

Japan International Cooperation Agency (JICA)

Ministry of Water Resources and Meteorology
The Kingdom of Cambodia

**THE STUDY
ON
THE REHABILITATION AND RECONSTRUCTION
OF AGRICULTURAL PRODUCTION SYSTEM
IN
THE SLAKOU RIVER BASIN,
THE KINGDOM OF CAMBODIA**

**VOLUME-I
MAIN REPORT**

March 2002

Nippon Koei Co., Ltd.
Docon Co., Ltd.
Pasco International Inc.

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PREFACE

In response to the request from the Government of the Kingdom of Cambodia, the Government of Japan decided to conduct the Study on the Rehabilitation and Reconstruction of Agricultural Reproduction System in the Slakou River Basin and entrusted the study to the Japan International Cooperation Agency (JICA).

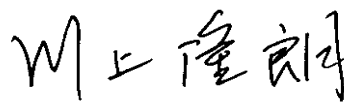
JICA selected and dispatched the study team headed by Mr. Higashikawa Toshikazu of Nippon Koei Co.,Ltd. and consist of Docon Co.,Ltd. and Pasco International Inc. to Cambodia, four times between January 2001 and February 2002.

The team held discussions with the officials concerned of the 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 projects and to the enhancement of friendly relations between our two countries.

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

March 2002



Takao KAWAKAMI

President

Japan International Cooperation Agency

March 2002

Mr. Takao KAWAKAMI
President
Japan International Cooperation Agency
Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir,

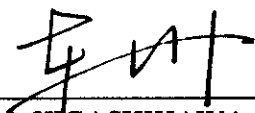
We are pleased to submit you herewith the Study Report on the Rehabilitation and Reconstruction of Agricultural Production System in the Slakou River Basin, the Kingdom of Cambodia. This report presents the results of the Master Plan Study and the Feasibility Study conducted in both Cambodia and Japan during a total period of 15 months from January 2001 to March 2002.

The Study was firstly conducted to formulate a master plan for the study area of 65,000 ha and select priority projects, and secondly the feasibility study was conducted for the priority projects. The priority projects consist of i) the upper Slakou river irrigation reconstruction plan (USP), ii) the small reservoir rehabilitation plan (SRP) and iii) the small pond construction plan (PDP). In order to make such plans economically, financially, technically, and environmentally sustainable, i) agricultural production program, ii) agriculture support program, iii) marketing assistance program, iv) institutional development and capacity building program, v) rural road improvement program and vi) environmental conservation program are established in the Study. The created plans and programs are a model for rehabilitation and reconstruction of Pol Pot reservoirs/canals existing throughout Cambodia.

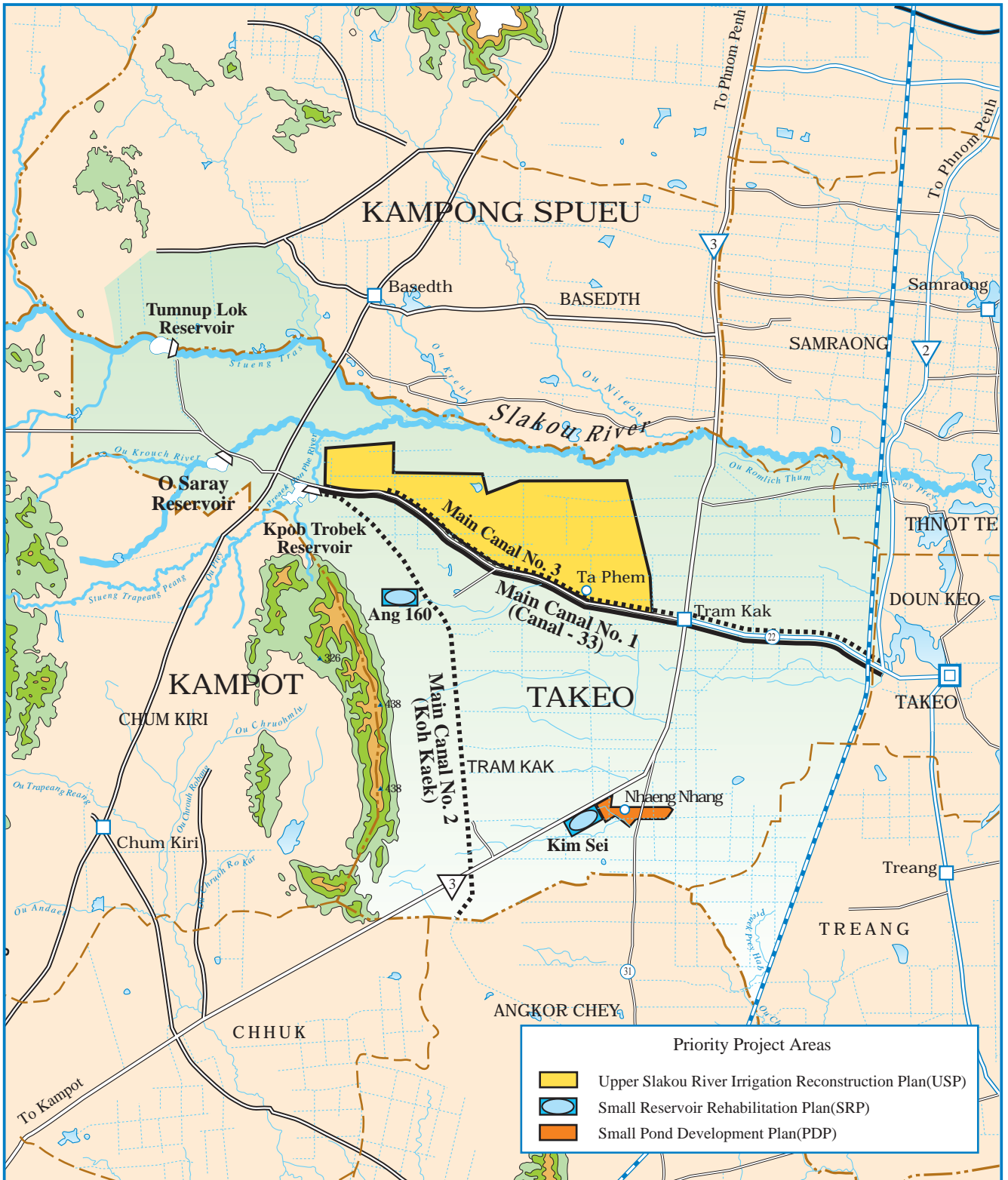
We believe that the implementation of the priority projects will help i) to improve farmers' income and living standard in the study area, ii) to contribute to attain the Cambodia's national target of mitigation of poverty by application of the model plans, and iii) to prosper the cordial relations and good-will between Japan and Cambodia.

We wish to express our deep appreciation and sincere gratitude to your Agency, the Ministry of Foreign Affairs, and Ministry of Agriculture, Forestry and Fisheries for the kind cooperation extended to us. We also wish to express our deep gratitude to your Cambodia Office, the Embassy of Japan, the Ministry of Water Resources and Meteorology (MOWRAM) and other authorities concerned of the Government of the Kingdom of Cambodia for the close cooperation and assistance extended to us during our field investigations and studies.

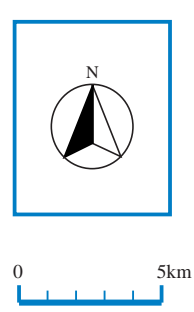
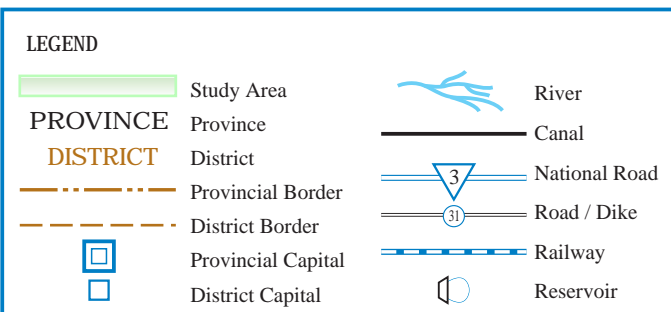
Very truly yours,



Toshikazu HIGASHIKAWA
Team Leader
The Study Team for the Rehabilitation and
Reconstruction of Agricultural Production
System in the Slakou River Basin,
the Kingdom of Cambodia



LOCATION MAP OF THE STUDY AREA





The Slakou River (Rainy Season)
(Looking upstream at National Road No.3.)



The Slakou River (Dry Season)
(Looking upstream at National Road No.3.)



USP Area Proposed Spillway Site of
Tumnup Lok Reservoir



USP Area Kpob Trobek Reservoir



SRP Area Ang160 Reservoir



SRP Area Kim Sei Reservoir



PDP Area Existing Pond and Irrigation Farming at Trapeang Snao Village



PDP Area Under Construction of Pond at Trapeang Snao Village



Meeting with JCC
(Joint Coordinating Committee for the Study)



Participatory Rural Appraisal Workshop 1



Participatory Rural Appraisal Workshop 2



Seminar on Planning Guideline

SUMMARY

Part I GENERAL INFORMATION AND BACKGROUND

I-1 Introduction

1. This Summary of the Final Report has been prepared by the JICA Study Team in accordance with the Scope of Work (S/W) for the Study on the Rehabilitation and Reconstruction of Agricultural Production System in the Slakou River Basin, the Kingdom of Cambodia agreed upon between the Ministry of Water Resources and Meteorology (MOWRAM), the Royal Government of Cambodia (RGC), and the Japan International Cooperation Agency (JICA) on October 09, 2000. The Report presents i) general information and background, ii) master plan study for the Study Area, iii) alternative study on the irrigation area of the Upper Slakou River Irrigation Reconstruction Project (USP), and iv) feasibility study on the priority projects selected through the master plan.
2. The Study area of about 650 km² in total is located about 70 km southwest from Phnom Penh and extends mainly on the right bank of the Slakou River. The Study Area is administratively extending mainly in Takeo Province and partly in Kampong Spueu Province, bordering on the Slakou River in the north, Kampot Province in the south and the west, and on the national road No.2 and the railway in the east (See the location map).
3. The objectives of the Study are i) to prepare a master plan for agricultural reconstruction/development in the upper to middle basin of the Slakou river as a model for the reconstruction/development of shallow bunded reservoir irrigation systems in the Kingdom of Cambodia, ii) to carry out a feasibility study on priority projects, and iii) to transfer technology to the counterpart personnel through on-the-job training in the course of the Study.

