ASIAN DEVELOPMENT BANK RRP:CAM 29257

REPORT AND RECOMMENDATION

OF THE

PRESIDENT

TO THE

BOARD OF DIRECTORS

ON A

PROPOSED LOAN

TO THE

KINGDOM OF CAMBODIA

FOR THE

STUNG CHINIT IRRIGATION AND RURAL INFRASTRUCTURE PROJECT

August 2000

CURRENCY EQUIVALENTS
(as of 1 August 2000)

Currency Unit	–	Riel (KR)
KR1.00	=	$0.00026
$1.00	=	KR3,887.50

For the purpose of calculations in this report, a rate of $1.00 = KR 3,800 is used, the rate generally prevailing at the time of loan appraisal.

ABBREVIATIONS

ADB	–	Asian Development Bank
AFD	–	Agence Française de Développement
AP	–	affected person
ASP	–	Agriculture Sector Program
AusAID	–	Australian Agency for International Development
CARDI	–	Cambodia Agricultural Research Development Institute
CIAP	–	Cambodia-IRRI Agriculture Project
COS	–	Country Operational Strategy
CSES	–	Cambodia Socioeconomic Survey
EA	–	executing agency
EIRR	–	economic internal rate of return
EU	–	European Union
GDIMH	–	General Directorate of Irrigation, Meteorology and Hydrology
GDP	–	gross domestic product
GTZ	–	Deutsche Gesellschaft für Technische Zusammenarbeit
ICB	–	international competitive bidding
IEE	–	initial environmental examination
ILO	–	International Labour Organisation
IPM	–	integrated pest management
IRC	–	Interministerial Resettlement Committee
IRRI	–	International Rice Research Institute
JICA	–	Japan International Cooperation Agency
KfW	–	Kreditanstalt für Wiederaufbau
LBAT	–	labor-based appropriate technology

NOTES

(i) The fiscal year (FY) of the Government ends on 31 December.
(ii) In this report, “$” refers to US dollars.

LCB	–	local competitive bidding
MAFF	–	Ministry of Agriculture, Forestry and Fisheries
MEF	–	Ministry of Economy and Finance
MLM	–	Ministry of Land Management, Urban Planning, and Construction
MOWRAM	–	Ministry of Water Resources and Meteorology
MRCS	–	Mekong River Commission Secretariat
MRD	–	Ministry of Rural Development
NGO	–	nongovernment organization
O&M	–	operation and maintenance
OTEE	–	Office of Technique, Economic and Extension
PCC	–	project coordination committee
PDAFF	–	Provincial Department of Agriculture, Forests and Fisheries
PDRD	–	Provincial Department of Rural Development
PDWRAM	–	Provincial Department of Water Resources and Meteorology
PIU	–	project implementation unit
PMO	–	project management office
PRDC	–	Provincial Rural Development Committee
PSC	–	project steering committee
RIIP	–	Rural Infrastructure Improvement Project
RP	–	Resettlement Plan
SCIC	–	Stung Chinit Irrigation Committee
SCRS	–	Stung Chinit Resettlement Subcommittee
SEDP	–	Socioeconomic Development Plan
SESC	–	Socioeconomic Survey of Cambodia
SIEE	–	Summary initial environmental examination
SRAL	–	Special Rehabilitation Assistance Plan
TA	–	technical assistance
UN	–	United Nations
VOC	–	vehicle operating cost
WFP	–	World Food Programme
WUC	–	water user community
WUG	–	water user group

CONTENTS

LOAN AND PROJECT SUMMARY

Borrower	Kingdom of Cambodia
Project Description	The Project is designed to increase agricultural productivity and farmer incomes, and stimulate the rural economy of Kompong Thom Province by providing irrigation and drainage, agriculture extension, rural roads, and markets. The Project will organize farmers to operate and maintain irrigation systems, and assist households to obtain land title.
Classification	Primary: economic Secondary: poverty reduction
Environmental Assessment	Category - B An initial environmental examination (IEE) was undertaken, and is summarized in an appendix.
Rationale	The Government places a high priority on poverty reduction through growth of the rural economy. The Asian Development Bank's (ADB) strategy in Cambodia supports this objective by focusing investments in the populous rural areas of the plains and Tonle Sap region, where the majority of the poor reside. Agriculture, the mainstay of the rural economy, is hampered by lack of irrigation, poor roads and market facilities, and limited access to improved farming technology. The project area in Kompong Thom Province is dominated by rural subsistence or semisubsistence farming dependent on one low-yield rain-fed rice crop per year. The majority of households live below the Cambodian poverty line. Periodic droughts in the wet season, or severe flooding, force families into debt to meet their subsistence food needs. For lack of irrigation, most lands lie barren and fallow in the dry season. The provision of irrigation and drainage, agriculture extension, rural roads, and markets can have an important impact on agricultural productivity and poverty. In the wet season, reliable flows and drainage will ensure crop survival during droughts and floods, and reduce the risk of investing in inputs. Combined with the introduction of modern rice varieties, supplemental wet season irrigation will also permit double cropping. Dry season irrigation will permit the adoption of high-yield rice varieties and diversification into higher value cash crops. Improved roads reduce vehicle and harvesting costs, permit greater and timely use of inputs, and generate other economic activities. Improved markets reduce spoilage and transaction costs. Combined, such investments will stimulate the rural economy and reduce poverty.
Objectives and Scope	The primary objectives of the Project are to increase agricultural productivity and farmers' income, and stimulate the rural economy by providing irrigation and drainage for 7,000 hectares (ha), and improving rural roads and markets in and around the

project area. To achieve these objectives, water user groups will be formed and trained to operate and maintain the irrigation scheme, cost recovery measures will be applied for roads and irrigation works, government staff at the central and provincial level will be strengthened, and benefit monitoring and evaluation will be introduced. The Project will also assist farmers to obtain legal title to their lands.

Cost Estimates

The total project cost is estimated at $23.8 million equivalent, comprising $9.6 million (40 percent) in foreign exchange and approximately $14.2 million equivalent (60 percent) in local currency costs.

Financing Plan

($ million)

Source	Foreign Exchange	Local Currency	Total Cost	Total Percent
ADB	8.6	7.4	16.0	67
AFD	1.0	1.6	2.6	11
Government	-	4.8	4.8	20
Beneficiaries	-	0.4	0.4	2
Total	**9.6**	**14.2**	**23.8**	**100**

ADB = Asian Development Bank, AFD = Agence Française de Développement.

Loan Amount and Terms

The equivalent in various currencies of SDR12,183,000 from ADB's Special Funds resources. The amortization period will be 32 years including a grace period of 8 years, with an interest charge of 1 percent per annum during the grace period and 1.5 percent per annum thereafter.

Period of Utilization

Until 30 June 2007

Executing Agencies

The Ministry of Water Resources and Meteorology will be responsible for the farmer community organization and extension, irrigation infrastructure, and scheme management components; the Ministry of Rural Development will be responsible for the supporting infrastructure component.

Implementation Arrangements

The overall project implementation period is six years. In the first two years, the landownership survey and titling activities will be completed, as well as technical investigations, consultations with farmers on overall scheme management approach and system layout, detailed design, and any necessary resettlement and/or compensation programs. Civil works will proceed gradually, beginning with the 2,000 ha designated for year-round irrigation, and proceeding to the 5,000 ha designated to receive supplemental wet season irrigation.

Procurement

Goods and services financed by ADB will be procured in accordance with ADB's *Guidelines for Procurement*. Civil works for the irrigation infrastructure component, for the rehabilitation of

Stung Chinit and Stung Tang Krasang weirs, Stung Chinit spillway, flood embankments, main canal structures and earthworks, and secondary canal structures will be grouped in one package and undertaken through international competitive bidding (ICB) by prequalified international contractors. All other civil works related to this component involve low-technology construction and are unlikely to be of interest to international contractors. The remaining works will be undertaken through local competitive bidding (LCB) or force account in accordance with procedures acceptable to ADB.

For the supporting infrastructure component, civil works for road improvement will be undertaken through LCB wherever possible, using labor-intensive techniques, and in accordance with procedures acceptable to ADB. Alternatively, these will be implemented by the project implementation unit recruiting labor groups from among beneficiaries on a force account basis.

Materials and equipment to be financed under the Project will consist mainly of laterite for surfacing, service vehicles, motorcycles, a small amount of construction equipment, and office furnishing and equipment. Laterite will be procured through LCB or by force account if it is extracted by beneficiary labor. Other supply contracts will also be valued at less than $500,000 and be awarded using international shopping. The procurement of materials and equipment worth less than $100,000 per contract will be undertaken through direct purchase.

Consulting Services

The Project is expected to use 114 person-months of international and 418 person-months of domestic consulting services. The consultants financed by ADB will be recruited in accordance with ADB's *Guidelines on the Use of Consultants* and other arrangements satisfactory to ADB for the engagement of domestic consultants.

Estimated Project Completion Date

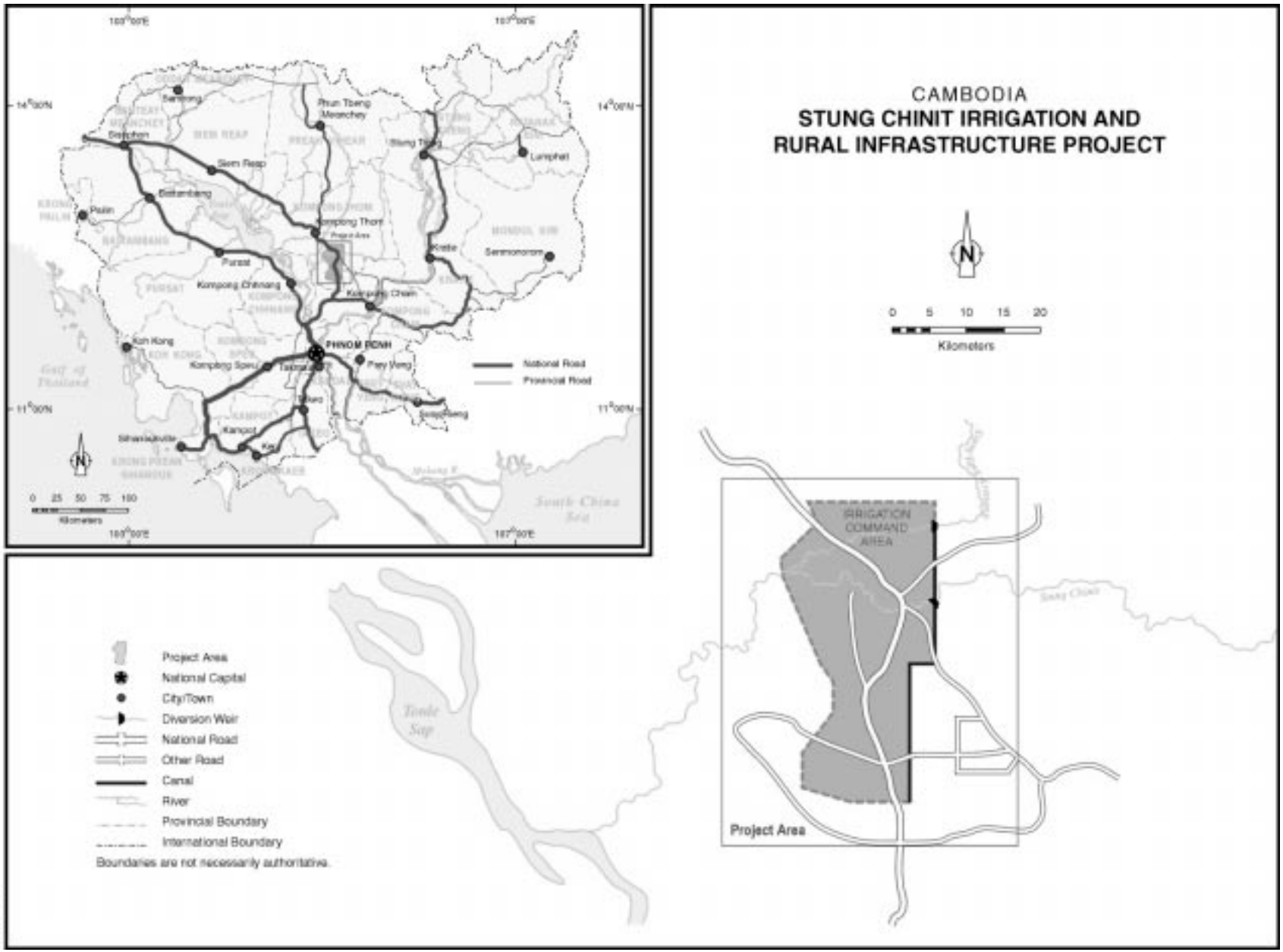
End December 2006

Project Benefits and Beneficiaries

The Project is expected to provide a host of direct and indirect benefits to poor farming communities. Irrigation will provide opportunities for higher yields in the wet season, for cultivation of a second wet season rice crop and new dry season crops including vegetables and legumes. The Project is also expected to result in higher fish yields in paddy areas. The economic internal rate of return (EIRR) for agricultural investments is 15.0 percent. Rural road benefits have been quantified in terms of vehicle operating cost savings and agriculture producer surplus. This component yields an EIRR of 32.4 percent. The combined project EIRR is estimated at 19.1 percent. The construction and rehabilitation of irrigation works, roads, and markets will provide substantial direct employment for people living in the project area. The benefits of improved markets have not been

quantified, but will include lower spoilage rates, better connections between buyers and sellers, reduced margins to intermediaries, and the creation of local markets for cash crops. Formalization of land titles will also provide a major, but unquantified benefit in the project area. In combination, these benefits will reduce poverty in the Project area and stimulate economic growth.

All project components have been designed to ensure that gender impacts and impacts on vulnerable groups are addressed. The beneficiary population includes a high percentage of households headed by women and may include households where the primary income earners are disabled. To ensure that the concerns of women and vulnerable groups are addressed, extensive consultations to include focus group discussions will be carried out during the design phase and appropriate mechanisms to address their special needs will be built into the project design. Women will be adequately represented in the farmer organizations, including water user groups and committees.


CAMBODIA
STUNG CHINIT IRRIGATION AND
RURAL INFRASTRUCTURE PROJECT
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Kilometers
PHNOM PENH
Siem Reap
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Koh Kong
Kompong Speu
Takeo
Prey Veng
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Kampot
Sihanoukville
Kep
Ream
Tonle Sap
Mekong R.
South China Sea
Gulf of Thailand
0 25 50 75 100
Kilometers
Project Area
National Capital
City/Town
Diversion Weir
National Road
Other Road
Canal
River
Provincial Boundary
International Boundary
Boundaries are not necessarily authoritative.
IRRIGATION COMMAND AREA
Project Area

I. THE PROPOSAL

1. I submit for your approval the following Report and Recommendation on a proposed loan to the Kingdom of Cambodia for the Stung Chinit Irrigation and Rural Infrastructure Project.

II. INTRODUCTION

2. Following the Paris Peace Accord for Cambodia in 1991, the Asian Development Bank (ADB) approved the Special Rehabilitation Assistance loan (SRAL) for emergency rehabilitation of infrastructure, including some irrigation systems.[1] During preparation of the SRAL, it became clear that there was scope for further investments in irrigation, as agriculture dominates the economy and rural infrastructure was decimated by war. At the request of the Government, ADB financed technical assistance (TA) in 1997 to assess the feasibility of rehabilitating the Stung Chinit irrigation system in Kompong Thom Province.[2] The consultants focused their efforts on the full development of the system, including an upstream dam and storage to provide wet and dry season irrigation over 12,000 hectares (ha). Concerned about the Government's implementation capacity and the environmental impacts of the dam, ADB requested analysis of a limited development option that would rehabilitate the existing system and use run-of-the-river flows to provide supplemental wet season irrigation for 12,000 ha and dry season irrigation for 2,000 ha.[3] Because the study was truncated due to deteriorating security and political turmoil in 1997, ADB was unable to make a firm decision on whether to proceed with project processing. The study was able to verify strong support for the Project by local people.

3. Subsequently the Ministry of Water Resources and Meteorology (MOWRAM) requested TA to reassess the Project. The TA commenced in November 1999.[4] The TA report concluded that a limited development option providing supplemental wet season irrigation over 7,000 ha and dry season irrigation over 2,000 ha, and improving rural roads and markets in the project area would be a cost-effective way of increasing agricultural production and farmers' incomes, and stimulating the rural economy in the province. A socioeconomic survey of the project area completed in April 2000 confirmed widespread support for the Project and found that almost 60 percent of the target beneficiaries live below the national poverty line. ADB and the Government agreed to proceed on the basis of the TA recommendations while keeping open the option for future development of a dam and storage reservoir. This report is based on the findings of the feasibility studies; external reports from the project area; ADB missions; and discussions with Government officials, project beneficiaries, nongovernment organizations, and international agencies involved in irrigation and rural roads. The project framework is given in Appendix 1.

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1 Loan 1199-CAM: *Special Rehabilitation Assistance*, for $67.7 million, approved on 26 November 1992.

2 TA 2592-CAM: *Stung Chinit Water Resources Development*, for $800,000, approved on 25 June 1996.

3 The Government confirmed at the final tripartite meeting and subsequent meetings that a dam and storage reservoir may be more appropriately considered as a second phase project.

4 TA 3275-CAM: *Study for Stung Chinit Water Resources Development Project*, for $150,000, approved on 13 October 1999.

III. BACKGROUND

A. Sector Description

1. Overview

4. Cambodia borders Thailand to the west and north, Lao People's Democratic Republic to the north, and Viet Nam to the east. More than 80 percent of its 11.4 million inhabitants live in rural areas. One of the least developed countries in the region and the world, Cambodia is marked by low life expectancy and literacy, and high rates of infant mortality and poverty. The most recent (1997) socioeconomic data indicate that 40 percent of the rural population live below the national poverty line of about $0.41 per person per day.[5] Seventy-five percent of rural poor are from households involved in some type of agricultural activity. Although peace has brought a measure of prosperity to the country, there is growing inequality in the distribution of income per capita, with urban areas benefiting from economic growth far more than rural areas.

5. Rural agriculture dominates the Cambodian economy, accounting for nearly half of gross domestic product (GDP) and 90 percent of employment. Cambodia's real GDP growth slumped from an average of over 6 percent in 1991-1996 to only 1 percent following political turmoil in 1997. The agriculture sector averaged less than 3 percent growth prior to 1997, and suffered in 1997 and 1998 from floods and drought.[6] Only a fraction of cultivated land is irrigated, production costs are high due mostly to the limited transport network, and agriculture technologies lag far behind regional norms. For the typical Cambodian farmer, unpredictable rice surpluses that depend crucially on the weather, plus limited fish and livestock, provide the sole source of cash.

2. The Impact of War on Agriculture

6. Rice is the staple food of the country, is the most commonly traded commodity, and accounts for more than 60 percent of agricultural output and 90 percent of cultivated land. But during the civil war from 1970 to 1975, Cambodia slipped from being a major exporter of rice, to a net importer, to the brink of starvation.[7] The next 15 years of civil strife, population dislocation, and neglect left rural infrastructure in shambles, destroyed human resources, and dramatically reduced agricultural output. During the period of Khmer Rouge control, all city dwellers were relocated to the countryside and together with rural farmers organized into indentured labor groups that were repeatedly moved to different provinces. All private property was abolished, men and women were forced to live separately, eating became a communal activity, and daily rations set at one can of rice per person per day. The impact on civil society was profound—more than two decades later rural Cambodia is still marked by lack of social cohesion and low investment in land improvement for agriculture. Rice yields remain among the lowest in Asia, averaging 1.4-1.6 metric tons per hectare (t/ha) in the wet season and 2.5-3.0 t/ha in the dry season, and many provinces suffer from food insecurity. Apart from rice, some cash crops are grown close to urban centers, but to date there is only modest development of alternative crops in rural Cambodia.

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5 National Institute of Statistics. 1997. *Report on the Cambodia Socioeconomic Survey*. Phnom Penh.

6 Food and Agriculture Organization. 1999. *Cambodia: Agriculture Strategies and Policy Framework for Sustainable Food Security and Poverty Alleviation*. Phnom Penh.

7 Kiernan, Ben. 1996. *The Pol Pot Regime: Race, Power and Genocide in Cambodia under the Khmer Rouge, 1975-79*. New Haven: Yale University Press.

3. Sector Issues

7. The main constraints to higher rice yields and crop diversification include (i) lack of irrigation facilities to tap groundwater and surface water resources, (ii) poor management and little or no farmer participation in the operation and maintenance (O&M) of existing irrigation systems, (iii) poor infrastructure for transporting and marketing products, (iv) limited capacity of public institutions to provide agricultural extension services, and (v) lack of research and development of suitable farm technologies. To be effective, investments targeting agricultural productivity will need to respond to all of these constraints in an integrated manner.

8. Water resource management is an especially pressing challenge in Cambodia, which faces annual floods and droughts, and sedimentation of waterways due to deforestation. Until recently, the irrigation subsector was marked by lack of investments. Only 12 percent of rice areas currently receive some supplemental irrigation, and dry season rice may be grown on only 6 percent of the total rice area. Where irrigation systems have been built, maintenance presents a problem due to lack of resources for recurrent expenditures and low participation by beneficiaries. Organizing and training farmers for O&M and eventually management of irrigation systems, and developing user fees for cost recovery are thus crucial elements to ensure the sustainability of future investments in irrigation.

9. There is a growing need for the Government to develop a comprehensive approach to the water sector with a clearly defined authority across agencies, modalities for stakeholder participation in setting the rights and responsibilities of water users, and separation of the responsibilities for water resource management and service delivery. Appropriate policies, legislation, and institutional framework should also be defined and established to support these reforms, and the concerned agencies given substantial capacity development in terms of planning, coordination, and implementation. Systematic and well-defined investment strategies for water resource management and service delivery also need to be developed.

