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EMPIRICAL EVIDENCE OF IRRIGATION MANAGEMENT IN THE TONLE SAP BASIN: ISSUES AND CHALLENGES

Water Resources Management Research Capacity Development Programme (WRMRCDP)

A Partnership of CDRI, RUPP and the University of Sydney with Support from AusAID

Empirical Evidence of Irrigation Management in the Tonle Sap Basin: Issues and Challenges

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Preface

The Water Resources Management Research Capacity Development Programme (WRMRCDP) is being implemented by the Natural Resources and Environment Programme (NRE) of the Cambodia Development Resource Institute (CDRI), with financial support from AusAID, and involvement from collaborating research partners, the University of Sydney (UoS), Royal University of Phnom Penh (RUPP), the Ministry of Water Resources and Meteorology (MOWRAM), and the Ministry of Agriculture, Forestry and Fisheries (MAFF). The programme covers five years from July 2006 to June 2011 and focuses on research capacity development and knowledge dissemination, within watershed areas surrounding the Tonle Sap Lake.

The activities implemented during June 2006 – December 2009 were based on the project design document, discussions from WRMRCDP launching workshop and a series of Consultative Committee meetings. Three important issues emerged at the launching workshop: (i) the relevance of scale of irrigation project for appropriate management design and likelihood of success, including financial viability; (ii) water governance of the irrigation schemes; and (iii) catchment governance issues relevant to irrigation water management.

The subsequent activities included a literature review of international, regional and local experience on water resources management in order to canvass existing written work on water resources management with lessons for Cambodia. A social assessment of irrigation in six provinces around the Tonle Sap Lake is also included in the subsequent activities, preceded by a test of research instruments in Kampot province, on whose findings this paper reports. The literature review and social assessment were undertaken to understand catchment hydrology, integrated water resources management (IWRM), and good governance concepts of water resources management from international, regional, and local perspectives in order to frame specific research activities to be undertaken for the remaining period of the programme implementation. The social assessment was designed to build knowledge of water management at existing irrigation schemes, hence to identify various research issues associated with irrigation and watershed management in order to assist in the scoping of key themes for further research and to identify in-depth study sites for this project.

Abbreviation

ADB	Asian Development Bank
ADRA	Adventist Development and Relief Agency
AFSC	American Friends Service Committee
AusAID	Australian Aids for International Development
CDRI	Cambodia Development Resource Institute
CEMARE	Centre for Economic and Management of Aquatic Resources
CNDMC	Cambodia National Disaster Management Committee
CNMC	Cambodia National Mekong Commission
FAO	Food and Agriculture Organisation
FGD	Focus Group Discussion
FWUC	Farmer Water User Community
ILO	International Labour Organisation
ISF	Irrigation Service Fee
IWRM	Integrated Water Resources Management
MAFF	Ministry of Agriculture, Forestry and Fisheries
MIME	Ministry of Industry, Mine and Energy
MRD	Ministry of Rural Development
NGO	Non Governmental Organisation
JICA	Japan International Cooperation Agency
MEF	Ministry of Economic and Finance
MOE	Ministry of Environment
MOH	Ministry of Health
MOWRAM	Ministry of Water Resources and Meteorology
MOP	Ministry of Planning
MPWT	Ministry of Public Work and Transport
NRE	Natural Resource and Evnironment
PDAFF	Provincial Department of Agriculture, Forestry and Fisheries
PIMD	Participatory Irrigation Management and Development
PRASAC	Programme de Réhabilitation et d' Appui au Secteur Agricole du Cambodge (Rehabilitation and Support Programme for Cambodia's Agricultural Sector)
PDOWRAM	Provincial Department of Water Resources and Meteorology
PPWSA	Phnom Penh Water Supply Administration
PRA	Participatory Rural Appraisal
RUPP	Royal University of Phnom Penh
UoS	University of Sydney
WFP	World Food Programme
WRMRCDP	Water Resources Management Research Capacity Development Programme

Acknowledgement

Initiated since 2006, this paper could be considered a long overdue one, but if the research process was to be emphasized and the aspect of researchers' capacity building was to be valued, this paper has seen a lot of it. This paper is a part of a joint research programme between the Cambodia Development Resource Institute (CDRI), the Royal University of Phnom Penh (RUPP) and the University of Sydney (USYD) with close collaboration from various government ministries, including but not limited to, the Ministry of Water Resources and Meteorology (MOWRAM) and Ministry of Agriculture Forestry and Fisheries (MAFF). The process involved training on the theories and research framework offered mainly by the University of Sydney, research framing and methodology by researchers from CDRI and RUPP with active participation from various government agencies. Although the process is long and frustrating at times, the result is rewarding in both the publication and the improvement in the research capacity of Cambodian researchers.