I-2 The Study Background

4. The GDP per capita of Cambodia is very low, US\$ 265 in 1999. Agriculture is the mainstay of Cambodia's economy, contributing about 43 % to GDP and 80 % of the labor force. Cambodian's staple food is rice, which is the principal agricultural crop. The total area of Cambodia is 181,035 km², but the paddy field is about 2 million ha and double cropping area is only 16 %. The average paddy yield on national level is low, about 1.69 ton/ha.
5. Population of Cambodia is 11,437,656 (1998). The average family size is 5.2 persons per household. Eighty-four percent of the population is living in rural areas and 42 % of these rural people live below the poverty line. The poverty issue always lies at the base of social and economic matters in Cambodia.
6. Under such circumstances, the Royal Government of Cambodia (RGC) is formulating the Second Five-Year Development Plan (2001-2005) to succeed the First Plan (1996-2000). The major targets of the Plan are development of the

national economy, and poverty alleviation. In order to fulfill the targets, it is very much necessary to improve rural people's income and living standard. For this, agriculture and irrigation developments have been highly expected.

Part II MASTER PLAN STUDY FOR THE STUDY AREA

II-1 The Study Area

7. Local administration and rural community in Cambodia is structured by Province, District, Commune, Village and Group. Commune is the lowest unit of public administration. The number of villages in the Study Area are 276 in total, 23 in Kampong Spueu Province and 253 in Takeo Province.
8. Total population and households in the Study Area are about 165,600 and 33,000, respectively. The average family size is 5.0-person/ household. As the Study Area is 650 km² in total, the population density is estimated at 255 persons/ km².
9. The elevation of the Study Area ranges from EL 6 m to EL 60 m. The geological layer in and around the Study Area is alluvium consisting of sand, silty sand and sandy silt.
10. The alternating monsoon system controls the climate of Cambodia. The rainy season is from May to November, while the dry season is from December to April. March and April are the hottest months and have high potential evapo-transpiration. Annual average rainfall is about 1,200 mm in the lowland, and about 90 % of rain occurs during the rainy season. The peak is in October. Rainfall is very erratic and usually of limited spatial extent.
11. There are no available runoff data in the Slakou River system. Only the Prek Thnot River, a neighboring basin of the Slakou River basin, has discharge measurement records for a few years. Rainfall patterns are almost the same for both basins, and the topographic conditions and land use patterns are also similar. Thus the Slakou river runoff was estimated on a monthly basis for 20 years, i.e. 1966 to 1969 and 1985 to 2000, by analyzing the relationship between runoff of the Prek Thnot River and rainfall. The estimated runoff of three streams at the three reservoir sites as shown in the location map, are summarized as follow:

Estimated Monthly Discharge at Three Reservoirs' Sites at Recurrence Period of Five Years and Two Years

Unit: m³/sec

Name of Reservoir	Return period	Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave.
Kpob Trobek	5 years	0.08	0.04	0.02	0.01	0.01	0.01	0.32	0.47	2.25	1.84	1.19	0.30	0.55
	2 years	0.13	0.06	0.03	0.01	0.01	0.47	0.56	1.15	3.24	4.60	1.88	0.53	1.06
O Saray	5 years	0.01	0.00	0.00	0.00	0.00	0.00	0.08	0.12	0.75	0.62	0.39	0.09	0.17
	2 years	0.02	0.00	0.00	0.00	0.00	0.13	0.17	0.35	1.13	1.62	0.66	0.17	0.36
Tumnup Lok	5 years	0.16	0.10	0.06	0.01	0.01	0.01	0.75	1.21	5.52	4.51	2.87	0.68	1.33
	2 years	0.28	0.19	0.09	0.02	0.01	1.16	1.42	2.83	7.87	11.17	4.55	1.28	2.57

12. The water resources of the Slakou River were utilized for paddy cultivation in the Study Area through a reservoir irrigation system constructed in the 1970s.

Nowadays, however, the water resources are not used in the Study Area.

13. Soils in the Study Area are classified into five soil groups: (A) recent alluvium soils, (B) alluvium soils, (C) gray soils (D) gray lessive soils, and (E) red yellow soils. Among the soil groups, the lessive soils are dominant occupying 54,000 ha or 83 % of the Study area. The lessive soils are major soils where paddy rice is cultivated. These soils are suitable for paddy and secondary crops including vegetables during the rainy season, and during the dry season under irrigation, but the fertility is low.
14. Out of the 65,000 ha, the net cultivated area is estimated at 44,240 ha, or 68 % of the Study Area, and consists of 42,540 ha of paddy field and 1,700 ha of secondary crop field. Paddy fields are dominant occupying 96 % of the cultivated land or 65 % of the Study Area. They are used for food production and as an income source for rural people. Crops are planted during the rainy season, and paddy rice, vegetables, etc. are rarely planted during the dry season.
15. According to the Land Law promulgated in 1992, land basically belongs to RGC, and farmers have land use right. The land registration program, which is implemented under the land registration office has registered less than 10 % of farmland in the country. Farmland dealings in the Study Area are not common. The farm size per household in the Study Area ranges between 0.09 and 4.15 ha, and the median farm size is 0.80 ha.
16. The agricultural households in the Study Area occupy about 97 % of the total households or approximately 32,000 families. Labor force in the Study Area is approximately estimated at 74,500. Average labor force per household is estimated at 2.3 persons. Labor force exchange system is traditionally practiced for on-farm works during transplanting and harvesting seasons.
17. Paddy is the main crop for the staple food as well as the main income source of farmers for daily life in the area. Paddy cultivation in the Study Area is classified into four (4) categories, i.e. early duration paddy, medium duration paddy, late duration paddy and dry season paddy, by growing period and planting season. Small areas of diversified crops for self-consumption or as cash crops as income source are planted before or after planting of the rainy season paddy.
18. The unit yield of paddy in Cambodia has been gradually increasing recently, although it is still low, 1.69 ton/ha. The average paddy yields in the rainy and dry seasons are 1.53 and 2.93 ton/ha, respectively. The average yields in Takeo Province are 1.8 ton/ha in the rainy season, 2.8 ton/ha in the dry season and 2.2 ton/ha on annual average. The unit yield of the Study Area is only 1.3 ton/ha.
19. Farming is carried out extensively by manual labor and draft animals without agricultural machinery. About 70 % of farmers raise draft animals for plowing and carting. Farmers without draft animals undertake land preparation on a contract basis. Around 30 % of farmers have not used chemical fertilizer due to the lack of fund. Weeding is usually carried out by manual labor. Chemical spraying for pest

and disease control is rarely done.

20. Livestock raising is an important activity for farmers in the Study Area as a cash income source and as draft power for land preparation work. A typical farm household has 2.6 heads of cattle, 1.7 heads of pig, and 18 heads of poultry. Annual farm cash income of US\$ 118 is very low. The main cash income source is livestock (about 66 % of gross income) and off-farm wages (about 28 % of gross income).
21. The RGC gives a high priority to food security, mainly to paddy. The self-sufficiency of paddy at a national level has been attained through the increase of rice production though the quality are not quite satisfactory. Only 2 % of paddy produced in the Study Area is surplus after consumption in the area. Since farmers use rice or broken rice for pig raising, it can be said that paddy in the Study Area is often in short in year of low production, and that farm households of smaller than the average are usually deficit in paddy.
22. The irrigation system of the Study Area consists of three main reservoirs and two main canals as shown in the location map. This system was constructed during the period of Pol Pot Regime in the latter half of the 1970s. After several years, most of the reservoir facilities were damaged by floods due to improper operation. The irrigation canals were damaged due to inadequate maintenance.
23. The Tumnap Lok Reservoir on the Slakou River is located on the up-most reach of the command area as an intake facility to the system. Water diverted from the Tumnap Lok Reservoir was conveyed to the O Saray Reservoir through a connection canal or diversion canal, then to the Kpob Trobek Reservoir, from which the Main Canals start. Main features of the three reservoirs are summarized below:

Main Features of Three Reservoirs

Description	Kpob Trobek	O Saray	Tumnap Lok
1. River	Don Phe	Krouch Stream	Tras (Slakou)
2. Catchment area	137 km ²	51 km ²	332 km ²
3. River gradient: Average	1/110	1/120	1/190
4. River gradient: At Reservoir	1/540	1/250	1/460
5. Reservoir Volume (Assumed)	2.63 MCM	0.23 MCM	1.00 MCM

24. Main Canal No.1 or Canal-33 runs on the south side of the District Road No.33 toward the National Road No.3. Water from Canal-33 is diverted to secondary canals mostly located to the north of Route-33 through pipe or box culverts. Main Canal No.2 or Koh Kaek Canal starts at the Kpob Trobek Reservoir and runs southward to Angkor Chey in Kampot Province. Secondary canals convey irrigation water from Koh Kaek Canal to the southwestern part of the Study Area. Since no authorized information is available on the design features of the irrigation system, such as design drawings and design documentation, the net irrigation command area has been regarded as 30,400 ha for a long time.