10. Another important issue in the agriculture sector is the unregulated use of dangerous pesticides. Although the Government passed a law in 1998 to regulate the sale and use of chemicals, vaccines, and medicines in agriculture, to date implementation and enforcement of the law is minimal, and pesticides banned in other countries are readily available in local markets. Farmers typically are unaware of the dangers to themselves and others from use of such chemicals, and agricultural runoff can distribute toxins to the Tonle Sap and into the human food chain through fish consumption. Improving the Government's capacity to monitor and enforce the Agricultural Materials Law will require a long-term, nationwide effort, but in the short term the focus should be on reducing demand through education on the hazards and demonstration of alternatives.

4. Institutions

11. The Ministry of Agriculture, Forestry and Fisheries (MAFF) has primary responsibility for the agriculture sector, and is in the process of developing a pilot system for agricultural extension with bilateral assistance. Prior to 1999, MAFF was also responsible for water resource management, particularly irrigation, through its General Directorate of Irrigation, Meteorology and Hydrology (GDIMH). In 1999 GDIMH was separated and upgraded to MOWRAM, an independent ministry. The third national institution relevant to agriculture is the Ministry of Rural Development (MRD); its responsibilities include rural roads. Each agency maintains provincial departments, which serve as the focal point for implementation of aid-assisted projects. Although all three ministries suffer from lack of qualified midlevel

professionals, the international community, including ADB, is dedicating substantial resources to institutional strengthening.

5. The Project Area

a. Socioeconomic Profile

12. The Project is located in the southwestern part of Kompong Thom adjacent to National Road 6, and about 12-15 kilometers (km) east of the flood stage of the Tonle Sap. It is a rural area dominated by agriculture. The most recent household-level data (collected in March-April 2000) indicates that nearly 60 percent of the people in the project area live below the national poverty line, compared with the national average of 40 percent for rural areas. Thirty-six percent of farmers surveyed borrowed money from local lenders last year to finance medical care and small investments in economic activity, and to cover food shortages at the end of the wet season. The province has the highest incidence of underweight children, and the second highest incidence of stunted growth—key measures of malnutrition. Kompong Thom ranks 18th out of 21 provinces on the human development index (HDI),[8] which combines information on life expectancy at birth, educational attainment, adult literacy, and real GDP per capita. Although it is close to Phnom Penh, it lags behind other agricultural areas in infrastructure and use of improved agricultural technologies due to its location on the front lines of internal conflict.

b. Agriculture

13. Kompong Thom is a significant rice-growing area, with 128,000 ha of paddy and more than a third of the total floating rice production nationwide. But rice production in the province suffers from floods, droughts, and rat infestations. Drought periods of up to 15 days during the wet season can cause severe crop losses, and farmers report dry year yields of less than half those of a wet year. Local varieties make up almost all of rice grown in the province. Although the Government has a small agriculture extension staff, it is not adequate to fully meet the needs of the province or the project area.

14. A social assessment of the project area conducted in the 1997 TA was updated in March-April 2000 through household surveys in 13 villages. The survey found current rice yields at 1.2-1.4 t/ha, with a maximum of 2.4 t/ha (using modern varieties) and a minimum of 0.5 t/ha. These yields compare poorly with those attained in neighboring countries because of lack of irrigation and agricultural extension, use of low-yield rice varieties and technologies, and impassable farm-to-market roads. Investments in fertilizer are low, and pesticide use is almost nonexistent. A few cash crops—maize, mung beans, soya beans, cassava, and melons—are grown in the area, and irrigated with water traps and from a few shallow hand-dug wells. Households are involved in some nonrice economic activities, including wood collection, fishing, animal husbandry, and services. Communities in the project area are not homogeneous. Villages to the east, near the Stung Chinit diversion weir, practice more dry season cropping due to easier river access, and communities at the western extreme of the command area plant more floating rice and practice fishing due to higher water levels in the wet season.

c. Irrigation

15. The Stung Chinit irrigation system was built by 40,000-100,000 forced laborers during the Khmer Rouge era to provide supplemental wet season and limited dry season irrigation by

[8] Royal Government of Cambodia. 1997. *Cambodia Human Development Report*. Phnom Penh.

diverting flows of the Stung Chinit and Stung Tang Krasang rivers. The weir gates and control and diversion structures are no longer functioning, and some canals are filled with sediment or have eroded banks, leaving many areas unsuitable for crops even in the wet season and entirely barren during the dry season. But the basic layout of the scheme is sound, the weir superstructures are intact, and many of the canals require only moderate earthwork. The situation presents an opportunity to restore irrigation at less cost than to establish a new system.

16. At present there are no formal farmer organizations to manage water in the area, because the system is completely dysfunctional. In the early years of scheme operation, the main canal and gates were controlled by military units, and secondary and tertiary canals were managed by districts, communes, and villages. There are no written records of these arrangements. Farmers report high rice yields during this period, but almost all production was shipped to other parts of the country. During the 1980s, scheme management apparently faltered, and on several consecutive years downstream villages lost their floating rice crop when upstream villagers opened canal gates just before harvest time. This highlights the importance of coordinated, participatory system management, and full representation of all communities in any irrigation management authority.

d. Rural Infrastructure

17. Rural roads in the area are generally impassable through the wet season, well into December, except by oxcart. But with rights-of-way well established and a major, recently rehabilitated highway nearby, these roads present an opportunity to rapidly improve living conditions in adjacent villages and reduce transport costs with a moderate investment in rehabilitation. The major towns neighboring the project area lack adequate market facilities beyond patches of cleared land with, at best, temporary plastic roofing. This is typical of rural Cambodia—the 1999 Cambodia Human Development Report notes that only 14 percent of villages in the country have a permanent market, and only 4 percent have access to an agricultural extension worker.[9] All these circumstances constrain agricultural productivity and farmers' incomes.

B. Government Policies and Plans

18. The Government's First Five-Year Socioeconomic Development Plan (SEDP) for 1996-2000 and Strategic Plan for 1997-2001 lay a foundation for poverty reduction and economic recovery focused on rural development. Key SEDP strategies that are directly relevant to the Project include (i) the achievement of poverty reduction and broad participation in the development process by focusing on rural development; (ii) substantial investment to upgrade physical infrastructure, particularly rural roads; (iii) development of the productive base of the rural economy by raising rice yields for food security and eventually for export; and (iv) enhanced income opportunities for farm households by diversifying crops.[10]

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[9] Ministry of Planning. 1999. *Cambodia Human Development Report 1999.* Phnom Penh.

[10] Royal Government of Cambodia. 1997. First Five-Year Socioeconomic Development Plan 1996-2000. Phnom Penh.

1. Agriculture and Water Resources

19. Major policy issues in agriculture and water resources are addressed under the Agriculture Sector Program (ASP),[11] which is based on the Sector Development Policy Statement of MAFF, and reflected in the 1996-2000 SEDP. The policy reforms under the ASP support the objectives of this plan and focus specifically on (i) improving property rights by preparing a new land law; (ii) liberalizing fertilizer pricing and marketing; (iii) increasing dissemination of agricultural marketing and technological information; (iv) formulating a strategy for microfinance; (v) defining an institutional framework for sustainable O&M of water resource infrastructure; (vi) decentralizing rural development activities by establishing local rural development committees; and (vii) facilitating divestment of the rubber subsector. In July 2000 the Government submitted the new land law to the National Assembly, fulfilling the final condition for release of the second tranche of ASP funds.

20. The Government also recognizes the need for integrated water resources management based on river basins, with appropriate stakeholder participation and coordination. Improvement in water resource management through physical investment as well as policy development, and institution building are essential elements of the strategy to boost agricultural productivity. An initial effort is under way to codify water resources management with the drafting in early 2000 of a water law, which is undergoing preliminary discussion by Government agencies. In January 1999, the Government issued the Circular on the Implementation Policy for Sustainable Irrigation System, which outlines the institutional arrangements and procedures to progressively transfer O&M responsibilities for irrigation systems from the Government to farmer water user groups. The policy is being implemented on a pilot basis in at least four aid-funded irrigation projects. On the trade and marketing side, the Government has lifted a ban on rice exports and liberalized the market for fertilizer.

2. Rural Infrastructure

21. In December 1999, MRD issued the Policy for Rural Roads. The policy sets a goal of decentralized responsibility for road management to the province, communes, and villages on the principle of users and beneficiaries pay, while MRD will provide advice on maintenance and local mobilization of resources. This policy has yet to be tested in practice, but lays a good foundation for sustainable development of rural infrastructure. MRD has also adopted labor-based appropriate technology (LBAT) for rural road construction, in accordance with the Government's policies on employment creation and poverty reduction, and with emphasis on creating opportunities (and where appropriate, establishing preferences) for participation by disadvantaged groups. MRD is in the process of delegating engineering, supervision, and civil works requiring substantial equipment to the private sector, and currently is training local contractors to meet its requirements.

C. External Assistance to the Sector

22. From 1992 to 1999, ADB provided Cambodia with 12 loans, totaling $286 million, and 65 TA projects amounting to about $42.4 million. Three of the investment projects and nine TA projects, totaling $65.1 million and $7.8 million, respectively, are in the agriculture and rural development sectors. Key investments in agriculture, rural development, and irrigation are described here, and a complete list of external assistance to these sectors is presented in Appendix 2.

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[11] Loan 1445-CAM: *Agriculture Sector Program*, for $30,000,000, approved on 20 June 1996.

23. External assistance to the water resources sector, especially for irrigation, is small relative to other infrastructure investments, and relatively new to the country despite the high priority given by the Government. Recently the Government asked ADB to help develop the overall policies, strategies, and programs for the water sector. In 1999 ADB provided TA to MOWRAM to strengthen its operational capacity for planning and implementing investment projects, and to develop the necessary policies and institutions for integrated water resources management.[12]

24. The World Bank provided a $20 million loan to support the development of the Social Fund under the Government's Council of Ministers. The Social Fund financed more than 1,400 subprojects for water supply, education, health, and village-level infrastructure facilities including small-scale irrigation in all 24 provinces. A follow-up loan of $25 million was approved in 1999. The World Bank will also provide institutional strengthening and support rehabilitation of small- and medium-scale irrigation systems through MOWRAM as part of its $27.5 million Agriculture Productivity Improvement Project, which commenced in 2000.

25. Several assistance agencies are implementing farmer-managed irrigation systems with various types of cost recovery measures for O&M. The European Union (EU) provided grant funds to rehabilitate small- and medium-scale irrigation systems in six provinces as part of a $44 million Support Program for the Agriculture Sector from 1994 to 1998. Water user groups have been established to operate and maintain these systems, collect user fees, and conduct various income-generating activities. A $40 million second phase project commenced at the end of 1999. Agence Française de Développement (AFD) has provided grant funds since 1996 to rehabilitate coastal polders and organize beneficiary groups to fund and conduct O&M activities. The Food and Agriculture Organization (FAO), through its Programme on Food Security, is developing seven small-scale irrigation pilot projects with farmer organizations and farmer field schools.

26. The Japan International Cooperation Agency (JICA) is providing technical support to MOWRAM and a $10 million grant for the rehabilitation of irrigation canals in Kandal Province from 1999 to 2001. JICA is also planning a five-year project for capacity building of engineers in MOWRAM and its provincial offices, commencing early in 2001.

27. The Australian Agency for International Development (AusAID), in association with the International Rice Research Institute (IRRI), has been assisting the Government since 1998 to develop agriculture research institutions and to support research programs for the development of improved rice varieties and rice-based farming systems. AusAID is also providing a $7 million grant for 1997-2002 for institutional strengthening and human resource development of the national agricultural extension system. These programs have contributed to increasing the area of high-yield variety (HYV) rice under irrigated farming during the dry season. Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) is providing assistance in agriculture extension as part of its Kompong Thom provincial development project.

28. Several nongovernment organizations (NGOs) have provided assistance for the rehabilitation of small-scale irrigation systems in the country. Their activities commenced in the early 1990s, preceding bilateral and multilateral assistance. In the project area, the Adventist Development and Relief Agency (ADRA) is developing groundwater resources and village

[12] TA 3292-CAM: *Capacity Building in the Ministry of Water Resources and Meteorology*, for $796,000, approved on 10 November 1999.

vegetable farming, helped form a district water management committee to operate and maintain wells and sanitation facilities, and built a market at Tang Krasang town.

29. Construction of rural roads has been successfully supported by the International Labour Organization (ILO) since 1992 and ADB since 1996. The Tertiary Roads Improvement Programme, a cooperative arrangement between MRD, Kreditanstalt für Wiederaufbau (KfW) and World Food Programme, is rehabilitating roads in parts of Kompong Thom. All these projects use LBAT and recruit large groups of laborers from local communities that will use the roads.

D. Lessons Learned

30. The 1999 ADB Portfolio Review Mission found that the Government's project implementation capacity is generally good, although weak in specific areas. Government agencies suffer from a shortage of skilled and experienced staff, due to poor initial conditions affected by civil turmoil in the past and low civil service salaries. Many staff trained under externally-assisted projects and programs are quickly absorbed by the private sector. Furthermore, time-consuming decision making, including lack of delegation of authority to the project implementation office, has constrained the implementation of some projects. The experience of other funding agencies and NGOs in the country verifies these findings.

31. Some parts of Cambodia suffer from a low level of social cohesion due to years of political and military conflict. Externally-assisted projects that include cooperative arrangements between beneficiaries have proven human-resource intensive, and require substantial investments of time and energy to mobilize participants. For irrigation projects, farmers need to be convinced of the benefits of cooperation, they need to realize these benefits within the life of the investment, and their organizations need to be recognized by the Government and protected by a legal framework.

32. The following lessons have been incorporated into the design of the Project:

(i) Project design should be kept simple.

(ii) Provincial and district agencies of the Government should have active roles in implementing projects that require beneficiary participation.

(iii) Prior to the commencement of physical works, an agreement should be reached with beneficiaries regarding general design features, intended implementation approach, and subsequent O&M arrangements.

(iv) The availability of sufficient counterpart funds during project implementation should be confirmed and closely monitored.

(v) Adequate consulting services must be provided to ensure the timely completion of surveys, detailed designs, and effective supervision of implementation. Realistic implementation schedules must provide adequate lead time for preparatory activities, especially for beneficiary consultations.

(vi) Sufficient authority should be delegated to the project implementation office to avoid implementation delays.

33. Some of these findings are mirrored in ADB's analysis of past projects in the irrigation and rural development sector.[13] Of particular relevance is the importance of close involvement of beneficiaries in project design, implementation, and management. This builds a foundation of ownership that is a necessary condition for successful farmer participation in O&M and for cost recovery. But strong ownership alone is not enough; farmers and key institutions also require adequate training. Finally, when local capabilities are constrained by financial, technical, and sociocultural factors, a process approach is recommended to ensure flexibility in design, implementation, and operation of irrigation systems.

E. ADB's Sector Strategy

34. The major thrusts of ADB's country operational strategy (COS) include (i) pro-poor sustainable economic growth in populous rural areas, (ii) human resource and social development, and (iii) promotion of private sector participation that addresses key institutional and infrastructure weaknesses. The COS recognizes that agricultural and rural development are key to pro-poor sustainable economic growth in Cambodia. In this context, key areas for improving agricultural productivity include (i) providing and properly maintaining critical infrastructure for irrigation, drainage, and rural transport; (ii) strengthening agricultural research and extension; (iii) promoting the private-sector participation in input supply, product processing, and marketing; and (iv) providing effective rural financial services.

35. ADB's strategy is to assist the Government to develop a comprehensive approach to the water sector with clearly defined authority across agencies, modalities for stakeholder participation in setting the rights and responsibilities of water users, and separation of the responsibilities for water resource management and service delivery. ADB's capacity building TA is a first step in this direction. The TA includes (i) detailed sectoral overview, (ii) formulation of investment strategies, (iii) establishment of the institutional framework for sustainable O&M of irrigation systems, (iv) identification of an action agenda for the draft national water sector policy, and (v) strengthening of planning and implementation capacities. These processes will be enhanced by implementation of the Project. ADB will also facilitate aid coordination in the water sector to promote a common approach in areas such as water user organizations for O&M of irrigation infrastructure, water policies and laws, and sectoral responsibilities across Government agencies.

F. Policy Dialogue

36. The Government's new policy on farmer management of irrigation systems is a key step to ensuring sustainability of future investments. Farmer ownership of irrigation investments is developed by ensuring farmer participation in all aspects of development, from planning and design to construction and management. Full ownership of the system increases the likelihood that farmers will shoulder a substantial share of costs for O&M. Although the new policy is being implemented in AFD's Prey Nup project, the EU Le Programme de Réhabilitation et d'Appui au Secteur Agricole (PRASAC) project and elsewhere, it needs to be supported by a legal framework, and adjustment of the method for calculating water user fees may be needed. The Government has agreed to implement the policy under the Project on a pilot basis, for refinement based on practical experience and especially the views of farmers. The Government is also sponsoring a series of national workshops and field trips to give all stakeholders, including the aid community, an opportunity to contribute to policy development. The medium-

[13] Asian Development Bank. 1995. *Sector Synthesis of Postevaluation Findings in the Irrigation and Rural Development Sector.* Manila.

term goal of these refinements is to achieve 100 percent cost recovery for O&M of secondary canals and structures and on-farm facilities; the long-term goal of the policy is to achieve full cost recovery for all O&M activities.

37. ADB recognizes good governance as one of the pillars of a sound poverty reduction strategy, especially elements of accountability for Government employees, people's participation in the development process, predictability in the application of rules and laws, and transparency in public sector decision making. The Project is designed to maximize people's participation from design to construction, to management of all major components. The role of farmers in irrigation system management will ensure not only that decision making is transparent, but that key decisions are made by the farmers themselves. Governance issues identified in Cambodia that are directly relevant to the Project include lack of independent auditing agencies, land disputes, and highly centralized administrative structures.[14] The Project's design addresses the audit issue by financing independent external audits based on international auditing standards.

38. Landownership, registration, and titling are crucial issues for the success of agriculture improvement, especially irrigation projects. As land values increase with the expectation of irrigation, there is a risk that target beneficiaries may be alienated from their lands because they lack land title or even less formal documentation, such as land certificates issued by local commune chiefs. The Government's draft land law, prepared with ADB assistance, addresses many outstanding issues on land policy, and was presented to the National Assembly in July 2000. Once the law is adopted, detailed rules and regulations will be needed to implement it. A recently passed subdecree[15] will simplify and accelerate the procedures for land titling of individual parcels, using a new orthophotomapping and survey process developed in the Department of Cadastre and Geography, with assistance from GTZ and the Government of Finland. This process will be used in the project area in the first two years of implementation to assist target beneficiaries to obtain land titles.

39. By establishing development committees at village, commune, and provincial levels, the ASP provided support for the Government's initiative to decentralize planning and implementation of development interventions, and involve target beneficiaries in their own development. The United Nations Development Programme (UNDP) supported a similar effort from the early 1990s. From that experience, the Government is now moving to establish elected commune councils by early 2001. Although the functions of commune councils and their relationship with national Government representatives at provincial and district levels, as well as with the existing development committees are yet to be defined, the councils are expected to play a key role in planning and implementing development activities in the concerned communes. In terms of project implementation, the focus of institutional strengthening will be at the provincial and district levels, and that of extension services at the commune and village levels. Focusing on the different levels will ensure the sustainability of services in the project area and recognizes that MOWRAM and other agencies need substantial human resource development at the local level. This strategy requires MOWRAM to dedicate more resources to Kompong Thom; the ministry has committed to do this.

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[14] Kato, T., J. A. Kaplan, Chan Sophal, and Real Sopheap. 2000. Cambodia: Enhancing Governance for Sustainable Development, Working Paper No. 14, Cambodia Development Resource Institute, Phnom Penh.

[15] Kingdom of Cambodia. 2000. Subdecree on the Procedure of Establishing Cadastral Index Map and Land Register. Phnom Penh: Ministry of Land Management, Urban Planning, and Construction.

40. Although the Government has limited capacity to enforce the Agricultural Materials Law, which establishes a regime to control the supply and use of certain pesticides, fertilizers, and animal medicines, MAFF is committed to reducing the demand for dangerous substances by supporting integrated pest management (IPM). The Project follows a similar approach by including IPM as part of a package of agricultural extension services, and provides training for provincial MAFF extension workers on IPM techniques and dissemination.

IV. THE PROPOSED PROJECT

A. Rationale

41. The Government places high priority on reducing poverty by improving the rural economy. ADB's strategy in Cambodia supports this objective by focusing investments in the populous and poor rural areas of the plains and Tonle Sap region, such as Kompong Thom Province. The provincial economy is dominated by rural subsistence or semisubsistence farming dependent on one low-yield rain-fed rice crop per year, with limited employment and income-generating opportunities during the dry season. Periodic droughts in the wet season, or severe flooding, force families into debt to meet their subsistence food needs. Due to lack of irrigation, most lands lie barren and fallow in the dry season. The project area presents an opportunity to address these problems as it has abundant water resources, an existing irrigation system that will need only low-cost rehabilitation, and its proximity to a major highway and to Phnom Penh.

42. The provision of irrigation and drainage, rural roads, and markets can have an important impact on agricultural productivity. In the wet season, reliable flows and drainage ensure crop survival during drought periods and floods, reduce the risk of investing in inputs, and, when combined with the introduction of modern rice varieties, permit double cropping. Dry season irrigation will provide a large boost to farmers' incomes, and permit the adoption of high-yield varieties and diversification into higher value cash crops. Improved roads (most rural roads in the project area are impassable except by oxcart) will reduce vehicle and harvesting costs, and allow greater and timely use of inputs, while stimulating other economic activities. Improved markets will reduce spoilage and transaction costs.