For this reason, the authors of this paper would like to sincerely appreciate AusAID for its funding, and to express our appreciation for its funding approach that allows for this kind of long-term research program, without which the capacity building aspect of this research process is impossible.

The authors would like to acknowledge the involvement of several researchers and scholars from CDRI, USYD, RUPP, MOWRAM, MAFF, and AusAID, namely Dr. Hossein JALILIAN, Mr. Sovannarith SO, Mr. Dararath YEM, Mr. Sour KIM, Professor Philip HIRSCH, Ms Kate GRIFFITHS, Mr. Kimkong HAM, Mr. Sopheak CHAN, Ms Phalika CHEA, Mr. Keamony NONG, Mr. Pov NAM, Dr. Brett Ballard, Dr. Sovith SIN, Mr. John DORE, and the peer reviewer, Mr. Sokhem PECH, who had been involved in the research, writing up of this paper and helpful comment and suggestions to improve the quality of this important working paper.

The authors would also like to acknowledge the involvement of Provincial Department of Water Resources and Meteorological staffs, district authorities, commune councillors and members of farmer water user community in Kampong Chhnang, Pursat, Battambang, Banteay Meanchey, Siem Reap, and Kampong Thom provinces, who had been involved in the social assessment, whose names could not be listed here for a reason of space, but who had contributed in many ways to this paper, from field data collection to the writing-up of the notes and giving valuable and helpful information to make this paper is possible.

CHEM Phalla
KIM Sean Somatra
KHIEV Daravy

Summary

In such developing countries as Cambodia whose economy depends largely on agriculture, it is hard to think of anything more crucial than irrigation water. Almost 80 % of the population is engaged directly and indirectly in agricultural production, which is mainly rice. The production of rice had been, until very recently, mostly dependent on rainfall, which makes it very unreliable and unpredictable for farmers.

With water being the most important determining factors for the success of rice and cash crops production, providing farmers with adequate water supply in their field help ensure their production success thus enabling a better living standard for them. Over last few decades, efforts have been made by various factors, including state agencies, private sector, development organizations and donors to develop irrigation sector, putting in place not only the irrigation physical infrastructure but also management mechanisms. Meanwhile, the state and its development partners have been trying to establish a legal framework in order to facilitate a smooth functioning of the irrigation community.

So far, a lot has been achieved in terms of physical irrigation infrastructure development, supporting policy formation and implementation, but more needs to be done to track and understand the process of changes and their consequences. Until now, little has been known about the nature and dimensions of relationship between irrigation policies designed to encourage the development of irrigation sectors and different regulations introduced for the purposes of sustainable water management and conservation. Meanwhile, there is not enough study on the process of policy implementation and emerging politics of resource governance at local level.

This paper is part of a research program funded by the Australian Assistance for International Development (AusAID) in order to contribute in development research and capacity building for water resources governance in Cambodia. It is an exercise for researchers to grasp essential understanding of social, political and economical context of irrigation water in Cambodia at local level. The knowledge gained from it is combined with the understanding of the national policies on irrigation in order to guide the researchers to come up with specific and practical research problems to be the focus of the research program. However, this paper should be treated as a project document, and the every purpose of it is to share with the general research audience our rich empirical data, which is not available or could not be accessible otherwise.

The empirical data brings to light the everyday issues of irrigation water governance at local level. It mostly concerns the issues of coordination between actors, water scarcity in terms of both economical and physical scarcity, water allocation within and between schemes, farmer participation, project evaluation and planning and the emergence of private schemes. As a result, three themes, namely governance, economic and physical, have been identified, and nine research problems have been proposed for in-depth studies in the research program.