25. At present, legally authorized farmer water user community (FWUC) does not exist in the Study Area. There are several FWUCs in areas neighboring the Study Area. These FWUCs were established during the period from 1994 to 1999 and are supported mainly by international organizations. Most of the FWUCs are carrying out i) operation and maintenance of irrigation facilities, ii) collection of irrigation service fee (ISF) decided by the Committee, iii) dispute resolution, and iv) accounting of FWUC, although they have difficulty and problems. According to the information from the FWUCs, ISF in cash or kind is not fully collected, and the collection ratio of ISF is 68 %.
26. Under Article 20 in the Draft Law on Water Resources Management of RGC, all farmers using water from the same irrigation system should form a FWUC. This law also enables FWUC to be established upon the initiative of MOWRAM. The statutes of a FWUC shall be registered with MOWRAM. As of the date of registration, the Community shall acquire juridical status. The procedures for the establishment, functioning and dissolution of FWUCs shall be determined by way of sub-decree.
27. Agricultural extension service is managed under the Department of Agricultural Extension, MAFF. The Agricultural Extension Section of DAFF Takeo has 32 staff including the section chief. The extension workers from this office cover 10 districts in the province.
28. Micro-credit service by NGOs is expanding in the Study Area. The interest rate of micro-credit varies between 2 % and 6 % per month, depending on the purpose and conditions.
29. Since they need money for daily life, most farmers sell their paddy/rice to collectors soon after harvest and store a small amount for home-consumption. Most farmers sell the paddy directly to middlemen, large rice mills and retailers in the market.
30. The fundamental community unit in the rural area is a village (Phum), which is a group of around 100 - 150 families. A commune (Khum), which is the terminal administrative unit in Cambodia, generally consists of around 10 to 20 villages. It seems that most of the people living in the rural area have a greater sense of belonging to their village than to their commune.
31. The MRD is responsible for rural development in Cambodia. For this, the MRD is implementing SEILA program (Stage II 2001 to 2005). The program aims at i) strengthening of local government's ownership and governance, and ii) alleviation of poverty in rural area by decentralization and deconcentration. The development plan on rural infrastructure prepared by a commune is evaluated/assessed and financed if approved by the MRD.
32. The MRD is promoting the establishment of a Village Development Committee (VDC) and Commune Rural Development Committee (CRDC) in each village and commune to facilitate the SEILA program. In the Study Area, a VDC generally

has five members, including two females. Some VDCs consist of three members including one female. Under VDCs, farmer groups (FGs) for credit service, agricultural extension service, etc. are organized.

II-2 Development Constraints

33. The majority of households in the Study Area depend on income from farming activity that is the mono culture of paddy production under rain-fed conditions. A small amount of harvested paddy is stored for home-consumption and most of it is immediately sold for cash to meet production and living costs. After the stored paddy has been consumed, some farmers need to buy rice at local markets or from neighboring farmers. In order to get more cash income, livestock raising and cash crop cultivation are practiced in the area, but the levels of productivity and income are still low. A problem tree for the low living standard of farmers was prepared on the basis of causes and effects assessment, and it is concluded that this low living standard of farmers is caused mainly by i) insufficient food (rice) and ii) low farm income arising mainly from non-availability of irrigation water and poor knowledge on improved farming technologies. To solve the problems, development constraints were studied, such as non-availability of water resources, damaged existing irrigation facilities, non-organization of FWUCs and lack of farming knowledge in the area.

II-3 Water Resources Potential

34. Under the condition that the existing reservoirs be rehabilitated or reconstructed to a present design level or similar level, 12 development alternatives of water resources or reservoir/diversion plan were studied in consideration of i) combination of reservoirs to be developed, ii) height of dikes, and iii) route of diversion canals (or connection canals). This study was conducted with irrigation dependability of 80 % and application of water-saving irrigation method, since MOWRAM and the beneficiaries strongly prefer more irrigation area and less irrigation water. The calculation of the study was made by a water balance of runoff of the rivers and irrigation water demands for 20 years.

II-4 The Master Plan

35. The objectives of the master plan are to i) increase farm income, and ii) improve the present low living standard of farmers in the Study Area in order to contribute to attain poverty alleviation and to stabilize regional food supply in the Study Area. In addition, the development plan proposed in the master plan shall be a model for irrigation-based rehabilitation and reconstruction of agricultural production system in Cambodia.
36. The development concept used to formulate the master plan was as follows:
- 1) To efficiently utilize water and land resources for sustainable development,
 - 2) To rehabilitate the existing reservoirs and irrigation facilities, as far as technically feasible, by minimizing new construction,

- 3) To construct ponds near farmhouses and use the existing canals as ponds for supplemental irrigation, domestic use and fishery,
 - 4) To improve the present paddy-oriented agriculture for stabilization of the regional rice supply by applying irrigation, improved varieties and improved farming,
 - 5) To introduce cash crops, such as beans, vegetables, and oil crops, and livestock raising, such as pigs and cattle for increased farm income and improvement of farmers nutrition,
 - 6) To improve the following agriculture support programs for realization and enlargement of irrigation and agriculture development effects, and to assure sustainable agricultural system by farmers themselves:
 - Organization of farmers groups at village level and training of leaders of FGs,
 - Agricultural extension service,
 - Micro-credit service, and
 - Improvement of marketing of agro-product.
 - 7) To improve rural and farm roads for enhancement of farming, marketing and organization activities of farmers groups and farmer water user communities (FWUCs),
 - 8) To organize sustainable FWUCs through beneficiary participation and undertake capacity building of the project office staff of MOWRAM for the implementation of the projects, and
 - 9) To prevent the negative environmental impacts in and around the Study Area.
37. The fundamental constraint for rehabilitation and reconstruction of agricultural production system in the Slakou river basin is the limited water resources to increase productivity and promote product diversification. Based on the present availability of water resources, the following three (3) development approaches as plans should apply to irrigation-based development in the area:
- 1) Upper Slakou River Irrigation Reconstruction Plan (USP),
 - 2) Small Reservoir Rehabilitation Plan (SRP), and
 - 3) Small Pond Development Plan (PDP).

In addition, in order to assure and enlarge the above irrigation-based development benefits, the following support programs are crucial;

- i) Rural road improvement program,
- ii) Agriculture production program,
- iii) Agriculture support program,
- iv) Institutional development program, and
- v) Environmental conservation program

Linkages between irrigation-based rehabilitation / reconstruction plans and support programs was formulated as follows :

Linkage between the Plan and Support Programs

Support Program	Irrigation-Based Development Plans		
	USP	SRP	PDP
Rural/farm road improvement	○	○	○
Agriculture production	○	○	○
Agriculture support	○	○	○
Institutional development	○	○	○
Environmental conservation	○	○	□

○ : Required □ : Required to a lesser extent

38. Taking the period for the Second Five-Year Development Plan (2001-2005) and the composition of the master plan components into consideration, the master plan period is set at from 2001 to 2010 for 10 years.
39. The RGC has estimated that the annual population growth rate will remain at a high level of 2.4 % for 2000 to 2010. Based on this growth rate and the population census in 1998, the population in the Study Area will increase from 165,600 in 1998 to 220,000 in 2010, that is 1.33 times the 1998 population. In order to secure the presently balanced demand and supply of rice in the Study Area, paddy production needs to be increased by 2.4 % per year. Paddy demand in the Study Area in 2010 is estimated at 64,600 tons.
40. Land use in the master plan was determined from the present land use as shown below:

Land Use Plan

(Unit: ha)

	Cultivation area	Forest / wood / tree crop land	Bush / shrub	Residential / facility area	Total
Present	44,240	4,370	9,130	7,260	65,000
Proposed	43,000*	7,000	5,000	10,000	65,000
Balance	-1,240	2,630	-4,130	2,740	0

* : Paddy filed 40,000 ha □ Dry crop field 3,000 ha

41. **Upper Slakou River Irrigation Reconstruction Plan (USP):** The examined alternatives were evaluated according to cost and benefit, technical soundness, negative impact, government intention and beneficiaries intention. As a result, alternative 3-1 (Kpob Trobek Low + Tumrup Lok Low) is proposed as the best development alternative. The irrigation area is 3,500 ha in total.
42. **Small Reservoir Rehabilitation Plan (SRP):** In the Study Area, there are 31 small reservoirs registered, which were mostly constructed under the Pol Pot Regime. The reservoirs which are located outside the USP area were given priority. Since little technical information is available on the small reservoirs, field inspection survey was conducted to evaluate technical and economic viability based on the availability of water source, estimated capacity and confirmation of beneficiaries' intention. As a result, rehabilitation of 15 small reservoirs with a

total irrigation area of about 280 ha is proposed as technically and economically viable rehabilitation plans. Out of 15 reservoirs, i) Tumnup Kim Sei Reservoir in Nhaeng Nhang Commune and ii) Ang 160 Reservoir in Trapeang Thum Khang Tbound Commune are recommended with top priority as pilot rehabilitation plan. Irrigation areas of these two reservoirs is 42 ha in total.