43. The returns to investments in hardware can be greatly enhanced by complementary investments in human capital. Thus, training in improved agricultural techniques, IPM, and on-farm water management should go hand in hand with the provision of irrigation. Participation in construction and the O&M of roads and irrigation systems imparts skills to beneficiaries, provides much-needed employment, and ensures the sustainability of infrastructure. Finally, if farmers are assisted in obtaining legal title to their lands, they are much more likely to invest in improved agricultural techniques and technology, and to participate in O&M of the irrigation system.

44. In combination, these hardware and software investments can stimulate the rural economy and have a measurable impact on farmers' incomes. By improving rural infrastructure and establishing a workable system for agricultural extension, crop diversification, and farmer-managed irrigation, the Project will also prepare the way for a second-stage investment in an upstream dam that will greatly expand dry season irrigation.

B. Objectives and Scope

45. The primary objectives of the Project are to raise agricultural productivity and increase farmers' incomes by providing irrigation and drainage for 7,000 ha, and improving rural roads and markets in and around the project area. The Project will also (i) form and train water user groups to operate and maintain the irrigation system, (ii) apply cost recovery measures for roads and irrigation works, (iii) strengthen Government staff at the central and provincial level, and (iv) conduct benefit monitoring and evaluation.

46. The Project will have the following components.

1. Irrigated Agriculture Development (Part A)

a. Farmer Community Organization and Extension Services

47. This component will address the software requirements for ensuring that the provision of water results in sustainable increases in agricultural productivity that benefit local farmers. The component involves investing in human resource development, community organization and training, and applied research and extension, through three subcomponents:

(i) Landownership survey and documentation for land registration and titling. Using orthophotomapping and ground surveys, the Project will assist farmers to obtain legal title to their lands. Completed orthophotomaps will also be used for the detailed design of water offtakes from the secondary canals and for the formation of water user groups.

(ii) Water user groups. The Project will help mobilize, form, and train farmer water user groups (WUGs), who will elect members to the farmer water user communities (WUCs) at the secondary canal level. The WUGs and WUCs will be the focal points for farmer participation in system design and O&M, and for training in water management.

(iii) Agriculture extension services and research. The Project will provide extension services including farmer field schools and demonstrations on IPM, improved rice seed and rice farming techniques, crop diversification, land leveling, animal husbandry, and postharvest practices. Provincial government agencies' capacity to provide long-term extension services will be strengthened.

b. Irrigation Infrastructure

48. Civil works under this component will (i) repair the main diversion weirs on the Stung Chinit river and its tributary, the Stung Tang Krasang; (ii) repair flood bunds, construct new bunds on the eastern side of the main canal, and provide drainage structures to protect low-lying agricultural areas between the two rivers; (iii) introduce a fish pass structure to allow annual fish migrations; (iv) remodel and repair the main and secondary canals and regulators, along with roughly 60 km of embankment service roads; (v) provide assistance to farmers constructing tertiary and quaternary canals; (vi) establish hydrometeorology stations in the Stung Chinit catchment area; and (vii) provide field offices and equipment.

c. Irrigation System Management

49. The system management component will establish the Stung Chinit irrigation committee, responsible for overall management of the system, and develop a system for farmer-managed O&M and cost recovery through WUGs and WUCs. The component will develop the capacity of the committee and MOWRAM staff in all technical and administrative aspects of system management.

2. Rural Infrastructure (Part B)

50. This component will improve roughly 150 km of rural roads in and around the project area to reduce the cost of transporting inputs and harvested crops, in anticipation of increased volumes of both stemming from greater agricultural production. In addition, the Project will upgrade six local markets that currently lack permanent roofing, drainage, access to clean water, truck-loading facilities, and sanitation facilities. The final selection of roads and markets during project implementation will give strong preference to the views of target beneficiaries through surveys and meetings at the village, commune, and district levels.

C. Cost Estimates

51. The total project cost is estimated at about $23.8 million equivalent, including physical and price contingencies, duties, taxes, and interest charges. Of this, about $9.6 million or 40 percent is the foreign exchange cost. Local currency costs including duties and taxes are estimated at $14.2 million equivalent, or 60 percent of the total cost. The cost estimates are summarized in Table 1. Detailed costs estimates are in Appendix 3.

Table 1: Cost Estimates
($ million)

Item	Foreign Exchange	Local Currency	Total Cost
A.			
1. Irrigated Agriculture Development (Part A)			
a. Farmer Comm. Organization and Extension	0.8	1.5	2.3
b. Irrigation Infrastructure	4.6	5.4	10.0
c. System Management	0.6	0.4	1.0
2. Rural Infrastructure (Part B)	1.5	3.4	4.9
Subtotal (A)	**7.5**	**10.7**	**18.2**
B. Contingencies			
1. Physical Contingencies [a]	0.5	0.9	1.4
2. Price Contingencies [b]	0.7	2.6	3.3
Subtotal (B)	**1.2**	**3.5**	**4.7**
C. Interest Charges	0.9	0.0	0.9
Total [c]	**9.6**	**14.2** [d]	**23.8**

[a] Physical contingencies are based on 10 percent of base costs.
[b] Price contingencies are based on average annual escalation of 2.4 percent for foreign exchange and 6 percent for local currency costs.
[c] Totals may not tally due to rounding.
[d] Local currency figures include taxes and duties of about $2.9 million equivalent.

D. Financing Plan

52. It is proposed that ADB finance $16 million equivalent (67 percent) of the total project cost covering the foreign exchange cost and $7.4 million equivalent of the local currency cost. AFD has expressed interest to provide grant cofinancing amounting to $2.6 million equivalent (11 percent) of the total project cost, on a parallel basis, for the entire farmer community organization and extension services component, and water quality monitoring and fisheries research in the irrigation system management component of Part A. The Government and the beneficiaries will finance $5.2 million equivalent of local currency cost (22 percent of the total project cost). Beneficiary contribution is through labor to construct tertiary and quaternary canals and drains within their parcels.

53. As AFD funds will be provided on a parallel basis, AFD will be responsible for administering their activities together with MOWRAM, in close coordination with ADB.

Table 2: Financing Plan
($ million)

Source	Foreign Exchange	Local Currency	Total Cost	Percent
ADB (including interest charges)	8.6	7.4	16.0	67
AFD	1.0	1.6	2.6	11
Government	0.0	4.8	4.8	20
Beneficiaries	0.0	0.4	0.4	2
Total [a]	**9.6**	**14.2**	**23.8**	**100**

ADB = Asian Development Bank, AFD = Agence Française de Développement.
[a] Totals may not tally due to rounding.

54. The Borrower will be the Kingdom of Cambodia. The loan will be from ADB's Special Funds resources with a term of 32 years including a grace period of 8 years. The loan will carry an interest rate of 1 percent per annum during the grace period, and 1.5 percent per annum thereafter.

E. Executing Agencies

55. The Project Executing Agencies (EAs) will be Ministry of Water Resources and Meteorology (MOWRAM) and the Ministry of Rural Development. MOWRAM will be responsible for three subcomponents: farmer community organization and extension services, irrigation infrastructure, and irrigation system management, and MRD will be responsible for the rural infrastructure component. The provincial Department of Agriculture, Forests and Fisheries (PDAFF) will provide support for agriculture extension activities, along with the Cambodia Agriculture Research Development Institute. The Department of Cadastre and Geography of the Ministry of Land Management, Urban Planning, and Construction (MLM) will conduct the land ownership survey and titling activities.

56. Project sustainability depends on the strength of institutions, sense of ownership by Government and beneficiaries, and financial mechanisms for cost recovery. Both MRD and MOWRAM have increased their technical and project management skills considerably through

practical experience on projects financed by ADB and others. Although irrigation systems can be more complex to operate and maintain than rural roads, MOWRAM will build its skills continuously during the investment period through on the job training by the implementation consultants, and new or planned institutional strengthening projects.

F. Implementation Arrangements

1. Project Organization and Coordination

57. MOWRAM and MRD will establish project management offices (PMOs) at their ministries, headed by national project directors at the level of undersecretary of state; and project implementation units (PIUs) in Kompong Thom, headed by the director of the Provincial Department of Water Resources and Meteorology (PDWRAM) and director of the Provincial Department of Rural Development (PDRD), respectively. Both PIUs will have full-time deputy project managers, plus full-time engineering, technical, and administrative staff. By the end of year two of the Project, once farmer organizations are in place and have elected their representatives, MOWRAM will establish an office for the Stung Chinit irrigation committee, with permanent staff comprising engineers, canal inspectors, and gate operators.

58. Interministerial coordination will be provided through a project steering committee (PSC), chaired by Ministry of Economy and Finance (MEF), and comprising the national project directors from MOWRAM and MRD, and representatives of other ministries involved in the Project. The PSC will be responsible for overall coordination of the Project and interagency dispute resolution. At the provincial level, a project coordination committee (PCC) will be established. The PCC will be chaired by the project manager, PIU-MOWRAM, and will include the MRD project manager as deputy chairperson, and representatives from relevant provincial agencies, the Stung Chinit resettlement subcommittee (SCRS), and the Stung Chinit irrigation committee. The PCC will coordinate implementation activities and make adjustments in work programs. A project organization and coordination chart is in Appendix 4.

a. Land Ownership Survey and Titling

59. The land ownership survey and titling component will be implemented through the Department of Cadastre and Geography in MLM. The process will begin with NGO-led workshops to explain to villagers their land rights and the planned cadastral activities. The department will prepare a cadastral index map of villagers' landholdings in the project area based on aerial survey, ground truthing, interviews, demarcation, and adjudication of land parcels. This process, including procedures for dispute resolution, is spelled out in a new subdecree on the Procedures of Establishing Cadastral Index Map and Land Register. The final output of this component will be land registration and submission of all necessary documentation for issuance of title certificates for all parcels in the project area.

b. Farmer Organization

60. The guiding philosophy of the irrigation system is bottom-up management. The Project will help form and train WUGs at the 50-ha-block level to participate in the design phase of the system, construct tertiary and quaternary canals and drains with material and TA from the Government, and contribute labor and collect user fees to finance the maintenance of secondary canals and drains. The WUGs will elect representatives to WUCs at the secondary canal level to represent their interests on the Stung Chinit irrigation committee (para. 64). The WUCs will be responsible for operating secondary canals and drains, will organize the WUGs

for canal and drain maintenance, and manage maintenance funds collected from the WUGs. To leverage consulting inputs, qualified NGOs will be used to mobilize farmers, conduct training, and implement public awareness campaigns—a model that AFD found to be effective in Cambodia. NGOs can also be used to more effectively target vulnerable groups such as households headed by women, households with disabled persons, and minorities.

c. Agricultural Extension and Research

61. Extension activities will include, (i) farmer field schools, (ii) field demonstrations for IPM, (iii) demonstration plots for improved rice varieties and alternative dry season crops, (iv) land leveling, and (v) postharvest processing to improve the quality of milled rice. Agriculture extension will be based on the systems, expertise, and materials developed in MAFF and the provincial Office of Technique, Economic and Extension (OTEE), which will be the Implementing Agency for this component. The Cambodia Agriculture Research Development Institute (CARDI) will conduct adaptive research activities to support OTEE in the field. AFD plans to expand the agricultural extension services subcomponent to include microcredit facilities for farmers, through their ongoing work with Ennatien Moulethan Tchonnebat (EMT), a local microfinance institution.

d. Irrigation Infrastructure

62. The irrigation infrastructure component will be managed by the PIU in Kompong Thom, with the assistance of the implementation consultants and monitored by the PMO. Major civil works including remodeling of the main canal and rehabilitation of the weirs and control structures in the main and secondary canals will be undertaken by a contractor engaged through international competitive bidding (ICB). Simple earthworks for secondary canals and drains may be contracted directly to WUCs and WUGs, under the technical guidance of the PIU and implementation consultants, or through civil works contracts that require the use of local labor along the canal wayleave. The guiding philosophy of the civil works is participation of the target beneficiaries in determining the location of offtakes, ease of O&M, and longevity of structures. Farmers will participate in system design from the outset to determine the optimal arrangement of canals, drains, and water management structures. At least two thirds of farmers along each secondary canal in the command area will have to endorse and sign off on the design of secondary canals and offtakes and tertiary block boundaries before they are incorporated in the overall design. For some small civil works, such as the rehabilitation of flood embankments east of the diversion weirs, the United Nations World Food Programme (WFP) will also participate to target vulnerable groups that do not directly benefit from irrigation, and provide rice, fish, oil, and salt as payment to participants doing piece work.

63. MOWRAM will be responsible for O&M of the main canal, weirs, cross-regulators and cross-drainage structures. The Project will provide funds for routine maintenance, but on a declining percentage over time, and the Government share of maintenance will increase proportionately to 80 percent of the total during project implementation. The total annual budget requirement of about $130,000 equivalent for the Government's contribution to O&M is modest in relation to total GDP and the national revenue budget. WUCs will be responsible for O&M of secondary canals, using labor and funds raised through fees collected by WUGs equivalent to about $10/ha. This is affordable to farmers who in the most pessimistic scenario will gain a minimum of $84 in annual income just from supplemental wet season irrigation. Farmers that also receive dry season irrigation will be expected to pay higher fees reflecting higher water usage. Social assessments completed during project preparation found farmers willing to pay water user fees. AFD and EU agriculture projects in Cambodia have successfully implemented

fees of the same magnitude, with payment in cash, rice, or labor. Their experience shows that user fees should not be imposed from above, but rather developed through a consensus of WUG membership. Not surprisingly, farmers are more willing to make contributions once they realize measurable gains from agriculture. It is therefore unrealistic to expect significant fee collection in the early stages of the Project. The objective of user fees is to eventually recover 100 percent of the costs of O&M of secondary canals and structures.

e. Irrigation System Management

64. The system will be managed by the Stung Chinit irrigation committee, comprising elected representatives from the WUCs and PDWRAM technical staff. The committee will be chaired by a representative of the WUC, and will have farmers as majority members. At least 20 percent of seats on the committee will be reserved for women, reflecting the share of households headed by women in the project area. The committee, with assistance from the PIU and implementation consultants, will (i) develop gate operating schedules; (ii) calibrate structures to ensure equitable distribution of water; (iii) prepare maintenance schedules and budgets and package routine maintenance tasks into contracts for the WUCs/WUGs; (iv) foster active farmer participation, through the WUCs and WUGs, in system O&M activities, and (v) prepare a detailed O&M manual to guide future management of the system. A diagram of system management arrangements is presented in Appendix 5.

f. Rural Infrastructure

65. The rural infrastructure component will be implemented by PDRD, with technical guidance and support from MRD and the implementation consultants. Roads will be rehabilitated in the command area of the irrigation system and peripheral areas in Baray and Santuk districts using the LBAT model pioneered and used successfully in Cambodia by ILO since 1992, and currently used in ADB's Rural Infrastructure Improvement Project (RIIP). Under the LBAT model, up to 40 percent of road construction expenditures are paid directly to local communities as wages. PDRD or beneficiary groups will propose individual road links and markets for consideration by the Provincial Rural Development Committee (PRDC). PDRD will prepare detailed financial and economic appraisals for all proposals. PRDC will recommend priority roads and markets to MRD according to the selection criteria used in RIIP.

66. Rural roads will require routine and periodic maintenance.[16] The Project will provide financial support to cover the maintenance of rural roads, but on a declining share over time, and the Government share of maintenance will increase proportionately. This will ensure that the Government shoulders the burden of maintenance before the Project is completed. The Project will test alternative surfacing materials that carry a higher capital cost but lower maintenance costs, and assess their technical and economic viability as well as replicability in the Project, taking into account the initial testing being conducted with the assistance of ILO.[17] Finally, the Project will experiment with the formation of road user committees to mobilize local funds and labor for maintenance, as described in MRD's policy on rural roads (para. 21).

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[16] Routine maintenance must be done on a regular basis to ensure the continued operation of roads. It includes activities such as filling potholes. This is conducted at relatively low cost ($300 per year per kilometer) using the LBAT model. Periodic maintenance involves overlaying of surface materials once every three to five years with a maximum cost of $4,000 per kilometer.

[17] An initial assessment by ILO indicates that using basalt blocks for road surfacing requires high initial investments, but may prove to be economically viable over the long run due to substantially lower maintenance requirements. This finding needs to be assessed on a wider scale.

67. For the O&M of rural markets, the Project will follow the design under RIIP, by establishing market committees in district or commune councils before upgrading the market with the agreement of market traders.[18] The committee will operate the market, and establish stall rental fees that will cover at least the cost for regular O&M and a fund for further maintenance and improvement of the market.

2. Implementation Arrangements under Parallel Financing

68. ADB and AFD have agreed on the general activities, cost estimates, and outline terms of reference for the farmer organization and agricultural extension component. AFD may improve the design of the component, reflecting its broad experience in Cambodia. All such changes will be agreed upon beforehand with ADB. As parallel financiers, AFD and MOWRAM will administer the component. Because of the close linkages between the components in part A, AFD- and ADB-financed consultants will work together as a team, share the same PIU office space, and attend meetings of the PCC, National Steering Committee, or other bodies where the presence of implementation consultants is required. Furthermore, both groups of consultants will produce joint progress and project completion reports, participate in benefit monitoring and evaluation, and participate jointly in midterm reviews. These understandings will be specified in a memorandum of understanding to be signed by AFD, ADB, and MOWRAM prior to loan effectiveness.

3. Implementation Schedule

69. The overall project implementation period is six years. In the first two years, the landownership survey and titling activities will be completed, as well as technical investigations, consultations with farmers on overall system management approach and system layout, detailed design, and any necessary resettlement and/or compensation programs. Civil works will proceed gradually, beginning with the 2,000 ha designated for year-round irrigation, and proceeding to the remaining 5,000 ha that will receive supplemental wet season irrigation. The implementation schedule is presented in Appendix 6.

4. Procurement

70. Procurement under the Project will be in accordance with the ADB's *Guidelines for Procurement*. ICB will be used for major civil works contracts in excess of $1 million and supply contracts over $500,000. Specifically, in the irrigation infrastructure component, civil works for the rehabilitation of Stung Chinit and Stung Tang Krasang weirs, Stung Chinit spillway, main canal structures and earthworks will be grouped in one package and undertaken by a prequalified contractor to be engaged through ICB. Prequalification criteria will be designed to ensure that the international contractor or associates have adequate experience and technical and financial capabilities. All other civil works related to this component involve low-technology, labor-intensive construction and are unlikely to be of interest to international contractors. These civil works will be contracted directly to WUCs and WUGs and undertaken through force account, or packaged for local contractors through local competitive bidding (LCB) procedures acceptable to ADB.

71. Because of the simple nature of the civil works for the rural infrastructure component, they are unlikely to be of interest to international contractors. The civil works for road

[18] In markets where the private sector is willing to take on the responsibility of improving facilities, the Project will limit the activities to upgrading common infrastructure such as roads, paving, and drainage.

improvement will be undertaken through LCB wherever possible, using labor-intensive techniques, and in accordance with procedures acceptable to ADB. Alternatively, these will also be implemented through the recruitment of labor groups from among beneficiaries by the PIU on a force account basis.

72. Materials and equipment to be financed under the Project will consist mainly of laterite for surfacing, service vehicles, motorcycles, a small amount of construction equipment, and office furnishing and equipment. Laterite will be procured through LCB or by force account if it is extracted by beneficiary labor. Other supply contracts valued at less than $500,000 will be awarded under international shopping. The procurement of materials and equipment worth less than $100,000 per contract will be undertaken through direct purchase. Tentative contract packages are included in Appendix 7.

5. Disbursement of Loan Proceeds

73. To ensure the timely release of loan proceeds, Imprest Accounts will be established for MOWRAM and MRD, who will manage fund flows to their respective PIUs at the provincial level. The imprest accounts will be operated in accordance with ADB's *Loan Disbursement Handbook*. For further simplification of disbursements, the EAs can use the statement of expenditure procedure for contracts costing less than $50,000 or the equivalent in local currency.

6. Consulting and NGO Services

74. The Government will engage ADB-financed consultants through several packages to assist in the implementation of the Project and transfer of technology. MOWRAM will recruit consultants for part A comprising 77 person-months of international and 202 of domestic specialists with expertise in engineering for detailed irrigation design, supervision of civil works, training, project and contract management, and fisheries. The lead firm will act as engineer for irrigation system design and construction, with sufficient delegated authority to effectively supervise the ICB contract on behalf of MOWRAM, and liability for successful completion of civil works. MRD will recruit consultants for part B comprising 15 person-months of international and 60 of domestic specialists with expertise in road and market engineering, supervision of civil works, training, and social organization and mobilization. Consultants will be recruited in accordance with ADB's *Guidelines on the Use of Consultants* and other arrangements satisfactory to ADB for the use of domestic consultants.

75. AFD will use its own procedures for recruiting consultants for the farmer community organization and extension services component of part A, comprising 22 person-months of international and 156 of domestic specialists. Expertise is required in mobilization of farmers and organization of WUGs, and agronomy. Domestic NGOs will be recruited under the AFD-financed component to assist with farmer mobilization, training, and socioeconomic surveys. For the fisheries research and water quality monitoring activities, AFD will engage the Mekong River Commission Secretariat (MRCS) on a sole-source basis because of its extensive experience in the field and in the ongoing project for Management of Freshwater Capture Fisheries (which runs through 2005).

76. The relatively large input of consulting services is justified by the integrated cross-sector design of the Project, the importance of organizing and training farmers to ensure sustainable O&M of the system, the lack of strong social cohesion in rural areas, and the low level of human resource capacity at the provincial level of Government to manage the system at the outset. Furthermore, many of the skills and technology transferred under the Project can be applied to

future water resource development projects, and thus confer a benefit beyond the Project. The outline terms of reference for loan- and grant-financed consulting services are presented in Appendix 8.