1 Introduction

In resource governance dialogue, two concepts are often used to describe a country's resource status. One is physical scarcity, a concept used to refer to countries like Australia where infrastructure is fully developed, or even over developed, to extract the natural resources, but there is not enough of a resource – for example water – to be extracted. The other is the concept of economic scarcity, used to refer to countries with abundant natural resources but which lack the infrastructure to extract them. Cambodia is seen to fall into the latter situation, in particular with regards to water resources. Although it has Tonle Sap lake, the biggest fresh water lake in Asia and it has access to the Mekong river, the longest and biggest river system in Southeast Asia, Cambodia is thought to be lacking the necessary infrastructure to tap into this resource.

There is currently a big push to improve agricultural productivity in order to address rural poverty, in part through increasing reliable water availability to farmers during both wet and dry seasons. Irrigation development therefore can potentially play a major role in poverty alleviation in Cambodia if it is properly managed. The Royal Government of Cambodia has responded to this concern by investing heavily in developing the country's irrigation infrastructure. According the statistic from MOWRAM, 1,120,246 hectares are irrigated land which is around 43 percent of total land cultivation area (MOWRAM, 2009). Meanwhile, efforts have been made to bring about good irrigation management practices. For instance, since 1999, the concept of Participatory Irrigation Management and Development (PIMD) was introduced into the governance of water resources in Cambodia. This concept calls for active involvement from the local farmers in the planning and everyday's management of water resources. The change in governance was marked by the establishment of a local water management body known as Farmer Water User Community (FWUC).

In Cambodia, the poor design and operation/maintenance of existing schemes, many of which were constructed during the Khmer Rouge era, hold lessons for current and future irrigation planning, design and management. Such planning, design and management challenges are not merely technical or physical but social as well. Existing irrigation schemes face problems of water scarcity, maintenance of infrastructure, and allocation of water and management roles within and between schemes (Somatra and Daravy, 2007). Irrigation success depends also on a range of social factors, since water is used and managed by a range of stakeholders at different levels. Further, international experience suggests that changes in institutional arrangements often take a long time to complete and have the potential to engender conflicts associated with reconfiguration of power structures.

To cope with and adapt to the challenges of irrigation expansion and institutional change, usable knowledge in one form or another - western scientific tradition and the informal knowledge of the sort accumulated by indigenous peoples - is required. From a review of the literature and interviews of various stakeholders, in spite of numerous efforts by concerned Cambodian agencies, and other research groups, the limited availability of usable knowledge and tools remains one of major constraints facing the national and regional institutions for the Mekong Basin's sustainable development of water resources (Pech & Sunada, 2006a). The gap between needed and available data has been increasing together with the expansion of the irrigation and other uses of water to

respond to the demands of economic development. From a preliminary analysis of the literature, there appears to be an adequate understanding of the physical (e.g. hydrology), environmental (e.g. land/water use) and biological (e.g. fish stocks) characteristics of the Mekong Basin. The biggest gaps remain in the areas of economic, social, institutional, policy and political knowledge (CERAME, 2002).

The main social knowledge needed to supplement existing knowledge on the natural conditions and trends, includes:

- Economics: What is the economic value of the water resources? What contribution do the resources make to livelihoods?
- Social: What is the composition of the stakeholder groups? What is the relationship between these groups?
- Institutional: What are the main institutional and organizational arrangements which affect the management and use of the water resources for irrigation?
- Policy: What are the current policy arrangements? What is the performance of policy in terms of economic, social and development indicators?
- Politics: How do different stakeholder groups in society affect policy-making and implementation? What incentives could lead to changes in policy and policy-making in order to promote sustainable development? (CERAME, 2002).