43. **Small Pond Development Plan (PDP)** : The water resources of rivers in the Study Area is very much limited. For the areas out of USP and SRP, water source is rainfall and drained water in upstream area. The only way to store and utilize such water is to construct ponds and utilize the existing canals as ponds. Three types of ponds are proposed as the Small Pond Development Plan (PDP), i.e. i) small ponds operated by farmers groups, ii) small ponds operated by individual farmer, and iii) small ponds utilizing existing canal. Aiming at providing ponds for all the households (at about 250 villages) located outside the USP and the SRP, the PDP with construction of 72 ponds per village is proposed over 10 years. As a PDP model project, PDP at one village of Nhaeng Nhang Commune is proposed for feasibility study.
44. **Agriculture Production Program**: For attainment of the objectives of the master plan, the proposed crops for the three (3) irrigation development plans were selected as shown below:

Selected Crops of 3 Development Plans

Plans	Paddy	Diversified Crops
1. Upper Slakou River Irri. Reconstruction Plan (3,500 ha)	HYVs (early duration period paddy of IR-series) and Improved local varieties (medium duration period varieties)	Maize, Beans (mung-bean, soybean), groundnut, sesame, and vegetables (cucumber, tomato, eggplant, string-bean, watermelon, pumpkin, mustard green, chili, etc.)
2. Small Reservoir Rehabilitation Plan (280 ha)		
3. Small Pond Development Plan (2,100 ha out of 39,220 ha)	HYVs or Improved local varieties (medium duration period varieties) under rain-fed condition	Beans (mung-bean, soybean), groundnut, sesame, and vegetables (cucumber, tomato, eggplant, string-bean, watermelon, pumpkin, mustardgreen, chili, etc.)

The principles for the above selection are as follows :

- i) To adopt paddy-based farming system in order to attain food sufficiency of the people in the Study Area, and to plant paddy during the rainy season,
- ii) To introduce crop diversification before or after paddy cropping within the extent of available irrigation water in order to increase farmers' income, and
- iii) To select suitable diversified crops for the natural conditions, and consideration of profitability, marketability of products including processing capacity for industrial development in Cambodia, and present level of farmers' farming technique.

45. Irrigation area of the three development plans is 5,880 ha in total, and the plans will cover all of villages and farm households in the Study Area. The beneficiary households of Upper Slakou River Irrigation Reconstruction Plan (USP), Small Reservoir Rehabilitation Plan (SRP), and Small Pond Development Plan (PDP) are roughly estimated at 4,500, 1,400 and 30,000, respectively.
46. Under the rehabilitation and reconstruction of irrigation facilities and the proposed cropping patterns, some improvements in i) farming practices, ii) utilization of farm inputs and iii) raising of cattle and pigs, are proposed for attainment of the development target. The estimated irrigation benefits are as follows:

Estimated Income Increase

(Unit: million Riel)

Plan	Gross income	Profit	Incremental profit	Note
Farmer of median size				
1. USP	1.52	1.06	0.83	Median size farmers: 0.8 ha/household
2. SRP	1.52	1.06	0.82	
3. PDP	0.48	0.31	0.07	Irrigation area: 0.07 ha/household

47. **Rural Road Improvement Program (RIP):** Roads in the Study Area play significant roles: i) access to living necessities and various services, ii) farm road to convey agricultural input, and iii) market road to transport agricultural products to the market. In order to prepare rural road improvement program, all roads in the Study Area were classified into three categories, i.e. i) primary, ii) secondary and iii) access to the primary and secondary roads. All the roads of 154.3 km were evaluated according to coverage area, present condition, and degree of importance, and priority for the rehabilitation was given to the roads. Out of the first priority roads, the following three roads having a total length of 24.5 km are given a highest priority:

- 1) Trapeang Thum Khang Cheung to Trapeang Kranhung (13 km)
- 2) O Saray to Slakou River road (5.5 km)
- 3) Kpob Svay road (6 km)

48. **Agriculture Support Programs:** The Agriculture Support Programs under the master plan consists of i) Farmers Groups (FGs) at village level, ii) extension service of agriculture, iii) credit service and iv) agro-processing and marketing.

(1) **Farmers Groups (FGs) at Village Level:** In order to support irrigation-based rehabilitation and reconstruction plans, an organization of FGs which are positioned under a VDC is necessary. In parallel with formation of FGs, an FWUC will be organized. The organizing VDCs and FGs are proposed to conduct credit service, agricultural extension service, etc.

(2) **Extension Service of Agriculture and Animal Husbandry:** The improvement program of agricultural extension service includes i) demonstration plots at field level, ii) group purchase of farm inputs, and iii) training of village extension workers (VEWs) at village level, who are leaders of the extension FGs.

In addition, organization of paddy-seed multiplication FGs is proposed.

(3) **Credit Service:** The future production costs will increase two to three times the present costs. The current financial capacity of farmers is insufficient for proper investment in farm inputs. In order to attain targets of the program, agricultural credit system is indispensable for farmers. Collaboration with NGOs and organization of credit FGs under VDC are proposed.

(4) **Agro-Processing and Marketing:** In order to conduct i) assembling and marketing of crops, and ii) marketing of ISF paddy for FWUC, it is proposed in the master plan to organize marketing FGs. The activities of FGs have several advantages for improvement of post-harvest and marketing activities through effective extension activities, creation of competitiveness, and increasing bargaining power.

49. **Farmers Water User Community (FWUC):** RGC issued Circular No. 1 on the Implementation Policy for Sustainable Irrigation System in January 1999 based on the following principles:

- Legal status of FWUC,
- Involvement of FWUC in system development,
- Obligation of farmers in paying O & M cost and emergency cost,
- Permanent maintenance and improvement of the existing irrigation systems, and
- Arrangement of equitable water delivery.

Formation of FWUC in the Study Area is proposed to have such a tier structure system, such as; i) watercourse committee at the watercourse level, ii) tertiary canal committee at tertiary canal outlets, iii) secondary canal committee at secondary canal outlets, iv) main canal committee at the reservoir intake or headwork, and v) apex committee at the project level.

50. In order to attain the objectives of FWUC, training of members of FWUC is essential. It is proposed that MOWRAM provides training of FWUC formation and operation including technical, and administrative matters necessary for O & M of irrigation facilities.

51. **Capacity Building of MOWRAM:** MOWRAM will establish a project office when the development plans are implemented. At present, DWRAM Takeo has little capacity for the implementation because current workload is beyond the capacity of the office. In order to smoothly implement the proposed development plans, the following capacity building of MOWRAM is proposed:

- 1) Strengthening capacity of planning, design and construction management,
- 2) Assignment of specialists for FWUC and O & M, and
- 3) Training of project office staff about planning of irrigation project, design of irrigation facilities, construction supervision, technology transfer of O & M to FWUC, etc.

52. **Environmental Conservation Program:** The following environmental conservation program was prepared based on i) the existing condition in and around the Study Area, ii) the characteristics of the main components of the Master Plan, and, iii) the results of Initial Environmental Examination (IEE):

- 1) Program for minimizing and controlling negative impacts (water-related hazard prevention, and assistance to affected households), and
- 2) Program for ensuring environmental sustainability (watershed management and forest resource conservation).

53. **Implementation Schedule:** The implementation schedules of Upper Slakou River Irrigation Reconstruction Plan (USP), Small Reservoir Rehabilitation Plan (SRP) and Small Pond Development Plan (PDP) are as follows:

Stage and Period of USP

	Development Area	Period
Stage-1	800 ha	Mid 2002 – Early 2006
Stage-2	2,700 ha	End 2003 – Mid 2008
Total	3,500 ha	

Stage and Period of SRP

	Development Area	Period
Stage-1	2 reservoirs	Mid 2002 – Early 2005
Stage-2	7 reservoirs	End 2003 – Mid 2008
Stage-3	6 reservoirs	Mid 2006 – End 2010

Stage and Period of PDP

	Development Area	Period
Stage-1	6 ponds/village	Mid 2002 – Early 2006
Stage-2	24 ponds/village	End 2003 – Mid 2008
Stage-3	42 ponds/village	Mid 2006 – End 2010
Total	72 ponds/village	

54. **Project Costs :** The estimated project costs for USP, SRP and PDP are as follows :

- 1) Upper Slakou River Irrigation Reconstruction Plan (USP): Riel 71,460.7 million
- 2) Small Reservoir Rehabilitation Plan (SRP)

Project Cost of the Representative Small Reservoirs

Name of the Reservoir	Priority	Irrigation Area(ha)*	Project Cost** (Thousand Riel)
Tumnup Kim Sei	1 st	21	395,870
Ang 160	1 st	21	379,100
Trapeang Lean	3 rd	10	261,030

* : Registered irrigation areas by commune and district office

** : Price contingency is excluded.

- 3) Small Pond Development Plan (PDP)

Project Cost of the Small Pond Development

Type of Pond	Effective Volume (m ³)	Irrigation Area/no. (ha)	Nos. of ponds	Irrigation Area(ha)	Project Cost* (Thousand Riel)
Pond (Group Management)	846	0.34	15	around 5ha	129,380
Canal Pond (Group Management)	846	0.34	15	around 5ha	97,550
Pond (Individual Management)	184	0.07	72	around 5ha	154,830

*: Price contingency is excluded.

55. **Project Evaluation:** The three irrigation development plans of USP, SRP and PDP were evaluated by clarification of economic viability using EIRR as described below :

- 1) USP (3,500 ha) has EIRR of 10 %, which means it has sufficient economic viability. It is highly expected to increase farm income sufficiently to compensate the future O & M cost of the project facilities.
- 2) Out of 15 reservoirs, Kim Sei SRP (21 ha) and Ang 160 SRP (21 ha) have the highest EIRR of 9.4 % and 9.8 %, respectively.
- 3) PDP has a higher economic viability in terms of EIRR, but the magnitude of impact to the farm economy in terms of incremental net income is comparatively smaller than those of USP and SRP.

