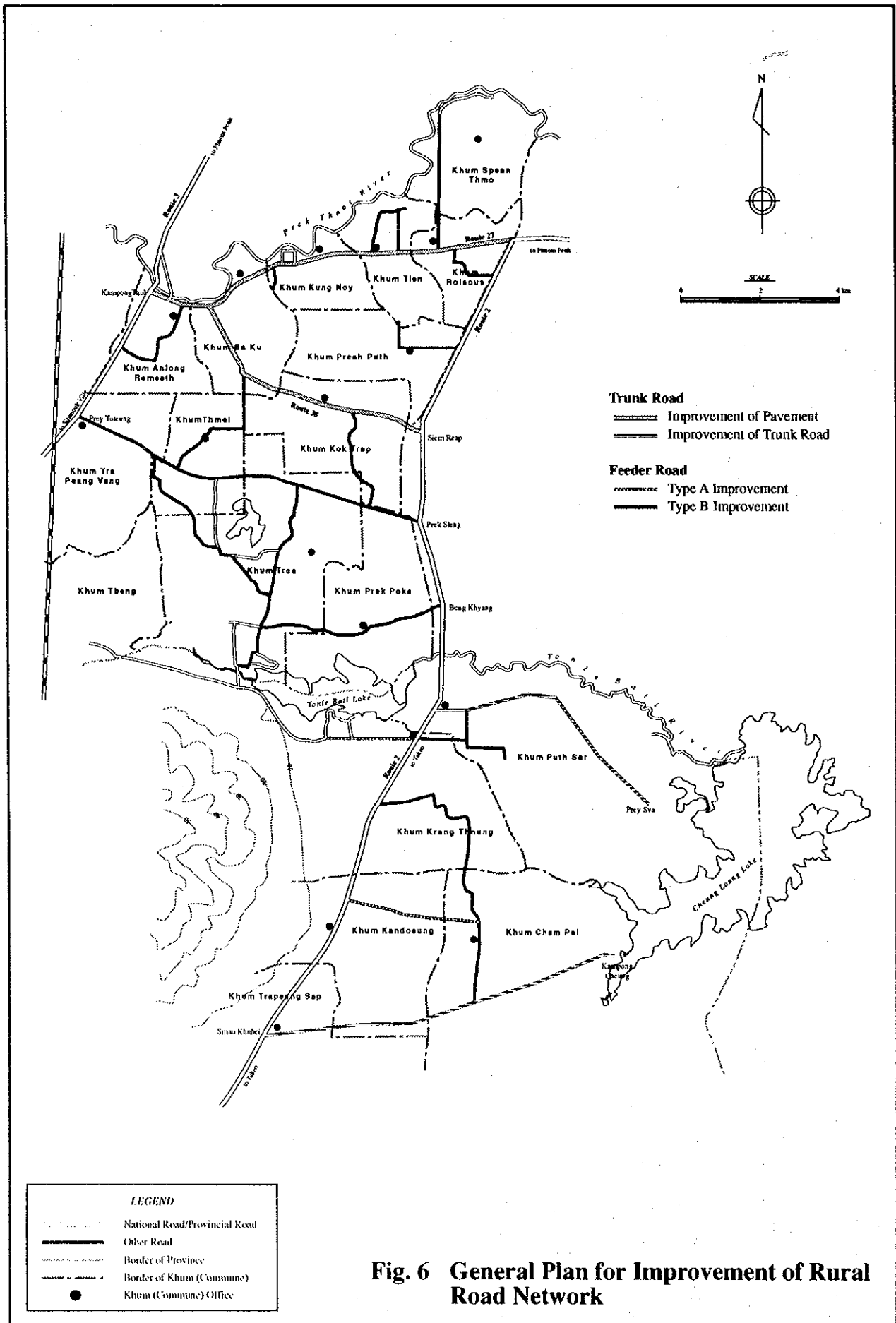
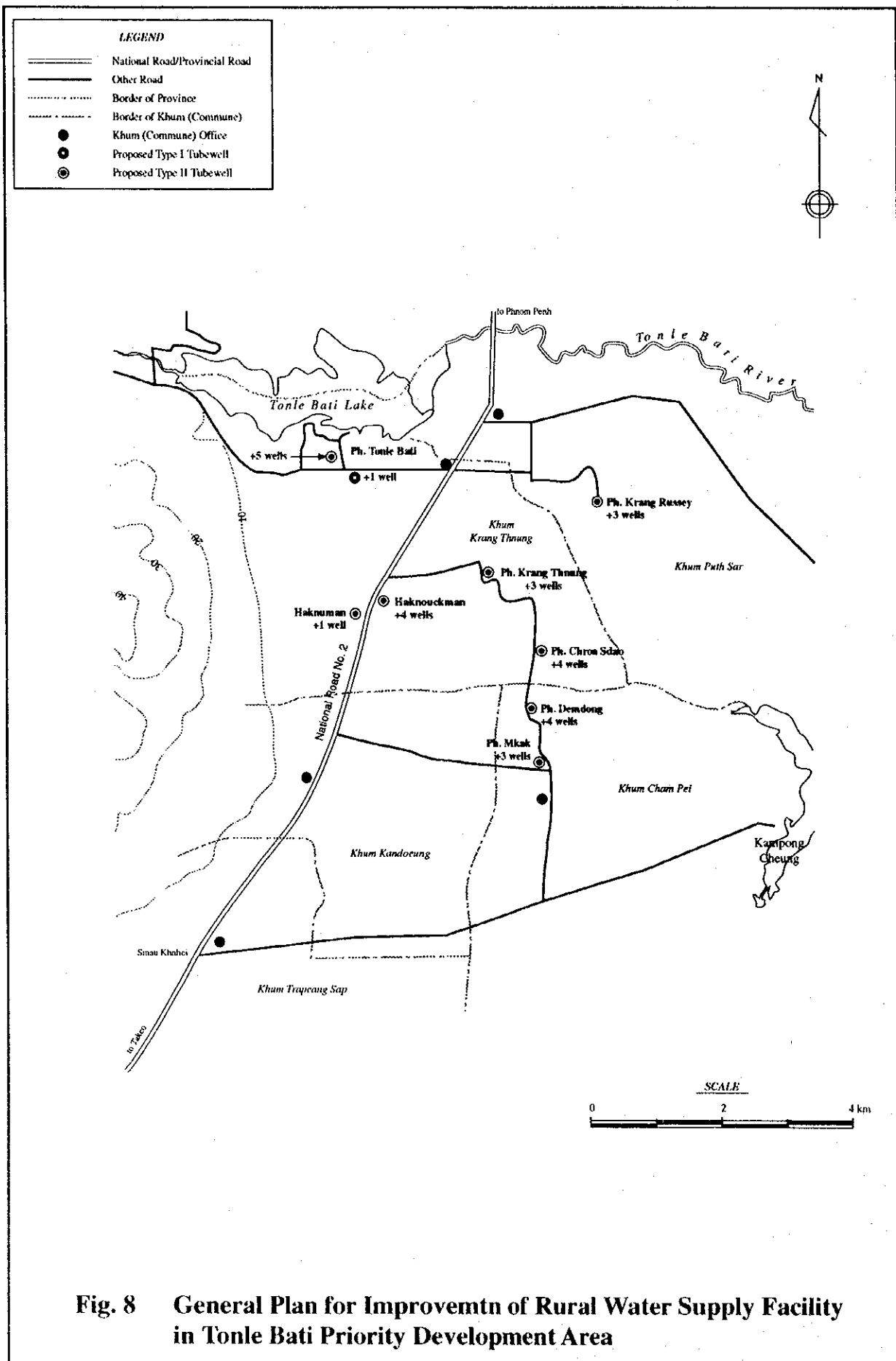
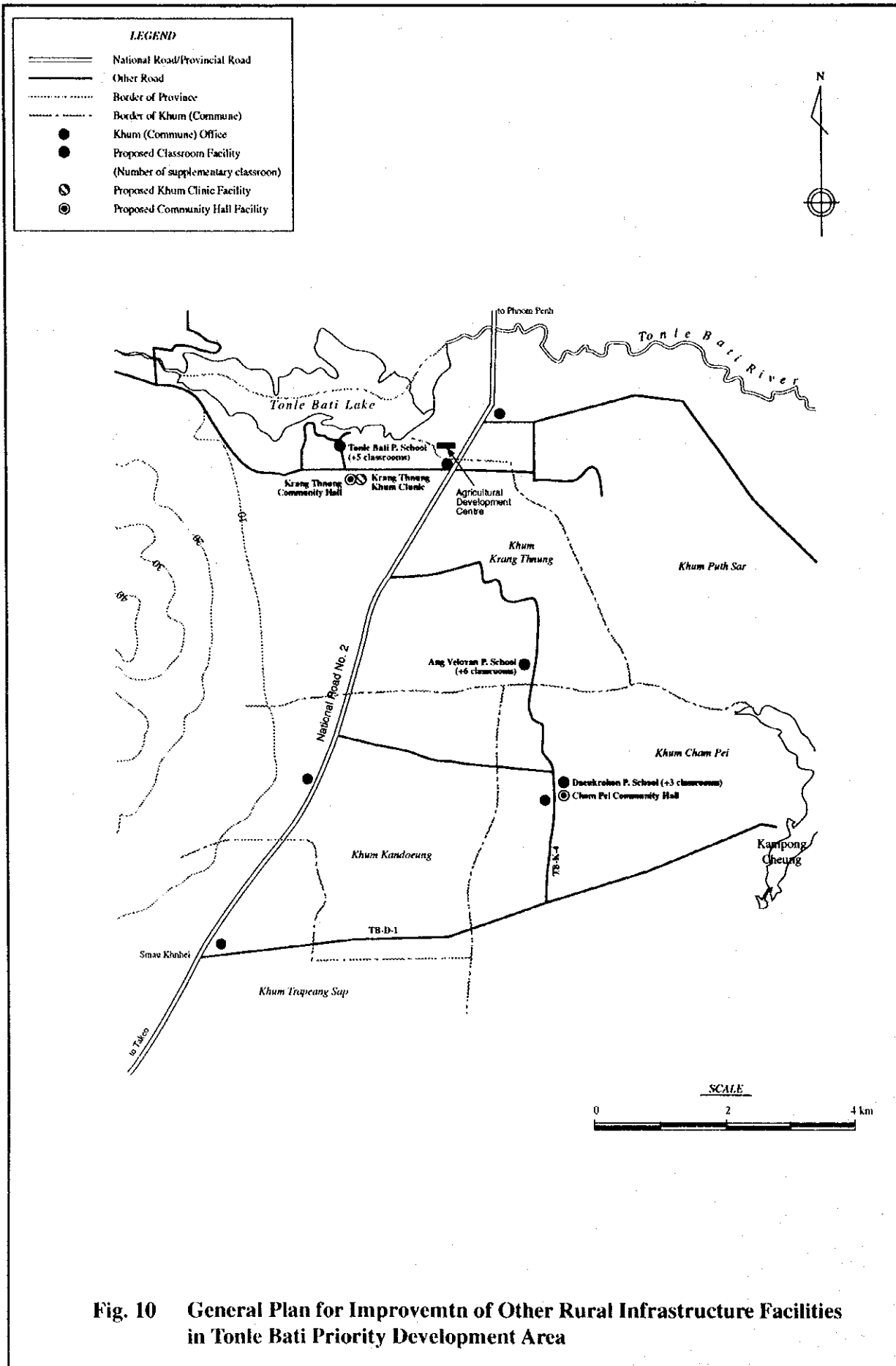