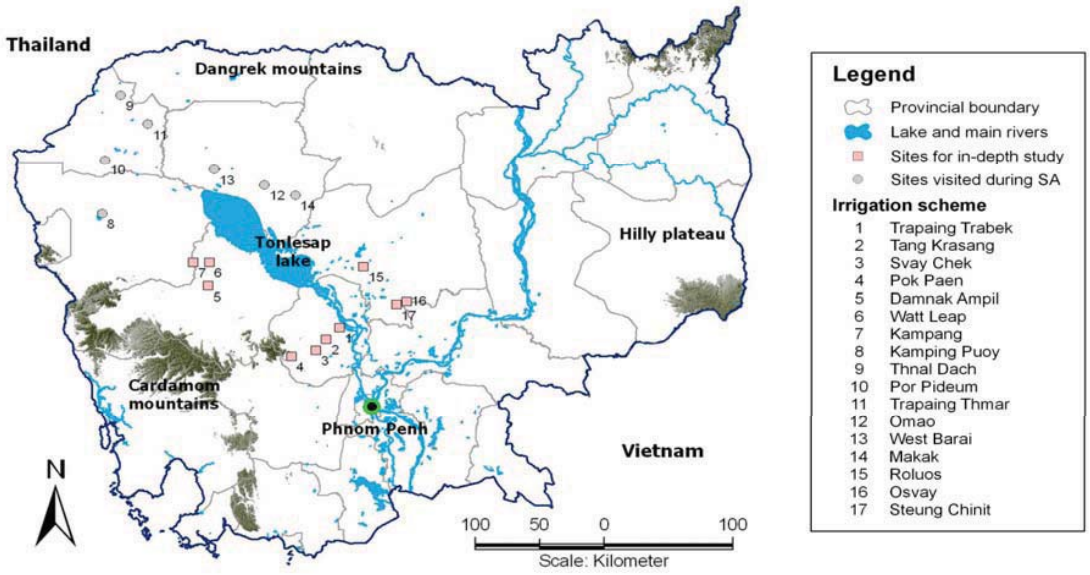
As part of the Water Resources Management Research Capacity Development Program, the Cambodia Development Resource Institute carried out an assessment of irrigation at a number of schemes in the catchment area of the Tonle Sap Lake. This assessment has generated findings and insights contained within this report, and it has also helped set the framework for more in-depth studies at three key sites. This social assessment report is divided into 7 main sections. Following the introduction, section 2 discusses the purpose and methodology of the assessment. Section 3 reviews some of the literature related to water governance both internationally and on Cambodia. Section 4 offers detailed accounts of irrigation-related issues found at 17 irrigation schemes in six provinces in Cambodia. Section 5 discusses key issues arising from field observations. Section 6 concludes the report and finally section 7 links the findings of this report to the gap in research on water governance in Cambodia. This section proposes three research components for further research.

2 Social Assessment of Irrigation

2.1 Purpose

As part of the overall programme of irrigation planning, management and associated research, a social assessment of irrigation for agricultural development is important for many stakeholders, including policy makers, donors or development agencies engaged in water for agriculture and water related development. The social assessment was designed to generate and share knowledge of current achievements and challenges, successes and failures, in sustainable development of irrigation in a wider catchment/basin approach. The findings are important for identifying research themes and a research framework for the subsequent in-depth studies.

Figure 2.1: Map of the Social Assessment Sites



2.2 Methodology

The social assessment was conducted in 17 irrigation projects (small, medium and large scales) located in provinces surrounding the Tonle Sap basin. Those provinces were Kampong Chhnang, Pursat, Battambang, Banteay Meanchey, Siem Reap, and Kampong Thom provinces.

The social assessment was divided into two stages. Stage one had several important aims: to build team work and team spirit; to identify the existing capacity of each team member; and to identify the knowledge and skills required to effectively conduct the main social assessment. Stage two was to develop an interview guide to be used in the main assessment. In this stage, all team members, the University of Sydney team, the CDRI team and the team from the Royal University of Phnom Penh, were asked to come up with a list of questions to be consolidated into an interview guide.

This approach allowed the research project to benefit from the team dimension in a way that ensured an interview guide which was well-informed on the basis of both international theory and local knowledge.

In stage two, the research team used the interview guide to collect data from the 17 schemes. Because the aim of the social assessment was to explore problems prominent in water resources management, in particular at sub-national level, it relied mostly on open-ended questions where the respondents were asked to talk about their everyday experience with water governance. This method enabled the research team to explore and gain a general understanding of the main issues people face in their everyday lives with regards to irrigation and water resources governance. A further step was also taken by the team in the interest of the validity and applicability of the interview guide. The research team selected one province, Kampot, which is not in the intended area of study, for a pilot test of the guide. The team spent three days in Kampot province testing the interview guide. Some minor changes were made to the content of the guide and some interview techniques were adapted to allow the respondents more time to answer.