56. **Selection of Priority Projects for Feasibility Study:** The following three irrigation development plans (USP, SRP and PDP) were selected as priority projects for the feasibility study:

- 1) Upper Slakou River Irrigation Reconstruction Plan (USP): 3,500 ha
- 2) Small Reservoir Rehabilitation Plan (SRP): 42 ha
 - Kim Sei SRP (21 ha)
 - Ang 160 SRP (21 ha)
- 3) Small Pond Development Plan (PDP)

There are three types of ponds in the plan, i.e. i) ponds operated by individual farmer, ii) ponds operated by farmers group, and iii) canal ponds operated by farmers group. In order to formulate the small pond development plan at feasibility level, at least one development plan for each pond type need to be studied as model PDP at one village. A canal pond has higher EIRR than the others, and the availability of existing canal having potential of water is a key factor. In due consideration of such conditions, one village in Nhaeng Nhang commune covering canal No.8 was selected for the feasibility study:

For the rural road improvement program (RIP), the following three priority roads with a total length of 24.5 km were selected for the feasibility study:

- 1) Trapeang Thum Khang Cheung to Trapeang Kranhung (13 km),
- 2) O Saray to Slakou River road (5.5 km), and
- 3) Kpob Svay road (6 km).

The following support programs for the selected priority irrigation projects should also be studied at feasibility level in order to assure the irrigation development

impact and other associated effects, specifically for the improvement of farmers' living standard:

- 1) Agricultural Production Program,
- 2) Agricultural Support Program,
- 3) Institutional Development Program, and
- 4) Environmental Conservation Program.

57. **PRA Workshops:** Twenty workshops were conducted during the period of four (4) days from June 13 to June 16, 2001; twelve with beneficiaries, six with local administration staff, one with related NGOs acting in the Study Area and one with related local governmental organizations. The total number of participants in the workshops was more than 280 people. The number of participants for each workshop was around fifteen. Most of the workshops were conducted with an average participation rate of females of about 40 %. As a result, the draft Master Plan was accepted by participants of the workshops.

Part III ALTERNATIVE STUDY ON THE IRRIGATION AREA OF USP

58. USP, which was selected as a priority project in the course of the Master Plan Study, aims to irrigate 3,500 ha by reconstruction of; two reservoirs located on the Slakou River and its tributary, a diversion canal between the two reservoirs, two main canals (Canal 33 and Koh Kaek Canal) and Canal 24 starting at Kpob Trobek Reservoir and their secondary canals. At the initial stage of the Feasibility Study (Phase-II), more detailed survey works were conducted along Koh Kaek Main Canal. In addition, a new 1:10,000 topographic map with 1-meter contour interval was prepared for the priority area of USP. Based on such data, it was judged that the existing Koh Kaek Main Canal was not adequately constructed, and it did not function as a canal even right after construction. The elevation of the existing canal bed fluctuates along the canal profile, which would need a cut depth of 6 to 7 m at the maximum for reconstruction of the canal. Moreover, the construction work volume for the excavation, treatment of the cut slope and drainage facilities required for stability of the canal would be very big and maintenance cost would also be quite high as well as the construction cost. Thus the rehabilitation of the existing Koh Kaek Main Canal was not considered as a "suitable model plan of rehabilitation and reconstruction".
59. Instead of the existing Koh Kaek Main Canal, the following two alternatives were compared mainly on construction costs:
- Alternative 1: New Koh Kaek Canal (1,600 ha: 11.5 km) + Canal 33 (1,900 ha: 7.3km) + Secondary Canals (36.5 km) + Tertiary System
- Alternative 2: Canal 33 (3,500 ha: 7.3 km) + Secondary Canals (44.7 km) + Tertiary System

Construction Cost of Alternative Plans

Item	Unit □ US\$ 1000	
	Alternative-1	Alternative-2
Main Canal 33	675	797
New Koh Kaek Main Canal	2,171	□
Sub-total	2,846	797
Secondary and Tertiary System	4,078	4,781
Total	6,924	5,578
Per ha cost *□	2.0	1.6

Taking the large difference between construction costs of the two alternatives, the Alternative 2 was finally selected as the irrigation area of USP. The irrigation area of 3,500 ha remained unchanged, but the location of the irrigation area was changed.

Part IV FEASIBILITY STUDY ON THE PRIORITY PROJECTS

IV-2 The Upper Slakou River Irrigation Reconstruction Plan (USP)

60. The feasibility study on USP was conducted and the following reconstruction plan is proposed :

- Net irrigation area: 3,500 ha
- Beneficiaries : 4,020 households of 32 villages in 5 communes in Tram Kak District
- Reconstruction of Tumnup Lok reservoir including spillways (Catchment area = 332 km², Effective storage volume = 1 MCM, Dike top EL=43.3 m, Flood discharge (100 years) = 420 m³/s, HWL=EL41.3 m, LWL= EL40.4 m, L= 2.5 km)
- Reconstruction of Kpob Trobek reservoir including intakes and spillways (Catchment area = 137 km², Effective storage volume = 2.63 MCM, Dike top EL=39.0 m, Flood Discharge (100 years) = 195 m³/s, HWL=EL37.3 m, LWL= EL34.2 m, L=3.3 km)
- Reconstruction of diversion canal (Q=3.5 m³/s, L=9.4 km) between the above two reservoirs
- Rehabilitation of Main Canal 33 (Q=3.2 m³/s, L=7.3 km)
- Rehabilitation of Canal 24 (Q=0.6 m³/s, L=5.7 km)
- Rehabilitation of other 6 secondary canals (L=39 km)
- On-farm development including tertiary canals (one / 33 ha on average) and watercourses (one / 5ha on average).

IV-3 The Small Reservoir Rehabilitation Plan (SRP)

61. The SRP has two projects, namely Ang 160 SRP and Kim Sei SRP. The feasibility study on these two projects was conducted and the following rehabilitation plans are proposed :

(1) Ang 160 SRP

- Net irrigation area: 25 ha
- Beneficiaries :130 households in Trapeang Chhuk village
- Rehabilitation of reservoir including intake and spillway
(Catchment area = 2 km², Effective storage volume = 29,300 m³, Dike top EL=46.5 m, Flood discharge (20 years) = 6 m³/s, HWL=EL45.3 m, LWL=EL44.0 m)

(2) Kim Sei SRP

- Net irrigation area: 27 ha
- Beneficiaries : 37 households in Kim Sei village
- Rehabilitation of reservoir including intake and spillway
(Catchment area = 5.2 km², Effective storage volume = 19,700 m³, Dike top EL=13.8 m, Flood discharge (20 years) =11.4 m³/s, HWL=EL12.6 m, LWL= EL12.0 m)

IV-4 The Small Pond Development Plan (PDP)

62. The PDP has three types of pond, namely i) group pond, ii) individual pond, and iii) canal pond. As a model project of PDP, Trapeang Snao village was selected in Nhaeng Nhang Commune, and the feasibility study on the model project was conducted and the following Trapeang Snao PDP is proposed :

- Net irrigation area : 5.8 ha in total
- Beneficiaries : for 88 households in Trapeang Snao village
- Number of ponds : 30 consisting of 14 group ponds, 13 individual ponds and 3 canal ponds

The above plan covers about 80 % of the households and 70 % of the population of the village.

IV-5 SUPPORT PROGRAMS**63. Agricultural Production Program**

(1) USP : Rainy season paddy of 3,500 ha will be irrigated, and the water will additionally irrigate 500 ha and 550 ha of diversified crops before and after the paddy cultivation, respectively. Diversified crops (maize, groundnut, soybean, mung-bean, sesame, and vegetables) will increase cash income of farm households. However, it is necessary to support them in the marketing of products.

(2) Ang160 SRP : Cropping pattern similar to USP will be applied to Ang160 SRP considering the availability of irrigation water. The rehabilitated reservoir will irrigate 25 ha of paddy in the rainy season: 17 ha of local paddy and 8 ha of HYV paddy. Additionally, diversified crops will be irrigated in an area of 2 ha and 3 ha before and after paddy cultivation, respectively.

(3) Kim Sei SRP : Kim Sei SRP has limited water resources due to the reservoir's capacity. Only one cropping will be irrigable during the rainy season. It is

proposed that three (3) ha of diversified crops will be planted after paddy nursery, 16 ha for local paddy, and 8 ha of HYV paddy. Irrigation for paddy nursery will improve production and yield of rain-fed paddy.

(4) Trapeang Snao PDP : Considering the limited water resource, irrigation is proposed for 1 ha of paddy nursery, 4.82 ha for diversified crops during the rainy season and 2.64 ha for diversified crops during the dry season.

64. Target yields of paddy and diversified crops were estimated through examination of yields in existing irrigation area in and around the project areas. The paddy production will be 10,350 ton in USP area, 74 ton in Ang160 SRP, and 71 ton in Kim Sei SRP. The incremental productions will be 6,050 ton, 37 ton, and 37 ton, in the respective projects. The diversified crops, especially vegetables in USP area, will become a major cash income source for the beneficiaries. The diversified crops in PDP will also contribute to income increase of the beneficiaries.

65. Food balance in the USP and the SRP areas will be improved by the increase of paddy production. Surplus paddy of each project will be 4,200 ton in USP, 20 ton in Ang160 SRP, and 47 ton in Kim Sei SRP. The average surplus paddy per household will be 1,050 kg in USP, 150 kg in Ang160 SRP, and 1,280 kg in Kim Sei SRP. Paddy production in PDP may decrease due to the decrease of planted area of paddy, but the beneficiaries will obtain more cash income from the diversified crops. The marketable surplus paddy will contribute to improve the food balance in Tram Kak District and adjacent villages to the project area. About 10 to 20% of vegetables produced in USP area will be consumed at home and sold in the local market. The remaining 80 - 90% will be marketable to the populated area, such as Phnom Penh and Takeo Town. A support program for vegetable marketing is, therefore, necessary.

66. **Agricultural Extension Program**

The proposed agricultural extension plan consists of the following three (3), i.e. i) strengthening plan of extension service, ii) paddy seed production plan, and iii) distribution plan of farm inputs.