7. Advance Procurement Action

77. At the request of the Government, ADB has approved advance procurement action in engaging the ADB-financed consultants. By starting the time-consuming process of consultant selection early, it will be possible to avoid implementation delays and rapidly start farmer mobilization and irrigation system design. MOWRAM and MRD have been advised that the approval of advance procurement action does not commit ADB to finance the Project.

8. Midterm Reviews

78. ADB will conduct regular annual reviews throughout project implementation. MOWRAM, MRD, ADB, and AFD will jointly undertake two comprehensive midterm reviews, in mid-2002 and end-2004. The reviews will cover the entire Project to determine whether adjustments are necessary in system design, implementation arrangements, and fund allocation. The reviews will also address outstanding procurement problems, financing and scheduling matters, the development impact of the Project, and progress of the training programs and farmer organization.

9. Reports, Accounts, and Audit

79. MOWRAM and MRD will maintain records and accounts adequate to (i) identify goods and services financed out of the proceeds of the loan and from counterpart local funds; (ii) identify the use of these goods and services for the Project; (iii) record the progress of the Project, including its costs; and (iv) reflect, in accordance with sound accounting principles, the Project's operational and financial condition. MOWRAM and MRD, with assistance from the implementation consultants, will prepare and submit to ADB quarterly progress reports covering items (i) through (iv). The detailed format for these reports will be included in the Project Administration Memorandum (PAM).

80. In preparing the project accounts, MOWRAM and MRD will make use of the Project Accounting Manual prepared for the Ministry of Economy and Finance (MEF) with ADB assistance. The project accounts and related financial statements will be audited annually by an internationally qualified accountant, using loan proceeds. Audited reports and financial statements will be submitted to ADB not later than 12 months after the fiscal year to which they relate.

10. Benefit Monitoring and Evaluation

81. As one of the larger irrigation development projects to be undertaken in Cambodia in recent times, this project provides an opportunity to assess the development and success of farmer group formation and capacity building where there is little prior experience, and provides sufficient period to adjust O&M procedures over time based on early results. As current cropping patterns, sources of income, and other features of households in the project area are not homogeneous, careful benefit monitoring and evaluation (BME) can reveal both the geographic distribution of benefits, and the Project's success in reaching the most needy, vulnerable households. Success hinges on adequate baseline data and consistent follow-up surveys. The implementation consultant will compile socioeconomic baseline data using the (i)

1997 TA social assessment; (ii) a recent household survey prepared by AFD; (iii) latest Cambodia Socioeconomic Survey (CSES); (iv) annual provincial, district, and commune data; and (v) if necessary, additional household surveys. Follow-up socioeconomic surveys will be conducted at midterm and near completion by the PIUs with the assistance of the consultant and participation of local communities either directly or under the auspices of the NGO involved in farmer mobilization. The follow-up surveys will measure the impact on cropping intensity, yields, crop diversification, transport costs, farmer incomes, and general economic activity. The Project will also be monitored for environmental impacts through a research program to test the effectiveness of the fish pass structure, and through water quality monitoring to test the effectiveness of IPM training. The MRCS will manage both activities in coordination with the PDWRAM PIU, with financing from AFD. To the extent possible, target beneficiaries will be involved in monitoring activities.

G. Environmental and Social Measures

1. Environment

82. The Project is classified as environmental category B, and an initial environmental examination (IEE) was conducted as part of project preparation. A summary IEE (SIEE) is presented in Appendix 9. Two major environmental concerns associated with the Project are the impacts of the restored weirs on migratory fish and the impact of the use of pesticide and fertilizers in the project area. The rehabilitation of existing rural roads will not have any negative impact on Tonle Sap or other environmentally sensitive areas along the alignment. Although small borrow pits may be required for some roads, they will be rehabilitated with due consideration for the needs of the local communities and, where appropriate, converted to fishponds or to provide water for irrigation of household gardens.

83. The fish populations of the Stung Chinit and Stung Tang Krasang can be broadly classified into two groups: fish of the upper forested catchment areas and fish of the lower sections of the two rivers. There are both migratory and nonmigratory fish in the lower sections of both rivers. The project impact on the upper forested catchment area fisheries will be minimal. The Project will likely have a positive impact on the nonmigratory fish population because of the increase in standing water behind the weirs. Fisherfolk living close to the Stung Chinit and Stung Tang Krasang weirs were unanimous in their opinion that they had greater fish catches when the irrigation system was in operation prior to 1989. In the absence of any mitigation measures, the rehabilitation of the diversion weirs on the two rivers would probably have a negative impact on the migratory fish population during the dry season. To mitigate that impact, a fish pass structure will be constructed at the Stung Chinit weir with a minimum slope that would allow the fish to migrate upstream.

84. The use of pesticides in the project area is of concern not only because of the health of the farmers in the area who work the fields and consume the rice but also for the impact on water quality, on fish in rice paddies and downstream, and on livestock and waterfowl. The Project will address this issue in the agriculture extension subcomponent, by training WUGs and establishing farmer field schools, and with technical assistance from CARDI. Water quality will be monitored throughout the project period to establish a baseline and to assess the efficacy of IPM measures.

2. Beneficiary Participation in Project Design and Implementation

85. A social assessment carried out in 1997 included numerous focus group discussions and workshops that elicited farmer views of the Project. The workshops revealed a general consensus that the Project should proceed as rapidly as possible, a willingness to contribute to project implementation and irrigation system maintenance, and a willingness to donate strips of land where necessary for tertiary canals and drains. Extensive household surveys conducted during the preparation of the Resettlement Plan (RP) in March 2000, and a socioeconomic update prepared by AFD in March-April 2000, confirmed these findings. Project implementation relies heavily on beneficiary participation. Designs for secondary canals must be confirmed by at least two thirds of the farmers, who will be subcontracted for construction through WUGs or directly by the civil works contractor. Farmers will operate and maintain the irrigation system up to the secondary canal headworks, and will hold majority representation on the Stung Chinit irrigation committee. Rural roads will be selected through a bottom-up approach that focuses on maximizing cost-effective positive impact for the greatest number of people, and constructed using the LBAT model, which will generate a large demand for local labor.

86. The beneficiary population includes a high percentage of households headed by women and may include some households where the primary income earner is disabled. To address the concerns of women and vulnerable groups, special efforts will be made during the early phases of farmer mobilization to ensure full participation in all project activities, including WUGs, WUCs, farmer field schools, land titling activities, and system operations.

3. Social Impacts and Resettlement

87. Preliminary canal design work indicates that about 110 ha of Government-owned land currently used for recession rice (rice planted as floodwaters recede, but without formal irrigation) will be inundated once the weirs are repaired. The size of the inundation zone will decline steadily from the end of the rainy season through the dry season, allowing some households to continue recession rice agriculture, but delayed by one or two months. The primary users of the land come from a nearby village of 73 households. Farmers estimate yields on these sandy soils to be less than 1 t/ha. Although no settlements will be flooded and no physical relocation of households is required, people currently using lands that will become permanently inundated will receive compensation, preferably in the form of alternate land for agriculture, and in accordance with ADB guidelines. Impacts from canal rehabilitation are expected to be minor because the rights-of-way are already established, except for 22 households located on the eastern bank of the main canal, near the Stung Chinit weir. These households will be relocated to an area near the Stung Chinit river to preserve their primary economic activity of bamboo collection upstream. Rural roads, which will use existing alignments, and markets, which will be built on existing market land or unoccupied public land donated by the district or commune authorities, are not expected to have adverse impacts.

88. Although the exact limits of inundation and potential land acquisition for expanded canal rights-of-way will not be known until the detailed design phase of the Project, ADB assisted the Government's Interministerial Resettlement Committee (IRC) with the preparation of a draft resettlement plan based on a full census of households that will likely be affected. The draft RP was prepared in accordance ADB's Policy on Involuntary Resettlement (November 1995) and the *Handbook on Resettlement: a Guide to Good Practice*. Where there are differences between Government procedures and ADB's requirements, the latter will govern. The draft RP includes an entitlement matrix, an indicative budget, indicative figures on the number of persons negatively affected by the Project, consultative mechanisms, grievance procedures,

implementation procedures, and details for external monitoring and evaluation of resettlement and compensation. The draft RP will be updated to include any additional negatively affected households identified during detailed design. An independent agency acceptable to ADB, together with district-level stakeholder groups, will monitor and evaluate implementation of the RP.

89. Compensation and resettlement activities associated with the RP will be coordinated at the national level by the IRC. The IRC will be chaired by MEF, and will include the governor or deputy governor of Kompong Thom, the national project director of PMO-MOWRAM, representatives of other provincial authorities and ministries as appropriate, and representatives from the affected districts and communes as members. Detailed implementation of the RP will be conducted by the Stung Chinit resettlement subcommittee (SCRS), convened by the IRC and chaired by the deputy governor. The draft RP is presented in Appendix 10.

V. PROJECT JUSTIFICATION

A. Economic Analysis

90. The Project was formulated in line with the Government's development priority of reducing poverty through growth of the rural economy, which is dominated by agriculture. Lack of irrigation is but one of many constraints to agricultural productivity. Cambodia in general and the project area in particular, also suffer from extremely poor transportation links, lack of knowledge about preharvest and postharvest improved agricultural techniques and technology, and inadequate marketing links. For these reasons, the Project includes substantial investments in rural roads, agricultural extension services, and markets in addition to irrigation infrastructure. The Project also provides training for Government staff in irrigation design, construction, and management, as well as agronomy, to ensure transfer of technology and know-how. Because of the important role to be played by farmers in regular O&M of the system, and current lack of experience in cooperative water resource management, substantial resources are allocated for farmer mobilization and training.

91. In combination, these investments are expected to increase agricultural productivity, reduce farming costs, and stimulate the rural economy. It is probable that during project implementation, the skills developed therein will be used to improve the operation of other MOWRAM irrigation systems elsewhere in Kompong Thom or nearby. However, benefits resulting from the improved operation of these systems have not been included in this economic analysis.

92. The economic analysis is based on a comparison of with- and without-Project scenarios. Separate analyses were conducted for part A and part B, and for the Project as a whole. The cost and benefits streams were estimated for a 20-year period, including 6 years of Project implementation. Economic prices for the main traded inputs are based on World Bank commodity price projections, and a standard conversion factor of 0.90 was used to estimate economic values for nontraded goods.

93. The main benefits accruing from irrigation and agricultural extension include incremental rice production, yields of other crops and paddy fish. Road improvement benefits are estimated using two conservative methodologies: vehicle operating cost (VOC) savings and increased agricultural producer surpluses (APS). VOC savings result from improved road surfaces leading to less wear and tear on vehicles, and indirectly from reduced charges associated with higher vehicle utilization rates (due to reduced journey times) and less expensive modes of transport.

APS benefits result from the removal of physical constraints to the transport of bulky items such as fertilizer, and from improved seed and surplus crop production. Care has been taken to avoid double counting of agricultural benefits from roads and irrigation.

94. Market improvement and the landownership survey and titling subcomponent are expected to yield major benefits that have not been quantified. Consultants implementing the RIIP in Cambodia estimate that postharvest quality improvements resulting from better market facilities amount to 2-5 percent of the value of the crop.[19]

95. The economic costs of part A – the three components directly concerned with irrigation – are combined with the economic value of incremental agricultural production to produce a net economic cash flow over 20 years, yielding an economic internal rate of return (EIRR) of 15.0 percent. The net cash flow for rural infrastructure yields an EIRR of 32.4 percent, which is consistent with that in other ADB-funded rural road projects. The combined Project EIRR is 19.1 percent.

96. The results of the economic analysis are summarized in Table 3, and full details are presented in Appendix 11.

Table 3: Summary of Sensitivity Tests and Switching Values

	EIRR (percent)				Switching Value at 12% Discount Rate	
Activity	Base Case	Cost Increase + 10%	Benefit Reduction - 20 %	Combined Costs +10% Benefits –20%	Costs (%)	Benefits (%)
Overall	19.1	17.2	17.0	15.2		
Irrigation & Ag. Extension	15.0	13.6	13.4	12.1	27	(20)
Rural Infrastructure	32.4	29.1	28.8	25.7	94	(47)

EIRR = economic internal rate of return.

B. Social Dimensions and Impact on Poverty

97. The project beneficiaries will include farmers with land in the irrigation command area, and people living and working within the areas of influence of the project roads and markets. There is compelling evidence that the majority of the beneficiaries are poor by Cambodian standards. The 1993-1994 Socioeconomic Survey of Cambodia (SESC) provides baseline data to measure poverty in the early years following the end of the major civil turmoil. The data reveal that poverty in rural areas was highest, at 40 percent of the population. Even more striking, 46 percent of the poor are in households headed by farmers, and 75 percent are in households involved in some type of agricultural activity.[20] The more recent 1997 Cambodia Socio-Economic Survey (CSES) reveals almost no improvement in the rural areas: the incidence of poverty declined marginally to 39 percent, and rural households still accounted for nearly 90

[19] I.T. Transport Ltd. 2000. Market Rehabilitation Sub-Projects: Screening, Selection and Appraisal. Phnom Penh.

[20] Prescott, N. and M. Pradhan. 1997. A Poverty Profile for Cambodia. World Bank Discussion Paper No. 373. Washington: The World Bank.

percent of Cambodia's poor in absolute terms. These statistics are based on a poverty line of about $0.41 per person per day, which is considered the bare minimum to meet daily caloric requirements plus a nonfood allowance, and is well below the $1 per day standard used by the World Bank and UN for international comparisons. The 1997 CSES also reveals growing inequality in the distribution of income per capita, with urban areas benefiting more than rural areas from economic growth. For example, the rural contribution to the overall poverty gap has increased from 85 to 88 percent, and to the poverty severity index from 83 to 89 percent, compared with the 1993-94 survey.[21] Although province-specific data is not readily available, the 1999 Cambodia Human Development Report notes that the poorest villages in the 1997 CSES are located along Tonle Sap, an area that includes the Stung Chinit system and environs.

98. AFD's recent socioeconomic update in the project area provides a much more focused picture of the beneficiaries. AFD found that average household income is at the poverty line, and 60 percent of households surveyed reported income below the poverty line. More than one third of the households surveyed are in debt from the previous year, and half of them borrowed money to cover food shortages or pay for basic medical care. Food deficits typically occur in September and November when paddy stocks are depleted before the next harvest.

99. The link between poverty and access to water resources is well established. In Kompong Thom, lack of irrigation is a key factor in areas of chronic food insecurity. Farmers will not risk investments in better agricultural technology without reliable water supplies, and so remain vulnerable as subsistence producers. Irrigation will provide an opportunity for higher yields in the wet season and opportunities for cultivation of a second wet season rice crop, new dry season crops including vegetables and legumes, and higher fish yields in paddy areas. By assisting farmers to obtain legal title to their land, the Project will also provide a major incentive for investments in agricultural productivity. Household margins from agriculture are expected to increase accordingly, by $84-$350 per year depending on cropping intensity and access to year-round irrigation. This represents an increase in annual income of 10-40 percent for the average household surveyed by AFD, and should elevate a substantial proportion of the poor above the national poverty line. Apart from income, higher yields of rice, other crops, and fish will improve food security and increase average caloric intake. Early impacts will be captured by the socioeconomic surveys planned for the midterm and at the conclusion of the Project.

100. Benefits from roads and market improvement include lower transport costs; enhanced access to agricultural extension, health, and education services; lower prices for input purchases and higher prices for produce sales; and improved access to agricultural inputs. This will directly increase household incomes and reduce the incidence of poverty. The construction and rehabilitation of irrigation works, roads, and markets will provide substantial direct employment (about 400,000 person-days at $1 per day) for people living in the project area. A survey of ILO's ongoing rural road project in Siem Reap Province found that road rehabilitation resulted in a doubling of travel trips, 43 percent reduction in travel times, 103 percent increase in loads carried, 38 percent reduction in passenger fares, and 600 percent increase in the number of local market shops.

C. Risks

101. Even with unfavorable changes in costs and benefits, the economic returns to the rural infrastructure component are robust. The major risks associated with rural roads is inadequate maintenance. MRD fully understands the importance of careful maintenance planning, and is

[21] Ministry of Planning. 1997. *A Poverty Profile of Cambodia – 1997*. Phnom Penh.

committed to raising resources through users at the commune or village level, and through labor contributions. The WFP will assist in this regard through their food-for-work initiative already in place in Kompong Thom. It must be noted, however, that although road user committees are included in MRD's new policy on rural roads, they have not been tried in practice, and this strategy must be viewed as a pilot test in the project area. Two political initiatives planned for 2001 should facilitate the local government's ability to raise and allocate resources: commune elections and the Government decentralization of financial management and development planning through the UN-supported Seila (foundation stone) program. In addition, the project design requires the Government to shoulder a substantial share of maintenance expenditures during the investment period, while ADB has strong leverage. Future ADB investments in rural roads should also be conditional on the Government's performance on maintenance in the Project.

102. There is also a risk that inadequate maintenance of irrigation infrastructure will reverse the growth in crop yields as water supplies become less reliable. Success requires active beneficiary participation to reduce the financial burden on the Government. Therefore the Project allocates substantial resources to early and sustained investments in human capital. The economic returns to the irrigation components remain acceptable at 12.1 percent in the event of a 20 percent reduction in expected benefits and a 10 percent increase in costs. A two-year delay in benefits reduces the EIRR of this component from 15 to 12 percent. The Project faces a risk of delayed benefits—directly through slow uptake of improved agricultural technology and water management, and indirectly through implementation delays. To ensure that farmers are able to benefit quickly from irrigation, the Project includes substantial investments for agricultural extension and will work closely with established agencies that have considerable experience in Cambodian rice farming systems, including IRRI, AusAID, CARDI, and AFD.

103. A common cause of implementation delays in Cambodia is lack of qualified trained counterpart staff with experience in aid-funded projects. This should not present a serious problem for the Project, as both MRD and MOWRAM have given generally satisfactory performance in implementing ADB projects. The Project will also benefit from two new ADB-financed TAs: Capacity Building in the Ministry of Water Resources, and Strengthening External Aid Portfolio Management,[22] which will provide assistance in project and financial management to all EAs of ADB-financed projects. Provincial Implementing Agencies also have worked with bilateral sources: PDWRAM is receiving training and material resources from the World Bank, OTEE is working with AusAID to refine and expand its agricultural extension services, and PDRD is working with KfW and WFP to build roads, and with GTZ on a provincial development project.

104. Rehabilitation of irrigation infrastructure and rural roads will increase land values in the area. The situation can lead to alienation of the original inhabitants by powerful and unscrupulous interests. Although most of the inhabitants in the project area hold some type of documentation for their land issued by communal authorities, few have formal titles. For this reason, the Project includes a land registration and titling component that will commence at the outset of project implementation. The component also includes counseling and a public awareness campaign to educate current landowners about their rights and possible remedies in the event that their holdings are threatened.

[22] TA 3287-CAM: *Strengthening External Aide Portfolio Management*, for $900,000, approved on 2 November 1999.

VI. ASSURANCES

A. Specific Assurances

105. The Government has given the following assurances, in addition to the standard assurances, which have been incorporated into the legal documents:

(i) Prior to 30 June 2002, MOWRAM will establish the Stung Chinit irrigation committee (SCIC). At least 50 percent of the SCIC members, including the chairperson, will be elected representatives from the WUCs in the project area. At least 20 percent of seats on the SCIC will be reserved for women. By 30 June 2003, MOWRAM will have completed construction of a building as headquarters for the SCIC.

(ii) All environmental mitigation measures set out in the SIEE report will be incorporated in the project design and implemented: (a) the construction and testing of a fish pass structure on the Stung Chinit diversion weir, (b) periodic water quality monitoring, and (c) inclusion of IPM techniques and safety programs on pesticides and fertilizers as integral parts of farmer training programs under the Project.

(iii) All people affected by the Project because of either loss of land or loss of livelihood will be compensated in a timely manner in accordance with the ADB *Handbook on Resettlement* and compensation measures set out in the RP agreed upon between the Government and ADB. Upon completion of the detailed design of the irrigation infrastructure works, but prior to the start of construction for such works, the Interministerial Resettlement Committee will submit to ADB for approval an updated RP that identifies any other negatively affected persons in addition to those households already identified. The updated RP will be prepared in consultation with the affected persons and will specify the detailed compensation measures applicable for all affected people. An independent, qualified agency acceptable to ADB will monitor and evaluate implementation of the RP. Stakeholder monitoring groups including affected people will be established in each district to participate in the monitoring and evaluation process.

(iv) By January 2002, the Department of Cadastre and Geography will have completed a survey of ownership in respect of all land in the project area, and prepared and publicly posted cadastral index maps in all villages in the project area. By June 2002, the technical inspection of all undisputed parcels will have been completed for the adjudication record.

(v) The secondary canals and offtakes and tertiary block boundaries will be prepared in consultation with the farmers affected by such design. The overall design of the irrigation structure will be completed only after at least two thirds of the farmers along each secondary canal have approved the designs for the secondary canals and offtakes and tertiary block boundaries.

(vi) Public markets will be constructed only on existing market sites or public land that is not occupied or used otherwise by private persons. In selecting roads and markets for upgrading, the Government will take into account the views of target

beneficiaries through surveys and meetings at the village, commune, and district levels.

(vii) MOWRAM and MRD will ensure that maintenance plans are prepared for rural roads and the main irrigation canal and control structures on the basis of physical measurements of needs and agreed-upon maintenance standards. MEF will ensure that the budget will fund the full cost of the maintenance activities after project completion. The Government will apply the system and financing arrangements for routine and periodic maintenance of rural roads to be developed under the ADB-financed RIIP.