This study relied on a very robust technique of data collection and triangulation. It employed participatory rural appraisal techniques (PRA) such as project mapping, focus-group discussion (FGD), and a project impact timeline to conduct the assessment. The research team started off the data collection from each site with a visit to the provincial department concerned. The research team met with directors and/or representatives from the provincial departments of water resource, agriculture, rural development, land use and planning and fisheries to talk about resource governance in each area. Each department was asked about their role in water governance, their success and the challenges they had faced so far. As a result, the research team gained an understanding of institutional arrangements for water governance, and an understanding of how each actor relates to one another. The research team also gained from meetings with state officials at the provincial level a general understanding of what each community is like. Next, the research team explored these issues from the perspective of the local community. By doing so, the research team could obtain not only an understanding of everyday issues of water governance, but also insights into some of the practices that were not based on formal institutional arrangements. In addition, this process allowed the research team to triangulate the information they obtained.

The preliminary assessment concluded that crucial dimensions for the main social assessment should include coordination, water scarcity (shortage), water allocation (both within and between schemes), participation in irrigation management and impacts of irrigation on rural socio-economic development (including impacts of upstream uses on downstream uses).

3 Literature Review

This section only discusses Cambodia-specific literature for the fact that the research teams already produced a comprehensive report discussing international literature on water resource governance (See CDRI 2008).

3.1 Overview of Water Availability and Irrigation Development Effort

The geography of Cambodia is characterised by a central plain in the centre of the country which is surrounded mostly by mountains: Cardamom in the west, Dangrek in the north, a hilly plateau in the east, and coastal areas in the southwest. The main water resources are the Mekong river and the Tonle Sap Lake and their many tributaries. 86% of the inland water drains into the Mekong system. Water availability is 75,000 million m^3/year of surface water while available groundwater was estimated to be 17,600 million m^3 (MOWRAM & CNMC, 2003). Only 14% drains into the coastal areas.

Based on both water availability and geography, Cambodia has the potential for water sector development to improve sustainable food security and livelihoods, for domestic water supply for humans and livestock, for sanitation and for recreation. Risks associated with drought and floods can be managed through better planning and implementation of sustainable water management policies (JICA, 2006 cited in CDRI, 2008).

Currently only about one percent of total available water, or about 750 million m^3, is used. Approximately, 95% of the water used is in the agricultural sector. In total, 2,615,741 hectares of land are under paddy rice cultivation in 2008 (MOWRAM, 2009). Most of these paddy rice cultivated areas are rain-fed. According to statistics from the Ministry of Water Resources and Meteorology, about 1,120,246 hectares were under irrigation in 2008. In percentage terms, this means 42.82% of the total paddy rice cultivated area. Amongst these irrigated areas, 347,058 hectares were dry season irrigation and 773,188 hectares were wet season supplementary irrigation (MOWRAM, 2009).

3.2 Overview of Legal Framework for Water Resources and Irrigation Management

Water is considered to be Cambodia's most abundant resource. Due to its seeming abundance, there were not many laws and/or regulations for how water resources should be managed prior to the establishment of the Royal Government of Cambodia in 1993. Water resources management, the management of irrigation water in particular, used to be the default duty of local state actors namely the village chiefs (Perrera, 2006). But privatization in the late 1980s, which opened up space for a private sector role in water extraction, changed the way water was perceived, from water as a common pool resource to water as private property mostly in connection with land ownership. In the meantime, the establishment of the Royal Government of Cambodia in 1993, which marked the shift of the country's political system to democracy, allowed the country to be integrated with the world community and thus opened up a broad space for civil society and international non-governmental organizations to influence the country's policy dialogue. I

In the context of water governance, some of the current laws and regulations are listed as follows:

- Constitution of the Kingdom of Cambodia (1993). Article 58 and 59 state that water is owned by state and the state has an obligation to plan for management (Jennar, 1995 cited in CDRI, 2008).
- Strategic action plan on the management and development of water resources and meteorology – phase II (2009).
- Law on water resources management (2007).
- National policy on water resources management of the Kingdom of Cambodia (2004).
- Circular No 1 on implementation of sustainable policy of irrigation system including the preparation of statute of farmer water user community (2001).
- Prakas (proclamation) 306 on establishment and development of farmer water user community (2000).