(1) Strengthening Plan of Agricultural Extension Service: Dissemination of improved farming practices and irrigation farming will be done by the extension service activities of DAFF Takeo through VDC and FWUC. The extension plan is basically the same as the present framework of the DAFF extension system, and the present system is proposed to be strengthened, especially for the activities of Village Extension Workers (VEWs). For this purpose, it is proposed as an agriculture support program that extension FGs including VEWs should be organized under VDCs, and demonstration plot (Demo-plots) should be set up in farmers' fields.

(2) Paddy Seed Production Plan : Distribution of improved paddy seed of both local and high yielding varieties (HYVs) is indispensable to increase the produce and improve the quality. It is proposed to multiply paddy seed by FGs of seed production in the priority areas. The required paddy seed will be produced in 25 -

30 ha of paddy field or by about 30 farm households. The produced seed will have to be inspected and certified by DAFF. The certified seed will be distributed to farmers through extension FGs.

(3) Distribution Plan of Farm Input : Under the free market policy, farm input, such as fertilizer and seeds of diversified crops will have to be supplied in markets by dealers. Due to the small farming size of the beneficiaries, the input requirement per household is very small. The transportation cost is high from market, (Ang Roka, or Angk Ta Saom) to village. The farm-gate price of fertilizer is generally 5 - 7% higher than that in Takeo and Angk Ta Saom market. It is, therefore, recommended that the extension FGs undertake group purchase of inputs including paddy seed produced by the seed production farmers group. Farmers would obtain the inputs at cheaper price and at higher quality through the group purchase. It is also recommended that extension FGs take a few percents of handling charge from farmers as funds for activities of the extension FGs, such as VEWs work and Demo-plots.

67. **Credit Service**

When farmers buy fertilizer and seed in the proposed plan of USP, the cost was estimated at Riel 810 million in total, which is equivalent to about 3.4 times the present level of Riel 240 million. The average cost per household will increase from Riel 60,000 at present to Riel 200,000 in total, which is composed of paddy (Riel 135,000) and diversified crops (Riel 65,000). Farmers will need cash credit to buy inputs. The following three (3) credit systems will be available to farmers for input purchase:

(1) Credit by FGs under VDCs : Fertilizer credit service is operated by FGs under the VDC in 30 villages. The same credit service will be started in 2002 in the remaining five (5) villages.

(2) Credit by NGOs : One commercial bank and several local NGOs work for micro-credit service in the priority area. The interest rate is generally 4% per month.

(3) Credit by FWUC's Reserve : FWUC will reserve capital for replacement of irrigation facilities from the collected ISF. The capital will be accumulated. It is proposed that a part of the reserve be used for credit service for the weakest families for input purchase, which is subject to the approval of the FWUC. It will be managed under the FWUC. The interest rate is proposed to be 2% per month, the same as that of VDC credit service.

68. **Marketing Assistance Program**

After farmer water user community (FWUC) for USP is organized, paddy will be collected as irrigation service fee (ISF) from the member farmers, however, there are no storage facilities suitable for collection, cleaning and storage before selling to buyers. The USP area will produce diversified crops, such as maize, beans, groundnuts, vegetables both in the rainy season (500 ha) and dry season (550 ha) which will be too much for farmers to trade them by themselves in the area. In

addition, there are no markets for assembling a large volume of products near the project area. As a support program for the selected priority irrigation projects, specifically for USP's area due to the magnitude of products in the future, the following marketing assistance services will be crucial for the project sustainability:

- Storage and sales of paddy collected as ISF
- Assembling and marketing assistance

69. (1) Storage and Sales of Paddy Collected as ISF : The collected ISF paddy will be stored at 6 depots (warehouses) and marketed when paddy price is the highest in the markets. Through the storage and sales, additional revenue of around Riel 15.7 million will accrue from the difference of sales prices.

(2) Assembling and Marketing Assistance : Assembling and marketing assistance program aims at:

- Provision of a public trading place to the member farmers of FWUC,
- Giving opportunities to the members to negotiate prices with buyers,
- Dissemination to the members on market price determined by quality and quantity,
- Getting information on markets and prices in the big terminal market, and
- Giving chance to increase the members' income through marketing assistance.

The assembling and marketing assistant comprises i) wholesale trade assistance by using the assembling market facilities, and ii) joint shipping assistance for producers groups. The wholesale trade assistance will be initiated in the first year after construction of the facility. The joint shipping assistance will be implemented after the 5th year. The gross revenue accrued from the assembling and marketing assistance by the marketing unit of the Apex Committee of FWUC was estimated at Riel 54 million from the wholesale trade assistance and Riel 128 million from the joint shipping assistance. The dealing amount for the wholesale trade assistance is 40 % of the marketable surplus out of crop production in the USP area, while that for the joint shipping assistance is 10 % of the marketable surplus out of crop production in the USP area.

70. **Rural Road Improvement Program (RIP)**

The feasibility study on the following road sections was conducted:

- 1) Road 33 (Trapeang Thum Khang Cheung ~ Trapeang Kranhung (Road-A)
- 2) O Saray ~ Slakou River (Road-B)
- 3) Road-B ~ Kpob Svay (Road-C)

Taking into consideration present and future road conditions and requirements after completion of USP, the target level of road improvement was determined for each road as summarized below:

Standard of Roads

Item	Road-A	Road-B	Road-C
Length (km)	13.32	4.14	6.16
Width (m)	Total 5 m, effective □ m	Total 5 m, effective □ m	Total 4 m, effective 3m
Design speed	30 km/h	30 km/h	20 km/h
Traffic Volume (heavy equipment)	15 □ 40 per day	15 □ 40 per day	Less than 15
Structure of surface and sub-base	Total height 0.65m □ local material □ laterite 10 cm sand & gravel 20 cm	Total height 0.65m □ local material □ laterite 10 cm sand & gravel 20 cm	Total height 0.65m □ local material □ laterite 15 cm
Slope protection	reshape / sodding	reshape / sodding	reshape / sodding
Design CBR	3	3	2

71. **Farmer Water User Community (FWUC)**

General : According to the MOWRAM's policy on FWUC, an FWUC is required to manage the operation and maintenance (O & M) of irrigation facilities by itself in both technical and financial aspects after the facilities are ready to be operated and its capacity is deemed to be adequate by MOWRAM. Behind the policy, there are two objectives that i) MOWRAM's financial burden for O & M of irrigation facilities of all the large and medium scale irrigation projects (more than 200 ha) in Cambodia should be reduced as much as possible and that ii) farmers or beneficiaries should make efforts to manage O & M of irrigation facilities by themselves without MOWRAM's technical and financial assistance as a sustainable autonomous organization by self-reliance.

72. Anticipated Problems of FWUC for USP : FWUCs existing outside the Study Area face many problems in technical and financial aspects. Financially, existing FWUCs suffer from fund shortage. Maintenance work of irrigation facilities cannot be carried out due to a shortage of operation funds. The price of paddy, which is an external factor that can not be controlled, has remained very low in recent years. It is, therefore, difficult to raise ISF, since farmers in the USP area are mostly paddy cultivation farmers. USP would be subject to the same situation. The preliminary financial analyses indicate that ISF can not cover all the expenses for operation of FWUC. Thus, other sources have to be considered. In this Study, it is proposed that FWUC should have a function of marketing assistance in addition to its primary function of O & M of irrigation facilities and it should provide a market place for member farmers to facilitate selling diversified crops to middle men and buyers, taking commission on a sale of crops from both farmers and buyers for supplementing the lack of operation funds of FWUC.
73. Whenever an FWUC faces technical difficulties, it always relies on MOWRAM to solve the difficulty. However MOWRAM can not always respond to all the requests due to lack of financial sources and technical staff. This finally leads to deterioration of the irrigation facilities. In order to enhance the spirit of self-reliance on FWUC, a change of farmers' mind is very important, although it

takes a long time. For this purpose, it is proposed that MOWRAM fully supports farmers to establish and reinforce FWUC during the design and construction stage and further initial operation stage of USP through the project office to be established in the USP area as an implementation agency under MOWRAM head office. The project office should be organized with qualified staff assigned by MOWRAM / DWRAM, and other agencies concerned.

74. Organization of FWUC : Organization structure of FWUC for USP was discussed with commune chiefs and some village chiefs. The organization structure of FWUC should consist of farmer water user groups (FWUGs) organized in every tertiary block, 6 FWUCs (so-called as SC FWUC) at the secondary canal level and FWUC Apex Committee at the head. The Apex Committee is the top management organization consisting of four units under the chairman, vice-chairman and secretary, i.e. accounting/administration unit, marketing unit, O & M unit and dispute resolution unit. The O & M unit will directly manage the reservoirs and the main canal of USP and supervise scheme operators (SOs). Each SC FWUC will be responsible for managing a secondary canal. One SC FWUC consists of several FWUGs, which will manage tertiary canals and watercourses within one tertiary unit (33 ha on average) . Upon the completion of the formation of FWUC and the project works, the project office will be curtailed to a small advisory unit, so-called as “the Technical Supervision & Assistance Unit (TSAU)”. The FWUC for USP will work under TSAU for the first 4 years as joint management. After the joint management, the FWUC should manage all the O & M work by itself.
75. Annual O & M Costs : In order to assess ISF for USP, the revenue and ordinary annual O & M cost, excluding replacement costs, were estimated. The staff required for FWUC for O&M of USP was estimated at 118 members. The annual O&M cost of FWUC was estimated for proper water management of the system as follows:

Personnel expenses:	Riel 99.2 million
Running costs:	Riel 64.4 million
Total	Riel 163.6 million

76. Revenue : In order to cover the above annual O & M cost of FWUC for USP, ISF rates were estimated at 140 kg /ha for paddy or Riel 40,600/ha for both paddy and wet season diversified crops and Riel 76,500 /ha or 264 kg/ha of paddy equivalent for dry season diversified crops respectively based on the prevailing ISF rate of paddy in Takeo. As shown in the following table, the total revenue would amount to about Riel 204.5 million. Provided that 80 % of collection rate is achieved, the total revenue would amount to about Riel 163.6million, which balances the annual O & M cost.