(viii) The Government will ensure that O&M of the irrigation system will be carried out in accordance with the principles of its Implementation Policy for Sustainable Irrigation Systems, and will consult ADB on any adjustments of this policy for the project area.

(ix) Before implementation of any market upgrading activities, a market committee for the market concerned will be established and market user fees determined. The composition of the market committee, its terms of office, and the market user fees will need approval from the Provincial Rural Development Committee. The market committees will be responsible for O&M of market facilities, and will finance these activities with market user fees.

B. Conditions for Loan Effectiveness

106. Prior to loan effectiveness, the following will be completed:

(i) AFD will have approved the provision of the AFD grant.

(ii) The Government will have approved a Resettlement Plan, satisfactory to ADB, and established the Stung Chinit resettlement subcommittee.

(iii) Project implementation units for each part of the Project will have been established and project managers appointed.

VII. RECOMMENDATION

107. I am satisfied that the proposed loan would comply with the Articles of Agreement of ADB and recommend that the Board approve the loan in various currencies equivalent to Special Drawing Rights 12,183,000 to the Kingdom of Cambodia for the Stung Chinit Irrigation and Rural Infrastructure Project, with a term of 32 years, including a grace period of 8 years, and with an interest charge at the rate of 1 percent per annum during the grace period and 1.5 percent per annum thereafter, and such other terms and conditions as are substantially in accordance with those set forth in the draft Loan Agreement presented to the Board.

TADAO CHINO
President

11 August 2000

APPENDIXES

SUPPLEMENTARY APPENDIXES
(available on request)

PROJECT FRAMEWORK

Design Summary	Verifiable Indicators	Means of Verification	Assumptions/Risks
Goals			
Reduce poverty through sustained socioeconomic growth in Kompong Thom Province	• Increased farmer incomes and economic activity in Baray and Santuk districts • Increased wet season paddy production, established dry season paddy production, established diversified dry season crops • Reduced production, transport, and marketing costs	• benefit monitoring and evaluation (BME) surveys, Project Completion Report (PCR) • BME surveys, progress reports; agronomic observation; local district-level agricultural statistics, PCR • BME surveys, PCR	• There are no major problems due to natural disasters. • Target beneficiaries will not be alienated from their land. • Implementation capacity of Government is adequate.
Purpose			
Increased incomes and improved quality of life in Kompong Thom Province through provision of sustainable irrigation, agricultural extension, and rural infrastructure (roads and markets)	• Farmer incomes increased by 10-40% by 2007 depending on access to dry season water. • Wet season paddy yields increased from 1.3 to 3.0 tons per hectare (t/ha) by 2007; dry season paddy production developed over 1,500 ha by end-2003; diversified dry season crops developed over at least 500 ha mid-2005. • Farmer operation and maintenance (O&M) of secondary canals and drains • Average farm-to-market transport costs are reduced by 40% by 2004.	• Progress reports, review missions, BME surveys	• Price of rice and inputs and other variables remain within ranges used in economic and financial analyses. • Stream flow discharges and rainfall are sufficient for command area. • Farmers show willingness and capacity for system management. • Government policies on O&M are implemented.

Design Summary	Verifiable Indicators	Means of Verification	Assumptions/Risks
Outputs			
Farmers organized and trained			
• Landownership survey and titling completed	• Public awareness campaign on land rights completed by June 2001; landownership survey completed by end-2001; undisputed title applications documented and submitted by June 2002	• Progress reports, review missions • BME surveys	• Survey and titling can be completed before land alienation occurs.
• Water user groups (WUGs) and water user communities (WUCs) organized, trained, and granted legal status	• About 140 WUGs (each with 50+ farmers) and 20 WUCs comprising WUG elected representatives established and trained by end-2002; WUC's O&M fund established by end 2003		• Farmers are enthusiastic for collective action; leadership of WUGs and WUCs is strong.
• Agriculture extension services delivered	• About 20 commune/village-level extension agents trained by June 2002; extension materials and farmer field schools provided throughout the project period		• Coordination between agriculture and irrigation activities is adequate. Adoption of improved agricultural practices is timely.
Irrigation infrastructure developed with input from farmers	• 66% of farmers sign off on designs for secondary canals and drains, offtakes.	• Progress reports, review missions	• Full consultations are possible within the design period.
	• Irrigation and drainage facilities covering 2,000 ha operating by end-2003, remaining 5,000 ha by September 2005	• Civil works contract requirement to use local labor in project area, or WUGs contracted directly	• Engineering quality control will be adequate.
	• Tertiary canals and drains constructed by farmers with technical assistance from the Project		• WUGs are able to agree on tertiary distribution system and cooperative work arrangements.

Design Summary	Verifiable Indicators	Means of Verification	Assumptions/Risks
Irrigation system management in place and functioning	• Stung Chinit Irrigation Committee (SCIC) established and functioning by end-2002 • WUCs trained to manage secondary canal headworks and organize maintenance by WUGs by mid-2003 • 20 Provincial Department of Water Resources and Meteorology (PDWRAM) and 5 Ministry of Water Resources and Meteorology (MOWRAM) technicians and engineers trained by end-2002	• Progress reports; review missions • BME surveys	• Government is willing to share management responsibility with farmers. • WUGs and WUCs are able to raise sufficient resources, including labor, for regular O&M. • There is retention of trained counterpart staff; transfer of knowledge from consultants is adequate.
Rural infrastructure developed using labor-based methods	• 150 km of rural roads upgraded and six rural markets improved and run by market user committees • 400,000 person-days of employment generated	• Progress reports, review missions, Project Completion Report (PCR)/Project Performance Audit Report (PPAR) • BME survey/PCR/PPAR	• Supply of local labor willing to participate is adequate.
Activities/Inputs			
Organization and training of farmers, land titling, agriculture extension	$2.8 million • 22 person-months of international and 156 of domestic consultants comprising irrigation institutional specialists and agronomists • Local nongovernment organizations (NGOs) for mobilization and training	• Progress reports, review missions	• Consultants are procured and fielded on time.

Design Summary	Inputs	Means of Verification	Risks/Assumptions
Development of irrigation infrastructure • Organize project implementation unit (PIU) at PDWRAM • Recruit consultants • Make surveys, investigations, and detailed design • Rehabilitate irrigation and drainage structures	$12.6 million • Predesign surveys and investigations of structures • 60 person-months of international and 186 of domestic consultants, comprising engineers for hydrological modeling, irrigation, and drainage design, structural design, contracting, and supervision; fisheries specialist, project accountants • Office space, support staff, equipment, vehicles	• Progress reports, review missions	• Consultants are procured and fielded on time. • Counterpart staff and budget are adequate.
Development of system management institutions and capacity • Establish Stung Chinit irrigation committee (SCIC) with full-time engineering staff; train farmer members • Develop and implement O&M plans for WUCs and WUGs • Test and implement O&M fund	$1.2 million • 17 person-months of international and 16 of domestic consultants for system water management and on-farm water management • SCIC headquarters and meeting halls for WUCs • Training of SCIC members, O&M manuals • Vehicles	• Progress reports, review missions	• Consultants are procured and fielded on time. • Counterpart staff and budget are adequate.
Development of rural infrastructure • Organize PIU at Provincial Department of Rural Development (PDRD) • Improve 150 km of roads • Rehabilitate 6 markets	$6.3 million • 15 person-months of international and 60 of domestic consultants comprising a roads engineer, rural infrastructure engineer, and social organizer • Office space, support staff, equipment, vehicles	• Progress reports, review missions	• Consultants are procured and fielded on time. • Counterpart staff and budget are adequate.

EXTERNAL ASSISTANCE FOR AGRICULTURE AND RURAL DEVELOPMENT
1995 – 1999

Source	Project Title	Amount ($ million)		Period
		Grant	Loan	
ADB	Special Rehabilitation Assistance	-	67.7	1992-1997
	Rural Infrastructure Improvement	-	25.1	1996-2002
	Rural Credit Review	0.1	-	1996-1997
	Agriculture Sector Program	-	30.0	1996-2000
	Agricultural Policy Reform Support	1.5	-	1996-1999
	Stung Chinit Water Resource Development	0.9	-	1996-1999
	Capacity Building in the Ministry of Water Resources	0.9	-	1999-2000
Australia	Cambodia-Australia IRRI Project	14.0	-	1988-2001
	Cambodia-Small Activities Scheme	1.4	-	1992-1999
	Cambodia-Australia Agricultural Extension Project	7.3	-	1997-2002
	CCDP-ADRA Siem Reap Diversified Agriculture	0.5	-	1996-1999
	Combating Poverty - Battambang	0.8	-	1996-1999
	CCDP-IWDA Food For Change Project	0.7	-	1996-1999
	Agriculture Quality Improvement Project	9.0	-	1999-2004
Canada	Canada Fund for Local Initiatives	0.3	-	1996-1997
	Cambodia-Canada Development Program (Phase 1)	3.7	-	1997-2002
Denmark	Integrated Agricultural Development Project	0.7	-	1995-1997
EU	Support Programme for the Agriculture Sector	43.5	-	1994-1998
	Support Programme for the Agriculture Sector (Phase 2)	40.0	-	1999-2003
FAO	Agricultural Information Center	0.2	-	1996-1997
	Implementation of Integrated Pest Management in Rice	0.4	-	1995-1997
	Food Security for Poverty Alleviation Strategy	0.2	-	1997-1998
	Special Programme on Food Security	0.3	-	1998-2001
France	Support for NGOs	1.0	-	1992-1999
	Integrated Rural Development in Pursat Province	1.6	-	1993-1997
	Support for Agricultural Policies and Education	2.5	-	1994-1997
	Funds for Rural Credit Schemes (UNICEF)	0.4	-	1994-1997
	Funds for Rural Credit Schemes (GRET)	0.7	-	1994-1997
	Rural Credit Training	1.4	-	1996-1997
	Support for Rehabilitation and Development of Polders	8.0	-	1996-2003
	Financing of Two Projects in Rural Credit	0.6	-	1997
	Agricultural Development in Peripheral Areas of Siem Reap	2.0	-	1997-2000
	Rural Credit Programme	4.3	-	1998-2001
Germany	Self-help Funds	2.3	-	1995-1998
	Tertiary Roads in Kompong Thom and Kompong Cham	8.0	-	1995-2002
	Land Management Project	3.2	-	1995-2002
	Food Security in Kampot Province	3.8	-	1996-1997
	Provincial Development Program for Kampong Thom	12.0	-	1996-2007

Source	Project Title	Amount (US$ million)		Period
		Grant	Loan	
ILO	Baray Irrigation Management	0.5		1999-2003
Japan	Colmatage Canal Improvement Project	9.9		2000-2001
	Technical Service Center for Irrigation Systems	1.0		2001-2005
Netherlands	Labor-based Infrastructure Development	6.9	-	1992-1997
	Small Enterprise and Informal Sector Production	1.2	-	1992-1997
	CARERE Area Development	2.6	-	1996-1997
Sweden	Labor-based Infrastructure Works	4.4	-	1998-2000
Thailand	Community Development Center	1.0	-	1996-1997
UNDP	Labor-based Infrastructure Development	4.1	-	1991-1997
	Vocational Training for Employment Generation	5.3	-	1992-1997
	CARERE II	21.7	-	1996-2001
	Rural Credit	0.5	-	1994-1997
	Food Security for Poverty Alleviation Strategy	0.2	-	1997-1998
	Natural Resource Based Development for the Tonle Sap Area	1.0	-	1996-1998
UNICEF	Community Action for Social Development	10.4	-	1996-2000
World Bank	Emergency Rehabilitation Credit - Agriculture	-	2.5	1994-1997
	Social Fund	-	19.5	1995-1999
	Social Fund II	-	25.0	1999-2003
	Agriculture Productivity Improvement	-	27.5	1998-2002
World Food Programme	Protracted Relief and Recovery Operation	41.0	-	1999-2000

ADB = Asian Development Bank, EU = European Union, FAO = Food and Agriculture Organization, ILO = International Labour Organization, UNDP = United Nations Development Programme, UNICEF = United Nations Children's Fund.
In case of cofinanced projects, the lead agency is indicated.
Source: Council for the Development of Cambodia, Royal Government of Cambodia.

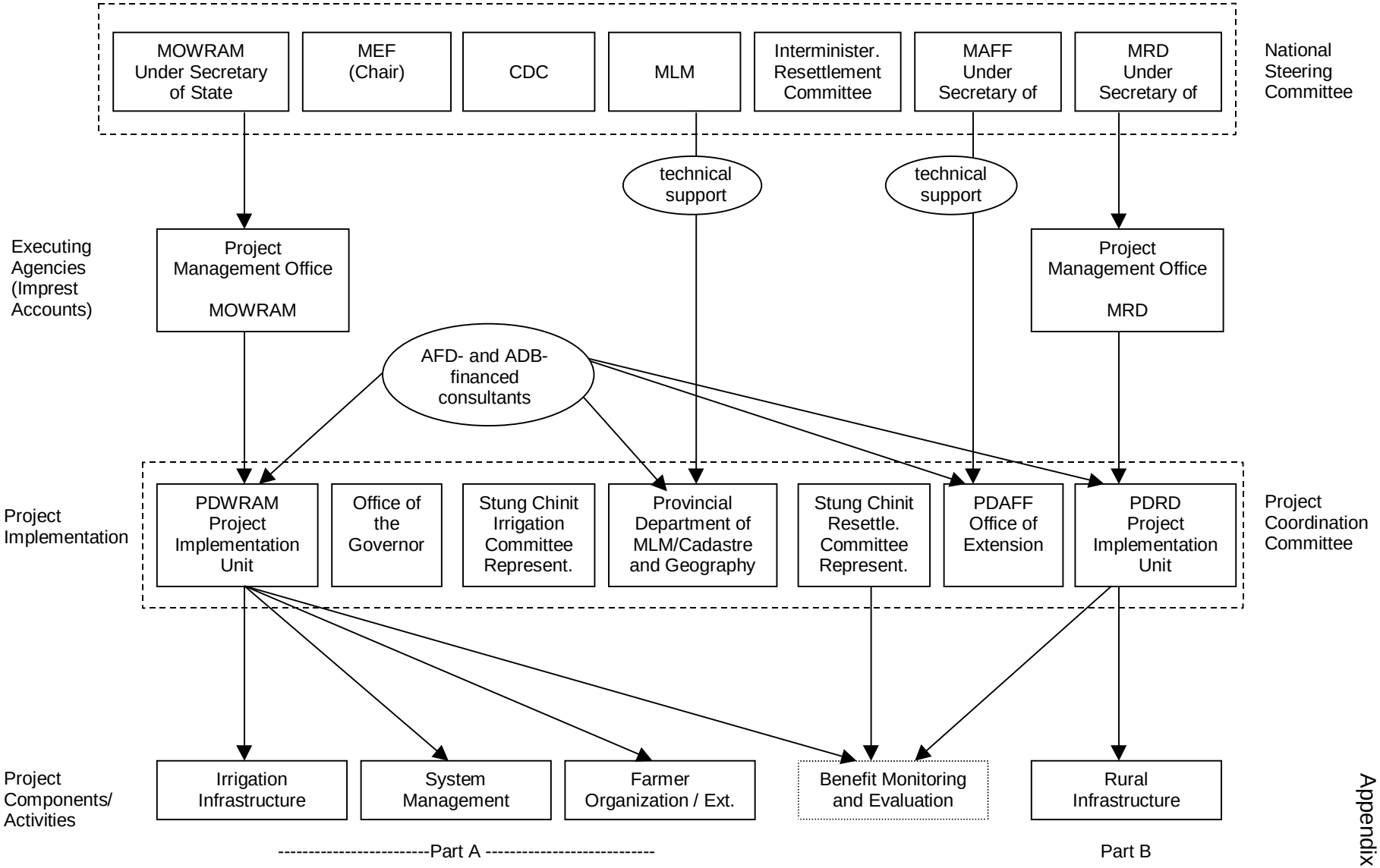
Appendix 3

DETAILED COST ESTIMATES
($ '000)

Item	Part A: Irrigated Agriculture Development			Part B: Rural Infra-structure	Total Cost
	Farmer Org. and Extension	Irrigation and Drainage Infra-structure	Irrigation System Mgt.		
A. Investment Costs					
1. Civil Works	61.8	7,870.5	125.9	3,568.6	11,626.8
2. Consulting Services	940.3	2,009.1	480.1	511.2	3,940.7
3. Other Technical Services	723.1	510.6	96.2	101.7	1,431.6
4. Training	279.1	46.9	144.2	38.2	508.5
5. Resettlement and Compensation	-	356.9	-	-	356.9
6. Vehicles	145.3	143.1	58.8	104.2	451.4
7. Equipment and Supply	413.0	468.7	108.9	361.5	1,352.1
8. Incremental Admin. Cost	257.4	860.7	185.2	682.4	1,985.7
Subtotal (A)	**2,820.0**	**12,266.5**	**1,199.3**	**5,367.8**	**21,653.7**
B. Recurrent Costs	**-**	**298.8**	**-**	**919.5**	**1,218.3**
Total Project Cost	**2,820.1**	**12,565.4**	**1,199.2**	**6,287.3**	**22,872.0**
Interest Charges					911.5
Total Costs to be Financed					**23,783.5**

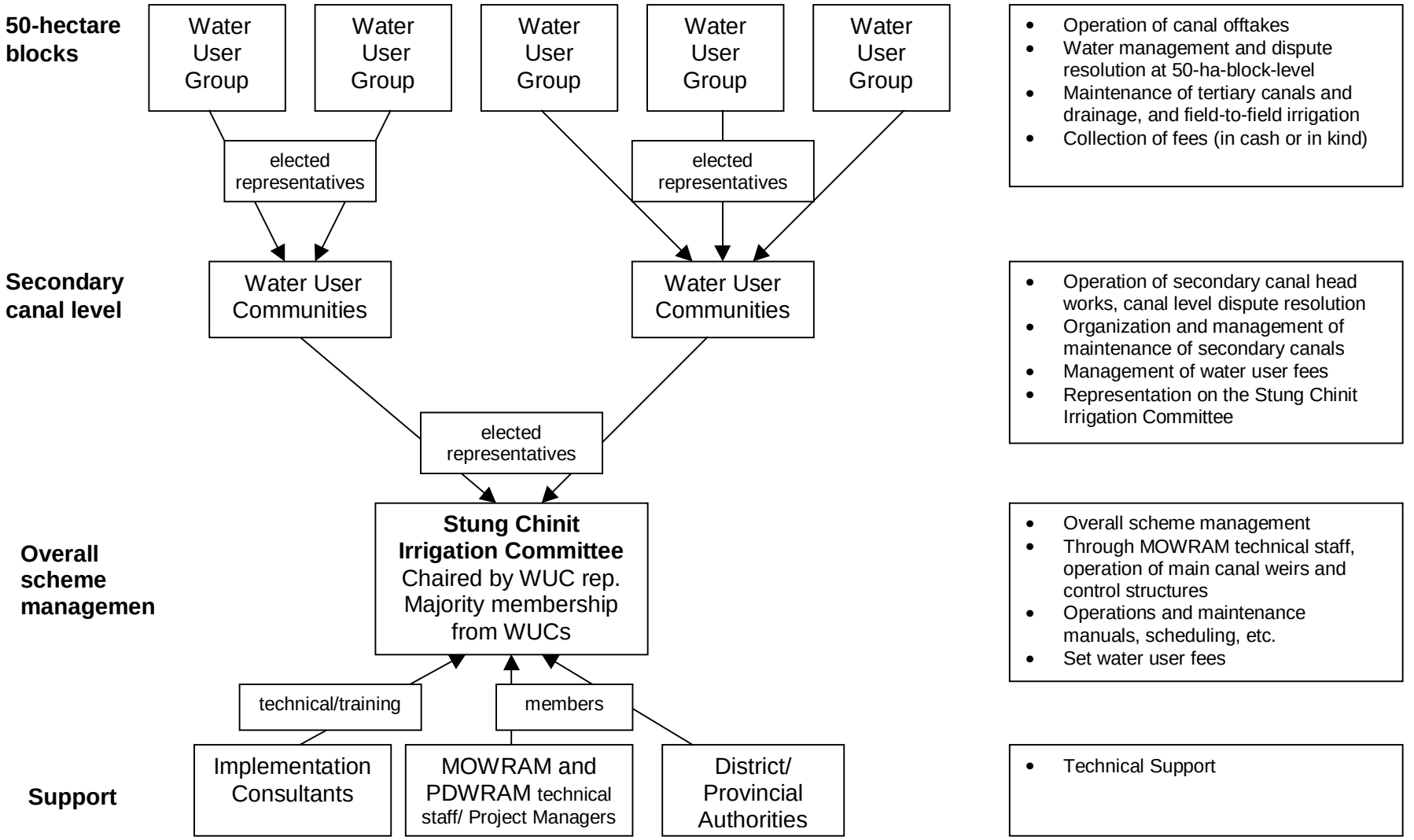
Source: Staff estimates.