In addition, the Royal Government of Cambodia has taken further steps in drafting new laws and regulations in response to criticism that the governance of water resources in Cambodia has not been as effective as it should be, particularly in regard to management of local water resources by local communities, water scarcity and an integrated approach to water resources management. Currently, four sub-decrees around these issues have been drafted and are pending approval:

- Sub-decree on procedure of farmer water user community establishment.
- Sub-decree on water allocation and licensing.
- Sub-decree on river basin management.
- Sub-decree on water quality.

Due to the importance of water as a source of both life and livelihood, the management of water involves multiple actors including the state, the private sector, local communities and NGOs. The most important government institutions involved in water resources management in Cambodia (Rapid Institutional Assessment of Water Resources, 2004) include:

i. Ministry of Water Resources and Meteorology (MOWRAM). MOWRAM is responsible for:

- Defining policies and developing strategies for water resources management and development.
- Research and investigation of water resources.
- Preparing plan for water resources development and conservation.
- Flood and drought warning.
- Managing direct and indirect water use, as stated in the ministry's mission statement, and mitigating water-related disasters.
- Gathering and managing data and information about surface water and groundwater and meteorology.
- Technical advice.
- Coordinating international collaboration including the Mekong Basin.

ii. Ministry of Agriculture, Forestry and Fisheries (MAFF). MAFF is responsible for:

- National food security, agricultural land-use planning (Department of agronomy and agricultural land improvement).

- Fishery-related impacts of regulation and other intervention (Fisheries Administration).
- Watershed management reforestation (Forestry Administration).
- Water related responsibilities includes:

  ✓ Development of strategy and policy for agriculture, forestry and fisheries related to water resources management.
  ✓ Management of forest which has relevance to watershed condition and hydrology and water quality.

iii. Ministry of Industry, Mine and Energy (MIME). MIME is responsible for:

- Planning for industrial water use and hydropower.
- Provision of water supply to provincial towns.
- Preparation of policy on water supply and sanitation.
- Administration of single-purpose scheme involving hydropower.

iv. Ministry of Rural Development (MRD). MRD is responsible for:

- Hydro-geological research, data collection.
- Water supply and sanitation, land drainage in rural areas.
- Preparation of policy on water supply and sanitation for rural areas.
- Awareness building on safe water consumption.
- Small scale irrigation.
- Preservation of environment and natural resources in rural areas.

v. Ministry of Public Work and Transport (MPWT). MPWT is responsible for:

- Land drainage and sewerage in Phnom Penh and provincial towns.
- Study, survey and construction of river works for navigation and water transport.
- Solid waste management.

vi. Ministry of Environment (MoE). MoE is responsible for:

- Protection of natural resources and environment from degradation. Its legal mandate includes water in the list of resources for which it is responsible.
- Dissemination of water related information.
- Water quality monitoring and pollution control including monitoring wastewater discharge.

vii. Phnom Penh Water Supply Authority (PPWSA). PPWSA is responsible for water supply and sanitation in Phnom Penh.

viii. Phnom Penh Municipalities has some public water supply system operations and is responsible for drainage and sewerage within their areas of jurisdiction.

ix. Ministry of Planning (MOP). MOP is responsible for:

- National 5-year socioeconomic development plans.
- National public investment plan (/PIP).
- Census, socioeconomic survey and development indicators (National Institute of Statistics).

x. Cambodia National Mekong Committee (CNMC). The CNMC is responsible for:

- Advising the Cambodian representative to the MRC Council on all matters relating to activities with the Mekong River Basin that could affect Cambodian Interests.
- Review of proposal prepared by the Royal Government of Cambodia agencies in the light of the Mekong Agreement.
- Coordination between MRC and concerned ministries of the Royal Government of Cambodia.

xi. Cambodia National Disaster Management Committee (CNDMC). CNDMC is responsible for emergencies related to flood and drought, etc.

xii. Ministry of Health (MoH). MoH is responsible for:

- Controlling the quality of surface and groundwater used for public water supply.
- Health education and other matters related to public health.

xiii. Ministry of Economic and Finance (MEF). MEF is responsible for:

- Compiling the socioeconomic development programme and public investment programme.
- Harmonizing the proposals for water-related investments and matching them against the government priorities.

xiv. Development Committees. Some development committees at provincial, district, commune and village levels have responsibility for socioeconomic development initiatives in water supply and sanitation and in irrigation.