Amount of ISF equivalent to O&M Cost

Crop	Unit	Area	ISF applicable Riel/ha	Total Million Riel	Paddy equivalent (Riel 290 /kg) Kg/ha
Paddy	ha	3,500	40,600	142.10	140
Wet S. Diversified Crop	ha	500	40,600	20.30	140
Dry S. Diversified Crop	ha	550	76,500	42.08	264
Total				<u>204.48</u>	
ISF Collection (80%)				<u>163.58</u>	

77. Proposed ISF : It is proposed to tentatively apply 140 kg/ha for paddy cultivation, Riel 40,600 for paddy and wet season diversified crop and Riel 76,500 for dry season diversified crops for USP only to cover the annual O & M cost. If the ISF covers costs of periodical maintenance and replacement (gates, office equipment, etc.), about 1.55 times of ISF (218 kg /ha of paddy equivalent) is needed. In other words, additional ISFs of 78 kg/ha for paddy cultivation, Riel 22,330 for wet season diversified crop and Riel 42,075 for dry season diversified crops are required. Without introducing other financial source, FWUC will be unable to compensate its total O & M cost. In order to balance the above deficit, it is proposed to introduce marketing activities for agricultural products into the operation of FWUC for USP.
78. Formation of FWUC for USP : The FWUC for USP will consist of about 4,020 families in 32 villages. The formation process of FWUC was discussed with village chiefs based on the formation process mentioned in Prakas 306 and was provisionally concluded to consist of the eight steps listed below. The project office will assist farmers in the formation of the FWUC under the MOWRAM's technical and financial support. Many farmers are not accustomed to farmers' group organization. The cadaster and cadastral maps are not available. Therefore, it will take time for farmers to recognize the FWUC and organize it. The period necessary for the formation was estimated at about 3 years. The eight steps are:
- Step-1: Farmers Awareness Creation (8 months)
 - Step-2: Setting Tertiary Units of FWUC (11 months)
 - Step-3: Election of Farmer Organizer (FO) (4 months)
 - Step-4: Formation of SC FWUCs (3 months)
 - Step-5: Formation of Apex Committee and Start of Participation to Construction Works (3 months)
 - Step-6: Preparation and Finalization of Draft FWUC Statute (6 months)
 - Step-7: Final Ratification of FWUC Status (1 months)
 - Step-8: Registration of FWUC (2.5 months)
79. **Institutional Development and Capacity Building Program**

In order i) to smoothly organize FWUC, ii) to conduct financially and technically sustainable operation of FWUCs, and iii) to ultimately increase farm income, an institutional development and capacity building program is essential for USP. For this, it is proposed that MOWRAM deploy experts of institutional development

and capacity building for six (6) years. Two steps are proposed for the implementation of the program. Firstly, the deployed experts will provide training to the project office staff. Secondly, the trained project office staff will give training to farmers and FWUC staff.

(1) Program to Project Office Staff : The program for the capacity building of the project office staff consists of the following two categories:

- 1) Planning and design for 1.5 years in the design stage and construction supervision of irrigation facilities for 2.5 years in the construction stage.
- 2) FWUC and its related works, such as FWUC formation and its process, on-farm development, management of FWUC, O & M of irrigation facilities, marketing assistance, farming practice, etc for six (6) years in total from design stage to initial operation stage.

Foreign/local experts are proposed to provide training for the project office staff and assist them in preparing the following manuals and guidelines necessary for training farmers and FWUC staff:

- Guideline for FWUC formation
- Management manual of FWUC
- Guideline for on-farm development
- Manual of O & M of irrigation facilities
- Manual of farming practices
- Guideline for marketing

(2) Program to Farmers and FWUC Staff : The training program to farmers and FWUC staff consists of the following six (6) courses:

- FWUC and its formation to farmers (for about 4,020 households)
- On-farm development to FWUC staff (for 72 persons in total)
- Management of FWUC to FWUC staff (for 22 persons in total)
- O & M of irrigation facilities to FWUC staff (for 82 persons in total)
- Marketing to FWUC staff (for 10 persons in total)
- Farming practice (for 120 leader-farmers)

80. **Environmental Conservation Program**

Some of the likely negative impacts on the environment were pointed out through the IEE. However, their magnitude is not serious and most of them can be mitigated/minimized by the proposed countermeasures, such as water quality monitoring, and monitoring of conditions of water-borne diseases and agricultural inputs.

81. **Implementation Organization**

(1) USP : Prior to the implementation, a project office will be constructed independently along Road 33 in the USP Area at Angk Roka, Ta Phem Commune. The project office will be established under direct administration of MOWRAM, and MOWRAM will appoint the project manager. The project office will consist of four units, namely, administration, technical, FWUC and task force, in which 11 technical staff and 2 administrative staff will be assigned. As for office and operational equipment, a four-wheel drive car, eight motorcycles, three walky-talkies, one generator, etc. will be procured. After completion of the

construction works, “Technical Supervision and Assistance Unit” will be in charge of supporting of the FWUC’s operation and maintenance works for four years. Two senior engineers of MOWRAM and a senior expert from MAFF or other related government offices are expected to be assigned to this unit.

(2) SRP and PDP : Considering development scale, and capacity / experience of DWRAM, SRP is proposed to be implemented by DWRAM, Takeo as part of its routine work. Technical guidance, extension and support will be conducted in collaboration and coordination with other line agencies. PDP will be conducted with technical support to Pond User Group (PUG) and management of PDP Fund by DWRAM, Takeo.

82. **Implementation Schedule**

(1) USP : Construction works of USP will take two and half years or two dry seasons. Construction of the diversion and main canals will be completed in the first year, then the reservoirs, secondary canals and tertiary development will be conducted for the whole construction period. Construction works of the reservoirs, diversion and main canals will be contracted through international competitive bidding, while that of tertiary development or on-farm development will be contracted through local competitive bidding. As a participatory approach, it is proposed that beneficiaries should construct their watercourses under technical supervision of the project office, and beneficiaries should provide the land necessary for construction of tertiary canals and watercourses.

(2) SRP : Two reservoirs of SRP will be constructed within one year. The construction works will be contracted through local competitive bidding. The project would consist of the construction of reservoirs and related structures other than irrigation facilities in the command area, as these will be undertaken by FWUGs.

(3) PDP: PDP will be implemented in three stages as proposed in the Master Plan, namely, Pilot Development Stage (Stage-1), Intensive Development Stage (Stage-2) and Self-supportive Development Stage (Stage-3), which would be performed in 10 years.

(4) RIP : Three routes of RIP will be constructed over two years. The construction works will be contracted through local competitive bidding. Design and construction supervision will be carried out by MRD (DRD).

83. **Project Cost**

(1) USP : The total amount of initial investment cost of the USP is Riel 76,624.6 million as shown below :

Initial Investment Cost of USP			
Work Item	(Unit : million Riel)		
	F/C	L/C	Total
1) Preparatory Work	2,484.9	846.3	3,331.2
2) Direct Construction Cost	30,633.5	14,238.0	44,871.5
3) O&M Equipment	156.7	10.3	167.0
4) Institutional Development	666.9	1,760.8	2,427.7
5) Relocation and Land Compensation Cost	3.3	197.0	200.3
6) Administration Cost	155.7	824.3	980.0
7) Engineering Service	11,921.7	623.5	12,545.2
8) Contingencies	8,358.0	3,743.7	12,101.7
Total	54,380.7	22,243.9	76,624.6

(2) SRP : The total amount of initial investment cost of the SRP is Riel 474.4 million consisting of Riel 223.7 million for Ang 160 SRP and Riel 250.7 million for Kim Sei SRP.

(3) PDP : The total amount of initial investment cost of the Trapeang Snao PDP is Riel 180.5 million.

(4) RIP : The total amount of initial investment cost of the RIP is Riel 4,175.1 million.

84. **Project Evaluation**

The economic and financial evaluation was conducted for the priority projects, and the following EIRRs (%) were obtained:

USP :	10.2 %
Kim Sei SRP :	13.7 %
Ang 160 SRP :	14.5 %
PDP :	8.7 %
RIP with USP :	18.8 %

Farm budget analysis was made by assuming the anticipated change in income and expenditure for the respective average size of farm operation at USP, SRP and PDP areas. The household income was estimated to increase by 99% for USP, 14 and 34% for SRP and 16% for PDP. The future net reserve of the farm households under the with project condition is expected to increase, specifically for the USP area. Because SRP and PDP can irrigate only a part of agricultural land operated by the farmers, financial impact to the farm economy of those areas will be limited. The future livelihood situation under the without and with project conditions was summarized as follows:

Farm Budget Assessment, Feasibility Study

(Unit : Riel '000)

Item	USP	SRP		PDP
		Kim Sei	Ang 160	
Average Size(ha)	0.87	1.33	1.10	1.15
Without Project				
Income	875.5	1,502.2	1,034.7	1,065.6
Expenditure	866.2	1,330.2	983.7	961.7
Net Reserve	9.3	172.0	51.0	103.9
With Project				
Income	1,746.0	2,017.7	1,184.4	1,239.2
Expenditure	1,033.9	1,459.5	1,023.2	978.3
Net Reserve	712.1	558.2	161.2	260.9
Increase (%)				
Income	99	34	14	16
Expenditure	19	10	4	2
Net Reserve	7,557	225	216	151

In addition, i) the capacity to pay for O & M cost and ii) FWUC's O & M activities and management of USP were examined. As a result, it was concluded that all the priority projects are economically and financially viable.