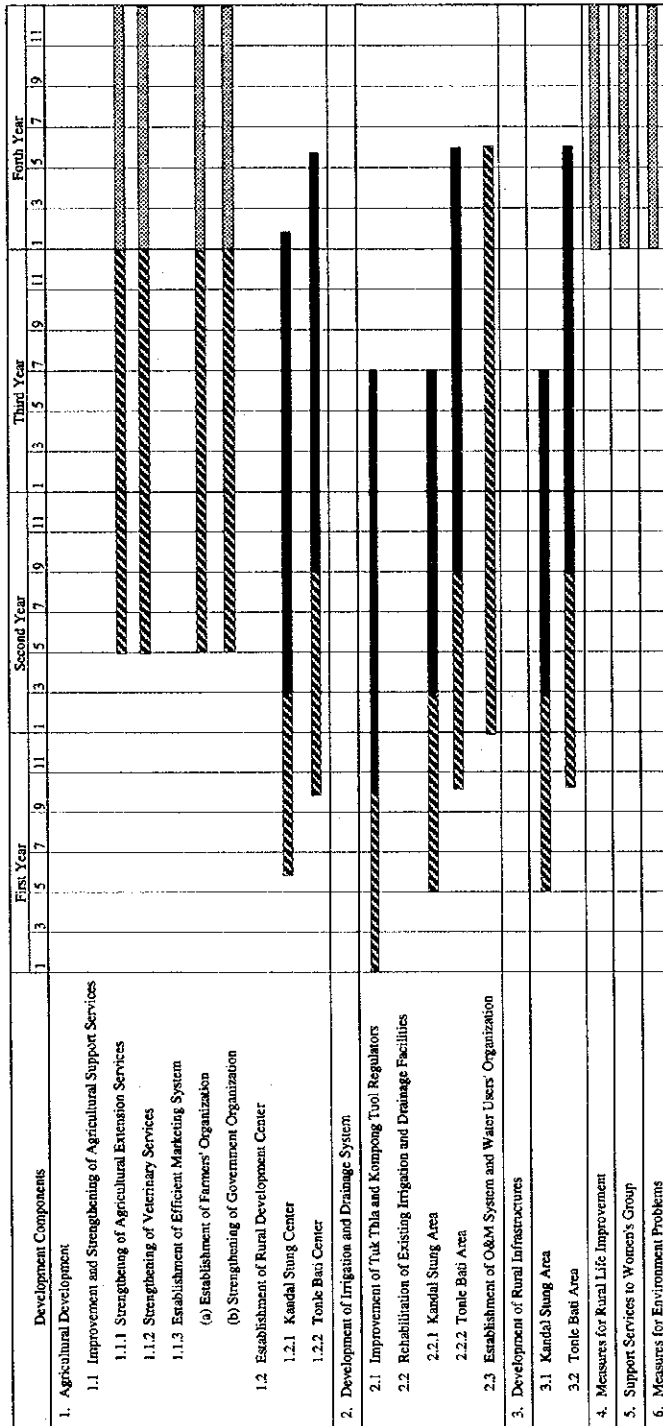


Fig. 5 Canal Layout of Tonle Bati Irrigation Project









Preparatory Works (design, tender, institutional set up etc.)

Construction

Operation

Fig. 11 Implementation Schedule of Priority Development Projects

JICA