PROJECT ORGANIZATION AND COORDINATION



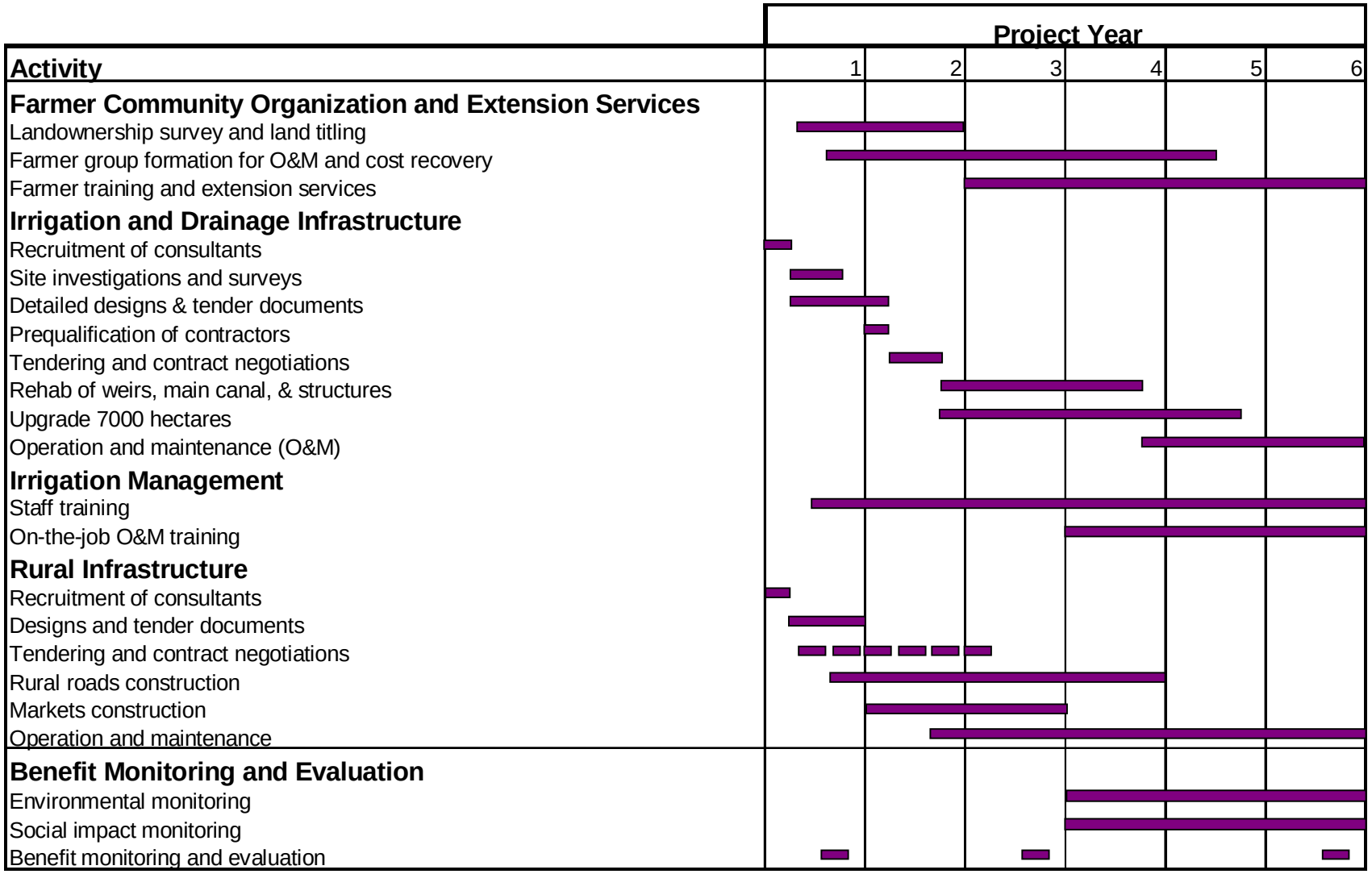
ADB = Asian Development Bank, AFD = Agence Française de Développement, CDC = Council for the Development of Cambodia, MAFF = Ministry of Agriculture, Forestry and Fisheries, MEF = Ministry of Economy and Finance, MLM = Ministry of Land Management, Urban Planning and Construction, MOWRAM = Ministry of Water Resources and Meteorology, MRD = Ministry of Rural Development, PDAFF = Provincial Department of Agriculture, Forests and Fisheries, PDRD = Provincial Department of Rural Development, PDWRAM = Provincial Department of Water Resources and Meteorology.

SYSTEM MANAGEMENT ARRANGEMENTS



MOWRAM = Ministry of Water Resources and Meteorology, PDWRAM = Provincial Department of Water Resources and Meteorology, WUC = water user community, WUG = water user group.

IMPLEMENTATION SCHEDULE



CONTRACT PACKAGES
(Unit: $'000 equivalent)

	Procurement Method							
	International Competitive Bidding	National Competitive Bidding	International Shopping	Direct Contracting	Force Account	Consulting Services	NBF (RGC, AFD, Beneficiaries	Total
Civil works (Part A)	4,942.3	1,321.0	-	-	1,665.8	-	427.9	8,357.0
	(4,026.5)	(948.1)			(1,175.2)			(6,149.8)
Civil Works (Part B)	-	2,905.9	-	-	1,582.2	-	-	4,488.1
		(1,997.6)			(1,176.9)			(3,174.5)
Vehicles (Part A)	-	-	157.4	44.5	-	-	145.3	347.2
			(81.8)	(34.3)				(116.1)
Vehicles (Part B)	-	-	77.7	26.6	-	-	-	104.2
			(40.4)	(20.5)				(60.9)
Equipment & Supply (Part A)	-	-	349.7	-	-	-	-	349.7
			(266.2)					(266.2)
Equipment & Supply (Part B)	-	-	284.4	77.2	-	-	-	361.5
			(213.7)	(61.7)				(275.4)
Equipment & Supply - Local (Part A)	-	-	-	697.5	-	-	636.9	1,334.4
				(558.0)				(558.0)
Equipment & Supply - Local (Part B)	-	-	-	355.2	-	-	-	355.2
				(284.2)				(284.2)
Consulting Services (Part A)	-	-	-	-	-	3,151.6	1,357.2	4,508.8
						(2,605.4)		(2,605.4)
Consulting Services (Part B)	-	-	-	-	-	612.8	-	612.8
						(520.9)		(520.9)
Other Technical Services (Part A)	-	-	-	129.3	125.2	-	51.6	306.2
Other Technical Services (Part B)	-	-	-	-	-	-	-	
Training (Part A)	-	-	-	135.5	-	-	279.1	414.6
				(135.5)				(135.5)
Training (Part B)	-	-	-	38.2	-	-	-	38.2
				(38.2)				(38.2)
Resettlement and Compensation (Part A)	-	-	-	-	-	-	356.9	356.9
Incremental Administrative Cost (Part A)	-	-	-	-	576.4	-	33.5	609.9
					(576.4)			(576.4)
Incremental Administrative Cost (Part B)	-	-	-	-	327.1	-	-	327.1
					(327.1)			(327.1)
Total	4,942.3	4,226.9	869.1	1,504.0	4,276.7	3,764.5	3,288.5	22,872.0
	(4,026.5)	(2,945.8)	(602.2)	(1,132.3)	(3,255.5)	(3,126.4)	-	(15,088.6)

NBF = Non-Bank Financing

Note: Figures in parenthesis are the respective amounts financed by the Asian Development Bank (ADB).

OUTLINE TERMS OF REFERENCE FOR CONSULTING SERVICES

1. Over the six-year period of project implementation, 114 person-months of international consulting services and 418, domestic, will be required (Table A8). Detailed terms of reference are presented in Supplementary Appendix G.

Table A8: Summary of Consulting Services

Expertise	Person-months	
	International	Domestic
Part A		
I. Farmer Community Organization and Extension [a]		
Irrigation Institutional Specialists	15	108
Irrigation Agronomists	7	48
II. Irrigation and Drainage Infrastructure		
A. Predesign Survey and Investigations (subcontract)		
B. Detailed Design Phase		
Irrigation and Drainage Engineer/Team Leader	20	
Water Resources Engineer/Hydraulic Modeler	4	4
Structural Engineers	2	4
Hydraulics/Irrigation and Drainage Design Engineers	6	12
Fisheries Specialist	1	
Contracts Engineer	2	
C. Project Supervision Phase		
Chief Resident Engineer/Resident Engineers	23	60
Contracts Engineers	2	36
Irrigation and Drainage Design Engineer		18
Field Engineer for Labor-Based Work		24
Project Accountant		28
III. System Management Training		
Water Management Engineer/On-Farm Water Management Specialists	17	16
Part B		
IV. Rural Infrastructure		
Road Engineer/Team Leader	13	
Training Specialist	2	
Rural Infrastructure Engineer		42
Socioeconomist/Social Organizer		18
TOTAL FOR PROJECT	**114**	**418**

[a] Agence Française de Développement has expressed its intention to finance this component, including consulting services.

I. Farmer Community Organization and Extension

2. **Irrigation Institutional Specialists** (1 international, 15 person-months; 2 domestic, 54 person-months each). The specialists will, in close coordination with the team leader, (i) coordinate and guide the formation and training of farmer water user groups; (ii) define the appropriate institutional framework and management practices of the institutions to be established; (iii) determine special measures that need to be taken to ensure full farmer participation in managing and operating the Stung Chinit project, especially the participation of women heads of households and other vulnerable groups; (iv) define appropriate consultation procedures with beneficiaries for establishing water user institutions and for system design to facilitate the envisaged water allocation; (v) conduct farmer workshops at the village level to elicit feedback on the system design and the planned extent of farmer involvement in scheme management; (vi) work with and monitor the functioning of the water user groups (WUGs), water user committees (WUCs), and the Stung Chinit Irrigation Committee (SCIC); (vi) design together with farmers an equitable and acceptable method of assessment and payment of irrigation service fees for dry season water and calculate possible fee levels and structure; (vii) identify international training needs and organize regional study tours for SCIC members to neighboring countries with successful participatory water resource management regimes.

3. **Irrigation Agronomists** (1 international, 7 person-months over 4 years; 1 domestic, 48 person-months). The specialists will (i) provide technical expertise on agronomy for irrigated conditions for improved yields, adapt existing extension materials to the agroecological conditions in the project area, and coordinate the research activities of Cambodia Agriculture Research Development Institute (CARDI); (ii) assess and make recommendations on (a) wet season and dry season agricultural practices during the first year of scheme operation; (b) sources of seed, fertilizer, credit, animal power and other inputs and take steps to facilitate their availability within the project area, (c) water management practices during dry season irrigation, (d) tertiary canal and drain rehabilitation requirements and role of the project implementation unit (PIU) and consultants in assisting and advising farmers on tertiary works; and (iii) ensure that all farmers as well as women heads of farming households identified as negatively affected persons in the Resettlement Plan (RP) receive agronomic advice on a priority basis.

II. Irrigation and Drainage Infrastructure

A. Predesign Survey and Investigations

4. **Orthophotomapping with Contours in Command Area and Inundated Areas**. A local contract package, to be included in the responsibilities of the implementation consultant, to locate and determine benchmark values in the project area with the Indian Datum 1960, and document—using dimensioned sketches—their locations and the source from which their values were obtained. Also, prepare an orthophotomap, scale 1:10,000, of the 12,000 hectare project area and of the maximum potentially inundated area to the east of the main canal, and submit this information to the Stung Chinit resettlement subcommittee and advise on the extent of further surveys needed to identify negatively affected persons for the updated RP.

5. **Investigations of Main Diversion Weirs at Stung Chinit and Stung Tang Krasang**. To be the responsibility of the implementation consultant, and estimated to cost $200,000. This work is to be carried out during the dry season at low river flows so as to limit the height of the cofferdam to be constructed. A local organization will be subcontracted to identify and remove unexploded ordnance in the vicinity of the two weirs and produce a detailed report describing and quantifying conditions beneath the weirs and the implications for structural repairs.

B. Detailed Design Phase

6. **Team Leader/Irrigation and Drainage Engineer** (1 international, 20 person-months). The specialist will (i) coordinate the activities of all team members, (ii) steer the project design phase, (iii) ensure full participation of target beneficiaries by developing a program for farmer consultations during the design process, (iv) liaise with MOWRAM and other Government officials, and (v) provide technical and managerial quality control.

7. **Water Resources Engineer/Hydraulic Modeler** (1 international, 4 person-months; 1 domestic, 4 person-months). The specialists will determine the necessary design aspects for flood protection of the diversion weirs (spillway) and main canal cross-drainage structures, and conduct hydrological modeling for the canal distribution system as an input to the work of the hydraulic engineer.

8. **Structural Engineers** (1 international, 2 person-months; 2 domestic, 2 person-months each). The specialists will determine repairs required for existing structures and undertake structural design for rehabilitation and for new structures.

9. **Hydraulics/Irrigation and Drainage Design Engineer** (1 international, 6 person-months; 1 domestic, 12 person-months). The specialists will (i) determine necessary changes to existing structures to protect them from passing floods, as calculated by the water resources engineer; (ii) calculate the dimensions of new and rehabilitated structures to ensure that they fulfill their water conveying requirements; (iii) prescribe the requirements and prepare guidelines for system operation and maintenance; and (iv) prepare guidelines/typical designs for tertiary canals and drains.

10. **Fisheries Specialist** (1 international, 1 person-month). The specialist will (i) undertake detailed design of the proposed vertical slot fish pass structure at the Stung Chinit diversion weir; (ii) assist with design of secondary canals to ensure that provision is made for fish traps at locations that will not interfere with hydraulic functioning of distribution structures; (iii) advise on the setting up of procedures for monitoring of fish movements and the effectiveness of the fish pass and secondary canal structures in fulfilling their intended functions.

11. **Contracts Engineer** (1 international, 2 person-months). The specialist will assist the PIU to (i) prepare prequalification documents for contractors and, after approval by Ministry of Water Resources and Meteorology (MOWRAM) and ADB, issue documents to applicants for prequalification; (ii) receive applications and recommend contractors for prequalification; (iii) prepare conditions of contract, specifications, and tender documents for contractor procurement; (iv) issue and evaluate tender documents and prepare recommendations for selection of contractors; (v) assist MOWRAM with contract negotiations; and (vi) prepare contract documents on the basis of tender documents, working drawings, and any modifications agreed upon during contract negotiations.

C. Project Supervision Phase

12. **Chief Resident Engineer/Resident Engineers** (1 international, 23 person-months over 3 years; 2 domestic, each for 30 person-months over 3 years). The specialists will (i) assess methodologies and proposals submitted by the civil works contractor; (ii) provide technical supervision of the main civil works contract; (iii) monitor the performance of contractor and set up quality assurance procedures; (iv) prepare interim and final certificates for contractor payments on the basis of measured quanitities of work completed; (v) assist the PIU and the

SCIC in taking over any works from the contractor to be completed during the defects liability period; and (vi) supervise small-scale earthworks contracts to be executed by WUGs and WUCs, including training of nongovernment organizations or WUC representatives in quality control and monitoring.

13. **Contracts Engineer** (1 international, 2 person-months; 1 domestic, 36 person-months). Provision should be made for intermittent assistance from a contracts engineer during the construction supervision phase, to cover requests by resident staff for information and advice relating to specialized aspects of contract administration such as special claims or complex variations. A domestic specialist should be present full-time during the construction period to process contractors' interim and final payment applications and provide certification as appropriate. Many tens of WUG earthworks contracts will be running simultaneously in addition to the international contract, and all contracts will require close administrative supervision.

14. **Irrigation and Drainage Design Engineers** (1 domestic, 18 person-months over 3 years). Provision should be made for intermittent assistance from design engineers during the construction supervision phase, to cover requests by resident staff for information and advice relating to specialized aspects of design involving, for example, reference to the original calculations, changes due to different circumstances, or assessment of design aspects of proposals for alternative construction submitted by the contractor. The design engineers will be able to undertake modifications to designs as necessary to reflect changed conditions since tender designs were prepared, or to reflect revised requirements.

15. **Field Engineer for Labor-Based Work** (1 domestic, 24 person-months). The specialist will assist the PIU to (i) conduct necessary survey, design, and costing of the Project's earthworks to be constructed under labor-based appropriate technology (LBAT); (ii) ensure sufficient consultation with the concerned WUCs and WUGs during the design process, with the assistance of consultants under the farmer community organization and agricultural extension component; (iii) prepare contracts with WUCs, WUGs, and/or local contractors for these earthworks; and (iv) effectively supervise the WUCs, WUGs, and contractors for acceptable performance to predetermined standards.

16. **Project Accountant** (1 domestic, 28 person-months). The specialist will (i) keep records of project expenditures; (ii) prepare quarterly and annual reports on project costs and projections; (iii) monitor payments to the main civil works contractor and WUGs contracted to carry out simple labor such as earthworks on secondary canals; (iv) maintain cash and bank accounts for implementing consultants' operations; and (v) assist the irrigation PIU with accounting matters, especially financial planning for project activities and financial analysis for monitoring purposes and to assist review missions.

III. System Management Training

17. **Water Management Engineer/On-Farm Water Management Specialists** (1 international, 17 person-months over 4 years; 1 domestic, 16 person-months over 4 years). The specialists will (i) conduct training and system optimization, including formulation of recommendations for operational design modifications, based on experience gained in managing the system; (ii) assist MOWRAM and WUGs in making optimum use of the irrigation and drainage infrastructure for improved water management; and (iii) provide information and training to staff and representatives of WUGs and WUCs in operation and maintenance of the system.

IV. Rural Infrastructure

18. **Road Engineer/Team Leader** (1 international, 13 person-months over 4 years). The specialist will assist the PIU to (i) identify appropriate designs for the roads in the project area and the best means of contracting and implementing road construction; (ii) identify staffing arrangements and lines of responsibility for subproject identification, implementation, and monitoring to implement the subprojects using LBAT; and (iii) identify and pre-qualify local contractors capable of undertaking road and market construction works and make recommendations to project supervision consultants on design changes for future phases of the work.

19. **Training Specialist** (1 international, 2 person-months). The specialist will be identified, called upon, and supplied by the consulting firm as and when training needs are identified and training courses are organized. The subject matter may include, (i) identification, evaluation, and supervision of subprojects; (ii) labor-intensive construction of rural roads; (iii) surfacing of rural roads using alternative materials, (iv) quality control of construction and maintenance works, and (v) financial administration of subprojects assisted by ADB.

20. **Rural Infrastructure Engineer** (1 domestic, 42 person-months over 4 years). The specialist will assist the PIU in (i) subproject identification, screening, and planning, providing guidance to the engineering and environmental assessments including design, costing, and survey for rural roads and markets; (ii) supervision of construction operations, ensuring that the technical team under the PIU can effectively supervise the contractors and laborers for acceptable performance to predetermined standards; and (iii) operating the progress monitoring system of the Project.

21. **Socioeconomist/Social Organizer** (1 domestic, 18 person-months over 3 years). The specialist will assist in (i) subproject identification and screening, providing guidance in the socioeconomic assessment of subprojects; (ii) establishment of a market committee in each of the rural market subprojects and a mechanism for setting user fees to cover routine and periodic operation and maintenance; (iii) development of rights, roles, and responsibilities of market users and members of the market user committee internally and vis-à-vis district or commune councils relevant to the concerned market.

SUMMARY INITIAL ENVIRONMENTAL EXAMINATION

A. Introduction

1. This appendix presents the Summary Initial Environmental Examination (SIEE) of activities prescribed under the Stung Chinit Water Irrigation and Rural Infrastructure Project. It identifies potential environmental impacts of the Project and recommends mitigation and monitoring measures during implementation.

2. This SIEE is based on information provided in the final Environmental Impact Assessment of the Stung Chinit Water Resources Development Project,[1] two follow-up fisheries studies, field visits, and a detailed census of households that may be negatively affected. It follows the IEE procedures set out in the *Environmental Guidelines for Selected Agricultural and Natural Resources Development Projects, Environmental Assessment Requirements,* and *Environmental Review Procedures of ADB.*

B. Description of the Project

3. The Project is an integrated rural development project with substantial investments in water resources development, rehabilitation of rural roads and markets, training of farmers for long term management of the irrigation scheme and development of farmer water user groups to ensure sustainability of the project.

4. The Project has a broad and multisectoral approach to stimulate the rural economy and includes components for (i) farmer organization, training, and extension services, (ii) rehabilitating and upgrading irrigation infrastructure; (iii) developing farmers' irrigation management skills and operation and maintenance (O&M) systems; and (iv) upgrading rural infrastructure such as markets and farm-to-market roads.

5. The Project will be one of the larger irrigation development projects undertaken in Cambodia in recent times. Monitoring the progress and its implementation will give us information on the development process, the process of capacity building and training of local staff, monitoring the effects of the project on the project area and on the surrounding area. It will also assist in building the capacity of the Ministry of Water Resources and Meteorology (MOWRAM), the Executing Agency, should a second phase be considered.

6. The project was initially assigned environment category A because of the inclusion of a dam and reservoir, but was reclassified as category B with the deletion of the dam component.

7. The Project covers a gross area of about 10,000 hectares (ha) in Kompong Thom, about 150 kilometers (km) north of Phnom Penh on the eastern edge of the Great Lake (Tonle Sap). The province is one of the poorest in Cambodia and, due to its location on the frontline of an internal security conflict, has missed out on even the modest growth that has occurred in other parts of the country in the past decade. The province has few natural resources upon which to base economic and social development. Much of the population is made up of subsistence or semisubsistence rice farmers, dependent on one low-yielding wet season rice crop per year, with diet and income supplemented by capture fisheries and some livestock production. In the wet season, because of the wet climate and low-lying terrain, few crops other than rain-fed rice can be grown. In the dry

[1] The Environmental Impact Assessment completed in December 1997 was based on the original project concept that included a storage dam and reservoir in addition to the rehabilitation of the irrigation system.

season the situation is even more intractable. Without irrigation nothing can be grown, and most of the agricultural areas lie fallow. Irrigation can dramatically change the situation, by permitting multiple rice crops. In addition, providing irrigation opens the possibility of growing higher value crops and will encourage rice farmers to invest in improved rice production technologies. Thus, harnessing the waters of the Stung Chinit and its tributary, the Stung Tang Krasang, will stimulate the rural economy and increase incomes for one of the poorer sections of the country's population.