85. In addition, the following indirect and socio-economic impacts are expected:

(1) Self-sufficiency of Rice in the Project Area : The annual increment of rice production by USP, two SRPs and PDP projects will be around 6,100 ton of paddy and 4,000 ton of rice under the with project condition. This increment of rice production will be additional supply to reduce the deficit in local rice production.

(2) Vegetable Production and Foreign Currency Savings : Vegetables in the project area are produced mainly for home and local consumption at present. After implementation of the projects, annual increment of vegetable production will be around 3,500 ton, equivalent to Riel 2.4 billion (US\$ 0.6 million) in value at the farm gate. Future vegetable production by the projects will substitute for vegetable importation from neighboring countries.

(3) Improvement of Rural Accessibility : The USP will provide 44.7 km of inspection road along the secondary canals. These roads will affect the local economy not only through directly reducing the transportation cost, but also by saving time for transportation and minimizing post harvest losses, etc.

(4) Increase in Employment Opportunity : The projects will generate additional employment of around 134 thousand person-days annually for the farming activities. In addition, construction labor for USP will be around 303.8 thousand person-days in total. During the construction period from 2003 to 2005, around 580 persons will be deployed daily on average in the actual construction period of 21 months. The additional employment generated will reduce the present unemployment especially in the lean production season. The labor for the project construction will be employed mainly from the beneficiaries of the projects.

(5) Promoting Rural Industry : The agro-industry and agri-related service sectors will be activated by value adding to the crop products and enlarging trade of farm inputs. Project effects on the local economy including the industry and services

are considered significant.

86. **PRA Workshops:** Ten workshops were conducted during the period of two (2) days from December 5 to 6, 2001 to obtain opinions and comments from beneficiaries, local administration staff, and related NGO. The total participants were 140. The workshops were conducted mainly on the following subjects and finally the draft Feasibility Study Plan was accepted by the participants:

- Irrigation development plans, i.e. USP, SRP and PDP
- Formation procedure of FWUC
- Function and works of FWUC
- Right and obligation of FWUC and its members
- Participatory approach to on-farm development
- Marketing assistance service of FWUC
- Proposed ISF
- Institutional development and capacity building program

87. **Conclusions & Recommendations**

- The USP covering the irrigation area of 3,500 ha has sufficient economic and financial viability. The magnitude of project impact to the local economy by additional income and employment generation, creating rice self-sufficiency in the area, and promoting rural industry is considered significant. The direct beneficiaries were estimated at more than 20,000 persons, while indirect beneficiaries by stable supply of paddy were estimated at more than the population of Tram Kak District, 144,000 persons.
- Kim Sei SRP and Ang 160 SRP show indications of having high economic viability. However, the impact to farmer beneficiaries will be limited because the SRPs can irrigate only a part of the agricultural land, i.e. 27 ha for Kim Sei and 25 ha for Ang 160, operated by farmers (37 and 130 households, respectively).
- The PDP indicated affordable economic viability, but the magnitude of impact on the farm economy in terms of increment of net income was smaller than those of USP and SRP.
- RIP has the highest economic viability. The economic impact to the upper area of USP (1,477 ha of agricultural land) and outside area of influence (4,004 ha) covering the total households of around 4,400 in 2001, will be significant. The access road to Tumnap Lok reservoir of USP, one of the RIP routes, is very poor at present and needs to be rehabilitated for the effective implementation of USP. The development of the outside area of influence will also be accelerated by RIP. The direct beneficiaries were estimated at more than 20,000 persons.
- The above projects will not create any serious environmental negative impact.
- Taking the above assessment into consideration, the priority project implementation needs to be initiated as early as possible in order to apply the model plans to similar development activities in other potential areas of Cambodia as well as to accelerate the irrigation-based rural development of the project area. The implementation will contribute to an increase in farm income and improved living standards and ultimately to poverty alleviation in Cambodia.

**THE STUDY
ON
THE REHABILITATION AND RECONSTRUCTION OF
AGRICULTURAL PRODUCTION SYSTEM
IN
THE SLAKOU RIVER BASIN,
THE KINGDOM OF CAMBODIA**

VOLUME-I

MAIN REPORT

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Acronym / Abbreviations

ACR	Australian Catholic Relief
ADB	Asian Development Bank
AHA	Affected Household Assistance
AMDA	Association of Medical Doctors of Asia
ASEAN	Association of South East Asian Nations
CAAEP	Cambodia Australia Agricultural Extension Project
CARDI	Cambodian Agricultural Research and Development Institute
CDC	Council for Development of Cambodia
CEA	Cambodian Environmental Association
CIAP	Cambodian IRRI Australia Project
CMAC	Cambodia Mine Action Center
CNMC	Cambodian National Mekong Committee
CRDC	Commune Rural Development Committee
CRS	Christian Relief Service
DAALI	Department of Agronomy and Agricultural Land Improvement
DAFF	Department of Agriculture, Forestry and Fisheries, MAFF
DDFC	District Development Facility Committee
DOFO	Department of Forestry
DTR	Department of Training and Research, MRD
DWRAM	Department of Water Resources and Meteorology, MOWRAM
ED	Engineering Department , MOWRAM
EDC	Electricite du Cambodia
EIA	Environmental Impact Assessment
EMC	Credit for Rural Area
EU	European Union
FAO	Food and Agricultural Organization of the United Nations
FFS	Farmer Field School
FG	Farmers Group
FO	Farmer Organizer

F/S	Feasibility Study
FWUC	Farmer Water User Community
FWUG	Farmer Water User Group
GDIMH	General Directorate of Irrigation, Meteorology and Hydrology
GDP	Gross Domestic Product
GIS	Geographic Information System
GOJ	Government of Japan
H.E.	His Excellency
HH	Household
HYV	High Yielding Variety
ICB	International Competitive Bidding
IDD	Irrigation and Drainage Department, MOWRAM
IEE	Initial Environmental Examination
IFAD	International Fund for Agricultural Development
ILO	International Labor Organization
IMF	International Monetary Fund
IRRI	International Rice Research Institute
ISF	Irrigation Service Fee
JCC	Joint Coordinating Committee for the Study
JICA	Japan International Cooperation Agency
JVC	Japan International Volunteer Center
LTD	Land Title Department
LUMO	Land Use Mapping Office, MAFF
MAFF	Ministry of Agriculture, Forestry and Fisheries
MCC	Mennonite Central Committee
MIS	Market Information System
MOE	Ministry of Environment
MOWRAM	Ministry of Water Resources and Meteorology
M/P	Master Plan Study
MPWT	Ministry of Public Works and Transport
MRC	Mekong River Commission
MRD	Ministry of Rural Development
NGO	Non Governmental Organization
O & M	Operation and Maintenance
OXFAM	Community Aid Abroad Oxfarm Australia
PAFF	Provincial Department of Agriculture, Forestry and Fishery
PDP	Small Pond Development Plan
PICD	Planning and International Cooperation Department, MOWRAM
PRA	Participatory Rural Appraisal
PRDC	Provincial Rural Development Committee
PRASAC II	Support Program for the Agricultural Sector in Cambodia

PUG	Pond User Group
RD&RP	Rural Development and Resettlement Project in Cambodia through joint technical assistance of Governments of Japan, Indonesia, Malaysia, the Philippines, Thailand and Cambodia
RGC	Royal Government of Cambodia
RIP	Rural Road Improvement Program
SEILA	Foundation Stone in Khmer: This word is used as national rural development program to i) alleviate poverty and ii) strengthen local governance and ownership of local government.
SC FWUC	Secondary Canal Level Farmer Water User Community
SO	Scheme Operator
SRP	Small Reservoir Rehabilitation Plan
UN	United Nations
UNDP	United Nations Development Program
USP	Upper Slakou River Irrigation Reconstruction Plan
UXO	Unexploded Ordnance
VDC	Village Development Committee
VEW	Village Extension Worker
WFP	World Food Program
WMO	World Meteorological Organization
WUG	Water User Group

Khmer Words Used in the Report

Khet	Province
Srok	District
Khum	Commune
Phum	Village
Krom	Group or Sub-Group
Krom Samak	Solidarity Group
Provasdai	Mutual Help

Units and Measures

Length

mm	millimeter
cm	centimeter
m	meter
km	kilometer

Area

cm ²	square centimeter
m ²	square meter
km ²	square kilometer
ha	hectare
<u>Volume</u>	
cm ³	cubic centimeter
m ³	cubic meter
MCM	million cubic meter
<u>Weight</u>	
g	gram
kg	kilogram
t	ton
MT	metric ton
<u>Time</u>	
s	second
m	minute
hr	hour
d	day
mon	month
<u>Power and Energy</u>	
A	ampere
V	volt
W	watt
kW	kilowatt
kWh	kilowatt hour
HP	horse power
<u>Others</u>	
ppm	parts per million
□	degree centigrade
%	percent
<u>Currency</u>	
\$	USA Currency (Dollar)
¥	Japanese Currency (Yen)
R, Riel	Cambodian Currency

Exchange Rate (Internal Bank Rate)

Master Plan Study : as of May 15, 2001

\$ 1.00 = Riel 3,835.38

¥ 1.00 = Riel 31.13

\$ 1.00 = ¥ 123.32

Feasibility Study : as of October 05, 2001

\$ 1.00 = Riel 4,022.20

¥ 1.00 = Riel 33.38

\$ 1.00 = ¥ 120.53