C. Description of the Environment

8. During the Pol Pot regime in the mid-1970s, many diversion weirs, irrigation canals, and water control structures were built. Many of the structures were poorly planned and designed and did much damage to the rice ecosystem of ancient Cambodia. The structures on the Stung Chinit and Stung Tang Krasang are an exception, and functioned for a period from 1978 to 1989, when a large flood forced the Government to breach the embankment south of the weir to protect it from collapse.

1. Physical Resources

9. The Stung Chinit project area is located in the central province of Kompong Thom. The proposed command area is predominantly a savanna floodplain, comprising the northeastern fringe of the Tonle Sap floodplain at an altitude of 10-20 meters (m), while the river's headwaters reach altitudes of 100 m. A few scattered hills are found in the catchment area.

10. Kompong Thom experiences a typical monsoon climate with the major proportion of rainfall during the warmer months of May through October. Rainfall varies between 1,750 and 2,000 millimeters, the higher figure attained in the upper catchment area. The prevailing pattern in the Stung Chinit area is that the majority of rainfall events are short storms of high intensity lasting from 1 to 3 hours, which take place over a very small area. The Stung Chinit is one of the tributaries of the Tonle Sap River, and has a total catchment area of some 4,2000 square kilometers (km^2) (measured up to the Stung Chinit diversion weir). Downstream of the command area, the Stung Chinit forms an extensive floodplain-cum-delta system with numerous creeks, braided waterways, and permanent waterbodies such as oxbows and marshes. The highest reported flooding events reported by farmers in the project area occurred in 1931, 1942, 1944, 1953, 1979, and 1994. Longer duration typhoons during the southwest monsoon caused most of these flooding events although the largest flood was caused by the northeast monsoon. The 1 in 100 year and the 1 in 10,000 year floods flowing into Stung Chinit upstream of the Bangki Tanggren have been estimated at 2,400 and 10,000 cubic meters/second, respectively.

11. It is estimated that the specific yield of groundwater in the area is small and is assumed to range from 15 to 50 cubic meters (m^3)/day/m. For the area, the yield of the aquifer was calculated at 360-800 m^3/day/km^2, depending on the radius of influence. A second estimation was made by using the water balance model for the area, which yielded 1.4 million cubic meters/year/km^2, equivalent to 380 m^3/day/km^2. Therefore, prospects of irrigation from groundwater resources are limited although it is expected that recharge and yields would increase with the rehabilitation of the irrigation system in the area. Many households have private wells, especially along the main road, but few are equipped with pumps. Groundwater-based irrigation during the dry season from high-yield wells does not seem to have much scope.

12. The Tonle Sap is Asia's largest freshwater lake and is of outstanding international importance for its rich natural resources. The lake has been under consideration for UNESCO designation as a World Heritage Site. The lake acts as a storage basin—or outlet—for the Mekong River during the monsoon season. By mid-June, the Mekong water level rises faster than the Tonle

Sap, the drainage capacity of numerous outlets of the Mekong's deltaic system to the South China Sea cannot keep up with the sheer volume of water flowing in the Mekong River, and water is pushed westward through the 120 km long Tonle Sap River into the lake and its tributaries (including the Stung Chinit), thereby increasing the lake area sixfold. By the end of October, the flow into Tonle Sap reverses and the lake again drains into the Mekong. The inundated forests of the floodplains of the Tonle Sap serve as key spawning grounds and nursery for most freshwater fishes. The high organic content of Tonle Sap's floodplain further supports fish expansion and is a key factor in the inherent productivity of the country's inland fisheries. Over 200 fish species have been recorded in the Tonle Sap area including the giant Mekong catfish, which weighs up to 100 kilograms.

2. Ecological Resources

a. Flora of Stung Chinit Catchment and Command Area

13. Partly because of the long period of political instability and insecurity of the remote forested areas, much of the upper reaches of the Stung Chinit have retained their natural forest cover. The Stung Chinit catchment area comprises one of the last remaining stands of dry evergreen lowland forests in the Indo-Chinese subregion, which encompasses Viet Nam, Lao People's Democratic Republic, and the eastern parts of Thailand.

14. Most of the upper catchment area (2,528 km^2 or 84 percent) consists of dipterocarp forest. Some 336 km^2 (or 11.1 percent) of the Stung Chinit catchment area constitutes a patchwork of forest of different levels of disturbance. Patches along the lower sections of the Stung Chinit catchment area have been logged and treated so heavily that few large trees remain. It is assumed that most logging has been carried out by the various communities of the Stung Chinit prior to their evacuation in the late 1970s. Some 48 km^2 (or 1.6 percent) of the Stung Chinit catchment area is made up of former farmland and landholdings currently in use.

b. Fauna

15. Common wildlife species recorded in the upper catchment area of the Stung Chinit include pig-tailed macaque (*Macaque nemestrina)*, long-tailed macaque (*Macaque fascicularis*), and leaf monkey (*Presbytis cristata*). Mouse deer (*Tragulus* spp.), civet and mongoose species (Fam. Viverridae and Herpestidae), fishing cat (*Prionailurus viverrinus)*, and wild boar (*Sus scrofa)* are considered still common in the upper stretches of the watershed. Otters (*Lutra/Lutragale* spp*.)* are reported to inhabit the Stung Chinit River and tributaries. In the proposed command area, species diversity has greatly been reduced and only the more common (opportunistic) species still occur in small numbers, like rodents, bats, and mongooses. None of these species are endemic to the region or restricted to the command area.

16. Stung Chinit is part of the important fishery resource of Tonle Sap. The species diversity of the Tonle Sap and its tributaries is high, with 215 species recorded to date. Most fish species of Stung Chinit occur throughout the Mekong's lower reaches, and Stung Chinit is therefore unlikely to hold a large number of endemic species.

3. Human and Economic Resources

17. In 1995 the population of Kompong Thom totaled 542,573. Of these 280,510 were women. The 1994 population growth rate was estimated at 2.92 percent per year, which would cause the population to double within the next 25 years. The province comprises an area of 13,000 km^2, divided into 8 districts, 81 communes, and 720 villages.

18. The number of villages within or near the proposed project area proper is 80. In this area, there are 71,609 potential beneficiaries, of which 37,251 are women (52 percent). There are an estimated 12,500 rural households. The major economic activity of the project area is agriculture, characterized primarily by paddy cultivation during the wet season and supplemented by the production of livestock and an array of fisheries culture and capture activities. These activities occur both in the project area itself and on the nearby fringes of Tonle Sap. To the east of the project area some remaining forest areas also provide supplementary incomes from firewood gathering, hunting, and collecting wild forest products.

19. Over the last two years, four companies have been granted logging concessions covering 82 percent of the Stung Chinit catchment area. A combination of stagnant regional economic growth and new logging fees have brought most logging operations to a standstill. On the basis of a recent review of concessionaire performance conducted with assistance from ADB,[2] the Government has chosen to cancel some of the existing concessions and revise concession agreements to better protect the forest. In the future, logging activities in the upstream catchment will need to be closely monitored.

4. Quality of Life Values

20. To enhance the quality of life for rural Cambodians—who have already suffered from more than two decades of civil war—-it will be necessary to move away from subsistence-based agriculture. The districts of Baray and Santuk in the command area of the proposed rehabilitation project contain a substantial number of rural households that are already involved in market-oriented forms of agricultural development. If these households had access to irrigation water during the dry season and better forms of water management during the wet season, they could increase their household incomes. This will have a multiplier effect for other households, as more local agricultural wage labor opportunities become available with intensification and diversification of local agriculture.

21. Although provincial statistical data are generally considered to be unreliable, it provides a first indication of the incidence of waterborne diseases. The most common diseases in Kompong Thom are malaria, dengue fever, typhoid, and respiratory infections (including tuberculosis). Both dengue fever and malaria occur in the command area. Malaria is found to occur naturally. Annual parasitic incidence (API) is high, with high malaria potential, and moderate to high incidence rates. Other waterborne diseases prevalent in the command area are cholera, gastroenteritis, and hepatitis. Schistosomiasis and filariasis are absent. Hookworm is prevalent among the population.

22. As the Project will stimulate agricultural development, water resources are likely to become exposed to more agricultural waste and pollutants, as wastewater treatment facilities are not available. Polluted water in general could have serious impacts on public health and is a leading cause of high morbidity and mortality rates in rural communities. The main sources for drinking water for the communities of the command area are rivers and private wells. The provincial Department of Hydrology with assistance from a Christian NGO, Adventist Development and Relief Agency (ADRA), has constructed a number of public drinking wells in Kompong Thom.

23. Undernutrition remains an issue for deprived communities far away from Highway No. 6 and who are cut off from mainstream economic developments. A Gesellschaft für Technische Zusammenarbeit (GTZ) nutrition baseline survey carried out in March/April 1997 in the districts of

[2] TA 3152-CAM: *Sustainable Forest Management*, for $980,000, approved on 31 December 1998.

Stong, Stungsen, and Santuk found a high prevalence of undernutrition (49.3 percent) in children under five years of age, which could be attributed to long-term chronic food shortage.

D. Screening of Potential Environmental Impacts and Mitigation Measures

1. Migratory Fish Population

24. Rehabilitation of the Stung Chinit diversion weir and restoration of the breached embankment will negatively impact the migratory fish populations of the Chinit by blocking one of the migratory pathways to historical spawning grounds. The Stung Tang Krasang diversion weir has blocked the main upstream wet-season spawning migration in that river ever since it was constructed in 1978, although migration through the Stung Chinit and via the main canal to the upper Stung Tang Krasang is possible and documented. The Stung Chinit diversion weir was closed almost continuously from 1977 to 1989, and blocked fish migrations through the main channel during that time. A migratory route was reestablished following the breaching of the embankment in 1989 to protect the weir superstructure from further damage. It is not known what impact the 12-year weir closure had on migratory fish populations, but anecdotal evidence and observation suggest that a significant migration still takes place in the Chinit today.

25. The most promising mitigation measure for the migratory fish population is to install a fish pass on the Stung Chinit diversion weir during the rehabilitation phase of the Project. The current structure at the weir includes a navigation lock on which a fish pass can be constructed. With the correct design, this will permit a share of the migratory fish populations to pass the weir and give them access to historical spawning grounds in the upstream areas of the Stung Chinit and Stung Tang Krasang. Due to the superstructure design, a fish pass is considered less likely to be successful at the Stung Tang Krasang diversion weir, and the one at the Stung Chinit Diversion Weir will serve both river systems. This is borne out by the current situation – the Stung Tang Krasang weir is jammed shut, but fish are migrating above the weir through the main canal that connects both rivers. If the fish pass at the Stung Chinit diversion weir does operate effectively, and future monitoring suggests that the Stung Tang Krasang would benefit from its own fish pass at the weir, one can be designed at a later stage based on the results of the Stung Chinit model.

26. The recommended design will be based on an existing model at the Ben Anderson Barrage on the Burnett River, Australia. Without detailed knowledge of operational water levels above and below the Chinit diversion, the length of the structure, and hence the number of cells, cannot be estimated until the detailed design stage. Because the fish pass will be the first of its kind to be built in Southeast Asia, there exists an excellent opportunity to carry out original research that may be of tremendous value to other projects in the future. A research proposal for the fish pass at the Stung Chinit diversion weir is included as a supplementary appendix. The Mekong River Commission and the Cambodian Department of Fisheries will collaborate with the Project on this research component.

2. Minimum Dry Season Flow

27. To maintain the full health and integrity of downstream aquatic habitats, the entire normal dry-season flow is required. Clearly, this will not be available. Fish and many other forms of aquatic life are at their most vulnerable during the dry-season months because environmental conditions are usually most harsh during this period. Food is often scarce, levels of predation are highest, water temperatures usually peak during the hot season and, subsequently, oxygen often falls to its lowest level. All these factors stress fish, rendering them susceptible to disease and mortality.

28. In the absence of quantitative studies, minimum environmental flow releases of at least 10 percent of the mean monthly flow have been recommended to maintain healthy aquatic habitats in Europe, North America, and Australia. Given the diverse nature of tropical fish faunas, and the generally higher water temperatures, the figure 10 percent of mean monthly flow may not be sufficient for the Stung Chinit. But much of the water diverted from the river channel will be distributed into the same area through paddy, secondary and tertiary canals, and drains, and some will return to the river course through this system. The species of fish common to the area do not naturally spend most of their lifetime in the river system, but rather move throughout the landscape where water is available. Farmers interviewed during the feasibility study noted that paddy fish yields improved when the system was functioning in the 1980s.

29. Every attempt should be made to gather pre-impoundment data on physical and hydrological characteristics below the weir during the design phase of the Project, and to maintain these as much as possible without unduly compromising the irrigation function of the weir. These activities are included in the fisheries research component described in a supplementary appendix.

3. Increased Use of Agrochemicals

30. With the increase in rice and/or other cash crop cultivation, use of agrochemicals will increase and may create problems related to residual toxicity and nutrient enrichment of water in the command area. Use of pesticides in the area is currently negligible except for farmers growing cash crops in the dry season. But through the drainage system of the rehabilitated irrigation system, chemicals could affect wetlands surrounding the villages up to the ecologically important Tonle Sap and floodplain. Although there is a time lag between the beginning of irrigation and the observance of water quality deterioration (increased pollutants), the agricultural effects are already being observed for such aspects as nitrates as water hyacinth is already seen in the command area. Lab facilities to analyze pesticides residues in water samples are not yet available in Cambodia, but analyses could be carried out in neighboring countries such as Thailand and Viet Nam.

31. A recent study[3] showed that most pesticides available in Cambodia are of questionable quality. Most pesticides are not labeled in Khmer and sellers and farmers have no way of knowing the expiry date of most of the available pesticides. Two popular pesticides sold and used—mevinphos and methyl-parathion—are in the World Health Organisation (WHO) Hazard Class I, i.e., the most toxic of pesticides. In October 1998, the Cambodian Government passed the Sub-decree of Standard Agricultural Materials and Equipment Management, a law that includes pesticide regulation. This is the first law to deal with pesticides in Cambodia. It regulates the import, sale, labeling, packaging, quality, storage, disposal, and marketing of pesticides in Cambodia. Since the passage of the legislation, however, not much has been done to implement it.

32. The lethal effects of pesticides are rarely restricted to the species for which the chemical is applied. Most have a broad-spectrum impact that causes incidental damage to a wide array of wildlife, plant life, and water organisms. Pesticides also represent a major occupational health risk for farmers and their families. A WHO report (1990) revealed that occupational pesticide poisoning may affect some 3 percent of the farmers in developing countries every year. Accurate data for the command area is not available. Medical staffs in Baray and Santuk Districts are not trained in identifying or treating pesticides poisoning cases, and lack diagnostic equipment and antidotes. Pesticide-related health problems stem largely from improper handling, application (mixing and spraying chemical cocktails), and storage practices. WHO strongly recommends that Category I pesticides should be used only by trained personnel. Field surveys for this assessment revealed

[3] Jahn, G. 1999. The Cambodia-IRRI-Australia Project 1998 Annual Technical Report (CIAP).

that the present use of pesticides is limited to periods when pest outbreaks occur. This may reflect the poor socioeconomic conditions prevailing rather than the seriousness of pest attacks. Many farmers do not strictly follow the application prescriptions, spraying either less than prescribed doses (to reduce cost) or up to 2 times higher during pest outbreaks. Most farmers do not use sprayers, but flick the pesticide over their fields using bamboo brushes.

33. Excessive use of chemical fertilizers will result in enrichment of water bodies due to nitrogen and phosphorus runoff. Loading of water bodies (rivers, oxbows, ponds, and marshes) by these chemicals could cause eutrophication, which in turn will give rise to prolific aquatic plant growth, especially of algae. Aquatic weed growth can cause a drop in dissolved oxygen content and impact aquatic life, including fish.

34. To mitigate the impact of increased agrochemical use, the Project will develop farm safety training programs on integrated pest management (IPM) as part of the agriculture extension services envisioned for the project, and through farmer field schools modules on the appropriate use of pesticides and fertilizers.

35. Another mitigation measure is to develop and implement systematic monitoring programs for agrochemicals residues in wetland ecosystems and poisoning cases. Water quality at appropriately chosen sites will be monitored to measure changes in physicochemical levels, including buildup of pesticides residues. The Mekong River Commission will undertake this work on behalf of MOWRAM and prepare annual reports that identify negative impacts and recommend measures for water quality improvement. Future water quality standards for various uses, as defined by the Ministry of Environment should be adhered to.

4. Increase in Hookworm Incidence

36. With the irrigation project, more standing water will be available and for longer periods during the year. There is a possibility of increased incidences of hookworm in the population served by the Project. Hookworms cause chronic blood loss from the intestine and predisposes the victim to the development of iron deficiency anemia, sometimes of great severity, which constitutes a major public health problem. Their harmful effects are often aggravated by coexistent malnutrition or micronutrient deficiencies. The presence of hookworms reduces the productivity of the population.

37. According to the WHO office in Phnom Penh, a simple dose of mebendazol tablet will not only have a significant impact on the overall health of the population but also improve their overall productivity. Given the low cost of the tablet, $0.02 each, distribution of this medication is well within the means of a host of nongovernment organizations and international organizations that are focusing on health issues in Cambodia. In the farmer field schools and during extension activities, the Project should ensure that farmers are educated on the health risks of hookworm and seek partner organizations to provide mebendazol in the project area.

E. Institutional Requirement and Environmental Monitoring Mechanism

38. The potential impacts described above require careful monitoring of water quality and fisheries health. MOWRAM does not presently have the capacity to undertake such research. Instead the Mekong River Commission together with the Department of Fisheries will implement a monitoring program that includes annual water quality testing and periodic fish stock and migration assessments. The work will begin with establishment of environmental baseline data on water quality and annual fish migrations, and then use repeat samplings over the life of the Project to

determine Project impacts as early as possible. Annual research reports will highlight problem areas and recommend further mitigation measures as necessary.

F. Conclusions

39. The Project is expected to improve the quality of life for the population served by increasing their income and providing better food security. With the mitigation measures as recommended, the Project would have no significant adverse environmental impact.

SUMMARY RESETTLEMENT PLAN

A. Introduction

1. This summary draws on the draft Resettlement Plan (RP) prepared by the Government with assistance from the Asian Development Bank (ADB). The RP was developed from preliminary designs, and will need to be updated during the detailed design phase in the early stages of project implementation to ensure that all negatively affected persons (APs) are accounted for and compensated in accordance with ADB requirements. A loan covenant makes commencement of civil works conditional on satisfactory updating of the RP.

B. Negative Impacts

2. The main components of the project that will result in land acquisition are reconstruction of weirs that will increase flood-prone areas, renovation of canal banks, and rehabilitation of secondary canals and drains that have fallen into disrepair.

1. Residential Structures

3. Twenty-two households (86 APs) residing on the main canal bank will be required to relocate. The houses are made of bamboo and thatch. The primary economic occupation of these households is collection of bamboo from upstream areas and sale of bamboo products, and fishing. These households will need to be relocated to an area close to the Stung Chinit river to protect their sources of livelihood.

2. Loss of Productive Land

4. It is expected that water impounded by the restored Stung Chinit diversion weir will inundate some lands upriver that are currently used for agricultural purposes. According to a census of the area completed during preparation of the RP, some of the 70 households in village Taphok may be affected by loss of land in the flood-prone area. A preliminary hydrological study indicates that at maximum flood, some 110 hectares (ha) would be inundated temporarily, and up to 30 ha permanently. This area was inundated seasonally from 1977 to 1989, when the irrigation system still functioned. The collapse of the system permitted local households to expand recession rice to some areas closer to the river bottom. Interviews with farmers indicate that when the system was functioning, it was still possible to plant rice in much of the inundated area because the water level was 30 centimeters or less. The exact nature of the impact cannot be determined until the detailed design phase of the Project, but it is encouraging that Taphok remained in its current location throughout the period when the scheme functioned, and supported roughly the same number of families.

5. During restoration of the secondary canals and drains, some households may lose narrow strips of agricultural land along canal alignments. Focus group discussions and consultations indicated that households are willing to give up to 2-meter strips of land voluntarily. Furthermore, households with lands along the canals are expected to be the major project beneficiaries. The project design also requires that two thirds of the farmers agree on the design for secondary canals prior to commencement of civil works.

C. Consultations, Census, and Baseline Survey

6. During preparation of the RP, focus discussions with potential APs were conducted in five villages to inform stakeholders of the Project's objectives and likely impacts. Following focus

discussions, the village leaders participated in an information campaign to describe the planned census and baseline survey and inform the target villages of the schedule for consultations. During the survey, APs were given detailed information on the Project, the objectives of the survey, the general provisions of ADB's resettlement policy, and resettlement/compensation options. Based on the preliminary design, the census and social survey covered 91 percent of affected households. Except for the 22 families residing on the canal banks, all other families are engaged in farming activities. Secondary occupations are fishing and wage labor. Thirty-six households surveyed earn less than KR50,000 and are below the poverty line. The balance earn between KR50,000 and KR100,000, and only 2 households earn more than this in a year. The majority of the households have only verbal permission to cultivate the land, and although no formal titles exist for the land in the area, the Government claims right of ownership. The Government recognizes that regardless of legal status, negatively affected farmers are entitled to compensation.

D. Updating and Revisions in the RP

7. During the design phase of the Project, technical specifications for the diversion weir and main canal and detailed hydrological investigations will permit a more accurate estimate of inundated areas and APs upstream of the weir. At this stage it will also be possible to determine if any secondary canal or drain restoration will result in further APs. Thus at the end of 2001, the Government will review the original census data, update information on land use by the affected households, and identify any other households further upstream that may be affected. The Government will submit the revised and updated RP to ADB for approval prior to commencement of civil works.

E. Legal and Policy Framework

8. At present there is no legally documented resettlement policy in Cambodia. Resettlement will be guided by ADB's policy on Involuntary Resettlement (1995).

F. Entitlements

9. Attempts will be made during the detailed design to avoid or minimize adverse social impacts. Vulnerable groups will be given special assistance to deal with adverse impacts and assisted to benefit from the project, by participating in small civil works. The UN World Food Programme will participate to target vulnerable groups and provide rice and cash payments for piecework. Farming households will be entitled to participate in the agricultural extension services package under the Project. Severely affected vulnerable households will be entitled to agriculture inputs to the value of $200 per household.

10. Compensation will be at replacement value for lost assets. Transportation and a subsistence allowance will be paid to cover for any loss of income during the resettling period. A transport allowance of a maximum estimated $40 per household or assistance in kind would be provided. The subsistence allowance is estimated at $50 per household. Loss of land will be compensated with similar productive land, if available, or compensated at market prices, currently estimated at $2,000/ha. All unit prices for compensation will be reviewed and updated prior to payment of compensation.

11. The cost of compensation and resettlement activities is estimated at about $370,000 equivalent. This includes contingencies for up to 75 additional households and 80 ha of land in the event that more APs are identified based on detailed design.

G. Implementation Arrangements and Grievance Redress

12. The Government has established an Interministerial Resettlement Committee (IRC) chaired by the Ministry of Economy and Finance to take overall responsibility for resettlement in aid-funded projects. To handle day-to-day implementation matters, IRC will establish the Stung Chinit Resettlement Subcommittee (SCRS) that will include the governor or deputy governor of Kompong Thom Province, an appointed IRC member, representatives from the Ministry of Water Resources and Meteorology Project Implementation Unit (PIU), and other relevant provincial departments and at least four representatives of the APs. AP representation may be revised upward once the total number of APs is finalized during detailed design. Stakeholder monitoring groups will be established at the village level.

13. A grievance committee will be established within the SCRS and will include AP representatives as well as representatives from an independent nongovernment organization engaged to monitor RP implementation (see below). Members of the PIU will be assigned to assist the SCRS on the technical aspects of resettlement arising from planned civil works, scheduling of activities, and coordination.

H. Independent Monitoring

14. IRC will engage an independent agency to carry out monitoring and evaluation of the RP. The objectives and the terms of reference will be prepared by IRC and reviewed by ADB. AP representatives will work with the independent agency to ensure participatory monitoring. Grievance may also be expressed to the independent agency and the concerns raised will be included in the monitoring report. The agency will submit quarterly reports to IRC and ADB directly. Six months after the completion of resettlement activities, the monitoring agency will submit an evaluation report to ADB and IRC.

I. Implementation schedule

15. Resettlement activities will commence at the earliest in year 2002. Once the detailed design is complete and a revised plan is submitted, IRC will provide an updated implementation schedule that indicates resettlement activities as they relate to the civil works.

FINANCIAL AND ECONOMIC ANALYSES

A. Introduction

1. The Stung Chinit irrigation system was built in the late 1970s by the Khmer Rouge regime using largely forced labor. The system was designed to provide supplemental wet season irrigation over the maximum possible command area of 12,000 hectares (ha) using run-of-the-river flows, but with little regard for economic viability. Although there are few records, local farmers recall that the scheme operated more or less continuously until the late 1980s, when the main canal was intentionally breached to protect the Stung Chinit diversion weir during a major flood. Since then many of the canals have silted up, none of the major control structures are functioning, and service roads are largely impassable in the wet season. Agriculture continues in the area, but at a low intensity. Farmers rely on one rain-fed rice crop per year, fisheries associated with wet season paddy, and livestock including some cattle, pigs, chickens, and ducks.

2. The first Asian Development Bank (ADB)-assisted feasibility study to assess development options for the Stung Chinit, conducted in 1997, concluded that maximum benefits would be obtained by the construction of a dam upstream that would allow year-round irrigation over the full 12,000 ha command area. However, the Government and ADB subsequently agreed that proceeding with the full dam option would be too ambitious at this stage, in view of the Government's limited implementation capacity, farmers' lack of experience with fully irrigated rice production, and uncertainty about environmental impacts. It was therefore agreed that a two-stage approach should be adopted in developing the area. The first stage will be limited to areas close to the main canal that can be irrigated using run-of-the-river flows. A subsequent feasibility study estimated these areas at 7,000 ha, comprising 5,000 ha to receive supplemental wet season irrigation and 2,000 ha to receive year-round irrigation.

3. Irrigation, though crucial, is but one of many constraints to agricultural productivity. Cambodia in general and the project area in particular, also suffer from extremely poor transportation links, lack of knowledge about preharvest and postharvest improved agricultural techniques and technology, and inadequate marketing links. For these reasons, the Project includes substantial investments in rural roads, agricultural extension services, and markets. The Project also provides Government staff with training in irrigation design, construction and management, as well as agronomy, to ensure transfer of technology and know-how. Because of the important role to be played by farmers in regular operation and maintenance of the scheme, and current lack of experience in cooperative water resource management, substantial resources are allocated for farmer mobilization and training.

4. In combination, these investments are expected to increase agricultural productivity, reduce farming costs, and stimulate the rural economy. It is probable that during project implementation the opportunity will be taken to use skills developed therein to improve the operation of other irrigation schemes elsewhere in Kompong Thom Province or nearby provinces. However, benefits resulting from the improved operation of these schemes were not included in this economic analysis.

B. Assumptions on Project Costs

5. The costs were prepared according to standard ADB guidelines using COSTAB software. The costs were based either on local prices prevailing in the project area in late 1999 or in dollar terms inflated from previous studies at a rate of 3 percent per year. An exchange rate of KR3,800 per dollar was used where applicable. Physical contingencies were estimated for individual items

at rates shown in the detailed cost tables. Physical contingencies are based on Mission estimates, the Cambodian Rural Infrastructure Improvement Project (RIIP),[1] and the recent International Fund for Agricultural Development appraisal of the Agricultural Development Support to Seila (foundation stone) Project. International price contingencies were calculated according to ADB's estimates of international price inflation, currently 2.4 percent per year. Local inflation had been running at rates of up to 18 percent annually in recent years but, as a result of political changes and improved economic policies, fell to about 4 percent by the end of 1999. An inflation rate of 6 percent was applied to local costs, as specified in the ADB guidelines for Cambodia. Taxes and duties have been applied at rates supplied by the Cambodian Ministry of Finance.

C. Expected Impact of the Main Components

1. Irrigated Agriculture Development (Part A)

a. Agriculture

6. The proposed project area totals about 7,000 ha that, following the collapse or de-commissioning of the irrigation system structures, is currently cropped with only wet season rain-fed rice. The exact extent of the cropped area will be established during the detailed design phase. Yields are currently low by international standards at 1.2–1.4 tons per hectare (t/ha). Without the Project, per hectare yields are expected to rise from an average of 1.3 to 2.3 t/ha over a 20-year period as a result of the gradual adoption of improved technologies—which is already taking place in Cambodia—and improved marketing and road communication in the Kompong Thom area, which until recently has been virtually inaccessible.

7. With the Project, assuring supplies of supplementary irrigation water and introduction of improved technologies are expected to raise wet season yields from the initial 1.3 t/ha up to 3.0 t/ha, generally exceeding the without-project situation by 0.7 t/ha. It is anticipated that the 7,000 ha will be improved over a period of three years by 2,000, 2,000, and 3,000 ha per year, and with the first significant increase in yield occurring in the year 2005. Furthermore, and based on recent experiences in other improved irrigation schemes in Cambodia, the provision of supplementary irrigation in the wet season together with agricultural extension and improved rice varieties will allow about 40 percent of farmers to double-crop their land, growing one short-duration rice crop followed by another longer duration crop.

8. The rehabilitation of the weirs and associated irrigation works will also allow the reliable irrigation of about 2,000 ha in the dry season. Production on this land in the dry season is currently negligible and will remain so in the without-project situation. With irrigation, yields on this area are expected to increase over a four-year period from 2.5 to 4.0 t/ha, and it is anticipated that it will take two years to bring the full area into production. Again following the experience of other improved irrigation schemes in Cambodia, farmers are expected to diversify away from rice production into other cash crops on about 25 percent of the dry season irrigated area of 2,000 ha. The cropping intensity on the balance of the 1,500 ha, which is solely planted to rice, is expected to average 90 percent in the dry season.

9. The difference between the with- and without-project situations is expected to stabilize after 20 years, after which time yields will have reached their steady-state levels. In total, the Project is expected to lead to a sustainable increase in rice production of about 16,300 t of rice and about 950 t of other crops per year.

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[1] Loan 1385-CAM: *Rural Infrastructure Improvement*, for $25.1 million, approved on 28 September 1995.

b. Fisheries

10. Fish production in paddy fields is already a common practice in the project area, but yields are limited by the occurrence of drought periods during the wet season. During the socio-economic investigations undertaken as part of the project preparatory technical assistance, farmers reacted positively to the idea of supplementary irrigation, especially since it would make their fish production more reliable and profitable. However, fish production on irrigated land in the dry season is a more problematic concept in that the proposed high-yielding varieties require applications of pesticides, which may reduce paddy fish productivity. On average, and after discussions with local farmers, the increase in fish production resulting from the rehabilitation of the irrigation scheme was estimated at about 15 kg per ha per year, valued at about KR5,000 per kg, or a total of about $20 per ha per year over the 7,000 ha. These benefits will accrue as each wet season block is sequentially rehabilitated.

2. Rural Infrastructure (Part B)

11. ADB has established through a number of projects, especially in Bangladesh[2] and Cambodia (the RIIP), that the provision or improvement of rural roads and markets leads to definite and sustainable benefits. These include lower transport costs, enhanced access to agricultural extension, health and education services, lower prices for purchases and higher prices for sales of produce, improved access to agricultural inputs, the opportunity to diversify into higher value crops such as vegetables, increased availability of raw materials for nonagricultural industries, a wider market for crops and other locally produced goods, reduced levels of spoilage, and increased economic opportunities such as repair shops, roadside cafes, and fuel sales associated with improvements in transport. A further direct benefit is the employment created by the use of labor-intensive construction technology – completing 1 km of road is estimated to generate about 2,000 days of employment.

12. Because some of the preceding benefits are difficult to quantify or forecast, ADB has adopted two conservative methods of assessing benefits: vehicle operating cost (VOC) savings and the stimulation of agricultural producer surpluses (APS). VOC savings result from the direct reduction in costs as a result of less wear and tear on vehicles following an improvement in road surface conditions, a drop in prices charged when vehicle utilization rates can be increased as a result of a reduction in journey times, and changes to less expensive modes of transport. APS benefits result from the removal of physical constraints to the transport of bulky items such as fertilizer, improved seed and surplus crop production as well as from crop diversification. The calculation of the benefits accruing to the 150 km of roads to be rehabilitated under the Project is discussed below.

13. Direct benefits have not been attributed to the associated refurbishing of six rural markets since these benefits are difficult to quantify precisely. However, the consultants implementing the RIIP derived an estimate[3] of postharvest quality improvements resulting from better market facilities valued at 2-5 percent of the value of the crop. The average agricultural turnover of 12 markets investigated by the consultants was about $685,000.

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[2] For example, see PCR: BAN 21086: *Rural Infrastructure Development Project*, June 1999.

[3] I.T. Transport Ltd. 2000. *Market Rehabilitation Sub-Projects: Screening, Selection and Appraisal.* Phnom Penh, February 2000.

a. VOC Benefits

14. The RIIP based its estimates of VOC savings on a study undertaken on stretches of roads rehabilitated by the International Labour Organization (ILO) in Battambang Province. Battambang is more remote and less developed than Kompong Thom. The project area is directly adjacent to a recently renovated national highway, and is only two hours from Phnom Penh, therefore this ILO estimate is inherently conservative. The costs were inflated by 20 percent, using the increase in the price of labor from KR2,500 per day to KR3,000 per day from the time of the survey until now as a proxy for the general increase in costs.

15. According to the survey estimate, before roads were rehabilitated an average of about 780 vehicles of various types, mostly bicycles or motorcycles, traveled along a typical kilometer length at a weighted average VOC of KR210 per vehicle per kilometer. After rehabilitation, the traffic count rapidly increased to about 1,400 vehicles per day, at an average VOC of KR150 per vehicle per kilometer. The economic analysis does not include cost savings for incremental traffic generated by road rehabilitation, to avoid double counting of benefits attributed to APS (paras. 16-18). Thus, the VOC saving can be estimated at 600X(210-150) = KR36,000 or about $9.45 per kilometer per day. This equates to a total VOC saving of US$ 3,356 per kilometer per year. As in the RIIP, it was assumed that these savings will take two years to reach their full levels.

b. APS Benefits

16. Previous ADB studies have referred to research work in Bangladesh and elsewhere, which demonstrated that improving rural roads stimulates agricultural production on each side of the rehabilitated road and generates APS. The width of the corridor is generally at least 2 km on each side of the road. About 150 km of road will be rehabilitated under the proposed component, of which about 50 km pass directly through the Stung Chinit irrigation scheme. No APS benefits have been attributed directly to those 50 km of road since increased production along and near these roads has been assumed to come from the rehabilitation of the irrigation scheme and the provision of irrigation water.

17. Of the remaining 100 km, about 80 percent is assumed to pass through productive agricultural areas, the remainder being occupied by villages and fishponds or is used for other purposes or is idle. The net length of road for which APS benefits can be claimed and the associated benefit corridor are presented in Table A11.1.

Table A11.1: Road Lengths and Corridors for APS Benefits

Year	Net Road Length (km)	Benefit Corridor (ha)
2001	10	4,000
2002	30	12,000
2003	30	12,000
2004	10	4,000

APS = agricultural producer surplus.

18. It was noted above that, even without the Project, per hectare yields are expected to rise from 1.3 to 2.3 t/ha over the 7,000 ha over a 20-year period as a result of the gradual adoption of improved technologies and improved marketing and road communication. The APS impact of improving roads under the rural infrastructure component has been assumed to speed up this process by about five years over the amount of time that it would otherwise have taken. Thus, in

the calculation of APS benefits the without-Project increase in per hectare gross margins is accelerated by five years and multiplied by the area of the benefit corridor.

C. Financial Farm Analyses

19. Four simplified farm models were prepared to assess the Project impact on a typical farm family in the area. The average farm size was 1 ha. No account was taken of changes in the production of other crops within the homestead plot, of fish production, or of other off-farm incomes, since it had been assumed that those enterprises would not be directly affected by the Project. The four models refer to

- the present without-Project situation;
- the future without-Project situation in the year 2020;
- the future with-Project situation in the year 2020 on the 7,000 ha provided with supplementary irrigation in the wet season; and
- the future with-Project situation in the year 2020 on the 2,000 ha provided with irrigation water in the dry season.

20. The calculated financial gross margins per hectare in the various situations, based on the price of rice in the project area, about KR450 per kg or $118 per mt, are presented in Table A11.2.

Table A11.2: Gross Margins
($)

Situation	**Gross Margin** (per hectare)	**Gross Margin** (per family person-day)
Without Project – 2001	114	0.95
Without Project – 2020	153	1.28
Wet Season Irrigation – 2020	237	1.98
Dry Season Irrigation – 2020	266	2.21
Both Wet Season and Dry Season – 2020	503	2.10

21. By the year 2020, the provision of supplementary wet season irrigation should raise the average family's income by a minimum of $84 per year, earning an additional $0.70 per family person-day. Dry season irrigation only would raise it by $113 per year or $0.93 per family person-day. Those families cropping in both wet and dry seasons could expect an increase of $350 per year, or $0.82 per family person-day. This analysis assumes quite slow adoption of technologies and techniques to improve yields. A parallel study by Agence Française de Développement estimated annual incremental household returns to cropping in the wet and dry season at $236. The analysis assumed lower cropping intensities, and assumed these benefits are available by year 6 of the Project. The use of irrigation to allow cropping in both the wet and dry seasons is thus an effective way of sustainably and significantly raising family incomes. The analysis is inherently conservative because it does not attempt to capture the impact of improved post-harvesting practices on rice quality and price, though provision is made for training in this area as part of agricultural extension services under Part A.

D. Economic Analysis

1. Introduction

22. The economic analysis was carried out separately for both of the major components and for the Project as a whole in accordance with standard ADB procedures. Economic prices for the main traded inputs and outputs, which are mainly rice and fertilizer, are based on the latest World Bank commodity price projections for the year 2005, adjusted to constant 1999 values using the G-5 manufacturers' unit value index. Rice is freely traded from Cambodia across the borders to both Thailand and Viet Nam and in both directions depending on the time of year. Rice is commonly exported from Cambodia after the wet season harvest as farmers have to accept low prices to clear their debts and to purchase various goods, but rice is later imported again to Cambodia during the lean period before the next harvest. The price used in the analyses is thus the arithmetic average of the import- and export-parity prices. This situation is expected to continue in the medium-term future as increases in Cambodian rice production are offset by population growth. Rice has initially been priced at a 15 percent quality discount over the value of Thai 5 percent broken rice. However, given the large local and regional market for rice and the gradual nationwide improvements in communications and marketing information, it is expected that producers with access to reliable supplies of irrigation water will respond to quality price differentials and (i) 10 years from now will be receiving prices discounted by only 10 percent from the Thai indicator price, and (ii) within 15 years will be receiving prices discounted by only 5 percent.

23. Fertilizer prices were estimated at import-parity levels, reflecting the likely ongoing need for Cambodia to import fertilizer. Border prices were adjusted to farmgate prices by allowing for the economic values of transport, processing, and marketing. The prices of nontraded goods were also adjusted by a standard conversion factor of 0.9 in accordance with ADB's current practice for projects in Cambodia; hired farm labor was shadow-priced at 75 percent of its market value.

2. Irrigated Agriculture Development (Part A)

24. The volumes of incremental production and input use have been multiplied by their economic prices to derive the economic net value of incremental production, and combined with the economic costs of the three components directly concerned with irrigation to derive a net economic cash flow for the irrigation components. The resulting economic internal rate of return for Part A is 15.0 percent.

3. Providing Rural Infrastructure (Part B)

25. The EIRR for this component is based on the estimated VOC and APS benefits accruing to the rehabilitation of the rural roads; benefits from the improvement of the six selected village markets were not included. The calculated EIRR for this component is 32.4 percent.

4. Whole Project EIRR and Sensitivity Tests

26. Combining the net cash flow streams for both Parts A and B yields a project EIRR of 19.1 percent. Table A11.4 presents a resource statement with the major cost and benefit streams and calculation of EIRR by component and for the entire Project. A number of sensitivity tests were carried out to test the EIRRs under a range of assumptions. The results of the sensitivity tests are presented in Table A11.3. It is encouraging that the irrigation infrastructure component yields an estimated EIRR of 15 percent. The EIRR of this component remains above the 12 percent threshold despite a 10 percent cost increase and 20 percent reduction in benefits. The risk of a

cost increase beyond current estimates is low: the estimates are intentionally conservative, with generous contingencies, to ensure adequate funds are available despite possible economic shocks during the life of the Project.

27. The EIRR for rural infrastructure proves even more robust when costs rise and benefits fall by 10 percent. APS benefits claimed from the rural infrastructure component may prove conservative because the corridor of influence is assumed to be only 2 km on each side of the road, whereas experience in other countries has demonstrated that it may often reach up to 5 km on each side of a rehabilitated road.

Table A11.3: Summary of Sensitivity Tests and Switching Values

	EIRR (percent)				Switching Value at 12% Discount Rate (%)	
Activity	Base Case	Cost Increase + 10%	Benefit Reduction - 20 %	Combined Costs +10% Benefits -20%	Costs	Benefits
Overall	19.1	17.2	17.0	15.2		
Irrigation & Ag. Extension	15.0	13.6	13.4	12.1	27	(20)
Rural Infrastructure	32.4	29.1	28.8	25.7	94	(47)

EIRR = economic internal rate of return.

28. Although not presented in the table above, sensitivity tests were also conducted on the timing of benefit flows in Part A. If the benefits from irrigated agriculture accrue two years faster than expected, the return to Part A increases to more than 21 percent. A corresponding delay in the accrual of benefits drives the EIRR down to 12 percent. It was not considered necessary to test for the impact of delayed benefits for the rural infrastructure component since road benefits are known to accrue almost immediately after the investments have been made, and Ministry of Rural Development's ongoing experience in road building under RIIP makes construction delays unlikely.

Table A11.4: Resource Statement and Calculation of EIRR

(Unit: $'000)

Component	2001	2002	2003	2004	2005	2006	2010	2015	2020
Part A: Irrigated Agriculture Development									
Benefits									
Rice	-	-	-	-	626	1,283	2,220	2,312	2,442
Other Crops	-	-	-	-	99	197	197	197	197
Fish	-	-	-	-	40	80	140	140	140
Costs									
Farmer Community Org. and Extension	392	340	312	317	214	176			
Irrigation and Drainage Infrastructure	862	1,144	2,825	2,592	1,112	206	218	218	218
Irrigation System Management	61	-	203	207	198	104			
Net Cash Flow	(1,315)	(1,485)	(3,341)	(3,116)	(758)	1,075	2,339	2,430	2,561
EIRR (%) for Irrigation	**15.0**								
Part B: Rural Infrastructure									
Benefits									
Vehicle Operating Costs	-	30	136	287	408	453	453	453	453
Agriculture Producer Surplus	-	70	293	614	898	1,029	1,400	977	273
Costs									
150 km rural roads	700	971	984	721	290	299	299	299	299
Net Cash Flow	(700)	(870)	(555)	180	1,015	1,183	1,554	1,131	427
EIRR (%) for Supporting Infrastructure	**32.4**								
Whole Project									
Net Cash Flow	(2,015)	(2,355)	(3,896)	(2,936)	257	2,258	3,893	3,561	2,989
EIRR (%)	**19.1**								

EIRR = economic internal rate of return.