3.3 Overview of the Strategic Action Plan on the Management and Development of Water Resources and Meteorology – Phase II: 5 year (2009-2013)

Water is perceived as a key sector for contributing to poverty reduction goals through managing natural disaster, providing enough water for paddy and other crop irrigation, ensuring food security and domestic water supply, and sanitation. The Strategic Action Plan on Development and Management of Water Resources and Meteorology of MOWRAM was designed to enhance the implementation of the Rectangular Strategy – Phase II (2009-2013) of the Royal Government of Cambodia. The Rectangular Strategy articulates the:

1. Enhancement of agricultural sector.
2. Further rehabilitation and construction of physical infrastructure.
3. Private sector development and employment generation.
4. Capacity building and human resources development.

In order to ensure the equitable access of the population to water, the Water Vision of the Kingdom of Cambodia is:

- Ensure access to water for all,
- Access to safe, adequate, and affordable drinking water,
- Provide sufficient water for agriculture, industry and economic activities,
- Tackle and minimize all form of threats of loss of life and livelihood as a result of water related hazards,

- Manage the water resources in a sustainable manner.

In order to achieve this water vision, the National Policy on Water Resources Management of the Kingdom of Cambodia aims at ensuring effective and sustainable management of water resources through:

- Protecting, managing, and using water resources in a sustainable manner.
- Predicting and assisting related institutions to settle conflicts.
- Developing and implementing the national strategy on water resources management.
- Directing water resources development, management and utilization across institutions, private and public sectors.
- Improving and uplifting living standards to achieve the national goal of poverty reduction and sustainable national economic development.

MOWRAM, which operates on the basis of the national policy on water resources, plans to achieve its goal of increasing the irrigation area to 50,000 hectares each year from 2009 to 2013. In order to achieve this policy, MOWRAM strategies include:

- Administrative reform and human resources development.
- Management and development of water resources.
- Flood and drought management.
- Information management on water resources and meteorology.
- Fostering the preparation of law and regulations and sustainable water sector development.

The National Policy on Water Management was drafted in 2004. The Law on Water Resources Management was approved in 2007. Although the law states that it aims to manage water resources in an effective and sustainable manner, there are some challenges to these aims. The lack of cooperation among relevant institutions and the establishment of the water law retrospectively are two challenges faced.

Ineffective management of water resources has many causes. Inadequacy of the legal instruments for water and agriculture is one problem. Unclear roles and responsibility of relevant institutions and other stakeholders leads to overlapping roles, made more problematic due to a lack of cooperation between stakeholders. Another issue is that the information kept on agriculture and water among stakeholders, especially by MOWRAM and MAFF, is inconsistent, which leads to problems with achieving an effective master plan for water and agriculture management and development. Despite the fact the Strategic Plan on Water and Agriculture is prepared by MOWRAM and MAFF and other stakeholders together, the implementation of the strategic framework is on an individual basis.

3.4 Overview of Integrated Water Resources Management Implementation

The National Policy on Water Resources Management (2004) is at the centre of strategic planning for water management and development. The national policy emphasizes integrated water resources management, especially river basin management. However, implementation of Integrated Water Resources Management (IWRM) is still limited. So far, only a few projects have taken an integrated water resources management approach (Water Resources Management in Cambodia, 2008). The projects which have used IWRM include:

- Northwest Irrigation Sector Project.
- Study on Comprehensive Agricultural Development of Prek Thnot River Basin.
- Basin-wide Basac Irrigation and Drainage Master Plan Study.
- Water Resources Management Sector Project.
- Establishment of Master Plan of Water Resources Development in Cambodia.
- Krang Ponley River Basin Management and Development.

Currently, MOWRAM and MAFF (2007) are jointly implementing five strategic programmes under the Strategy for Agriculture and Water 2006-10. These five programmes are:

1. Institutional capacity building and management support programme for agriculture and water resources.
2. Food security support programme.
3. Agricultural and agri-business (value change) support programme.
4. Water resources, irrigation and land management programme.
5. Agricultural and water research, education and extension programme.

4 Field Observations

This section provides detailed information on water governance issues and challenges for each irrigation scheme studied in the social assessment. This empirical data was collected from 17 irrigation schemes in six provinces around Tonle Sap lake.

4.1 Trapaing Trabek Scheme, Kampong Chhnang

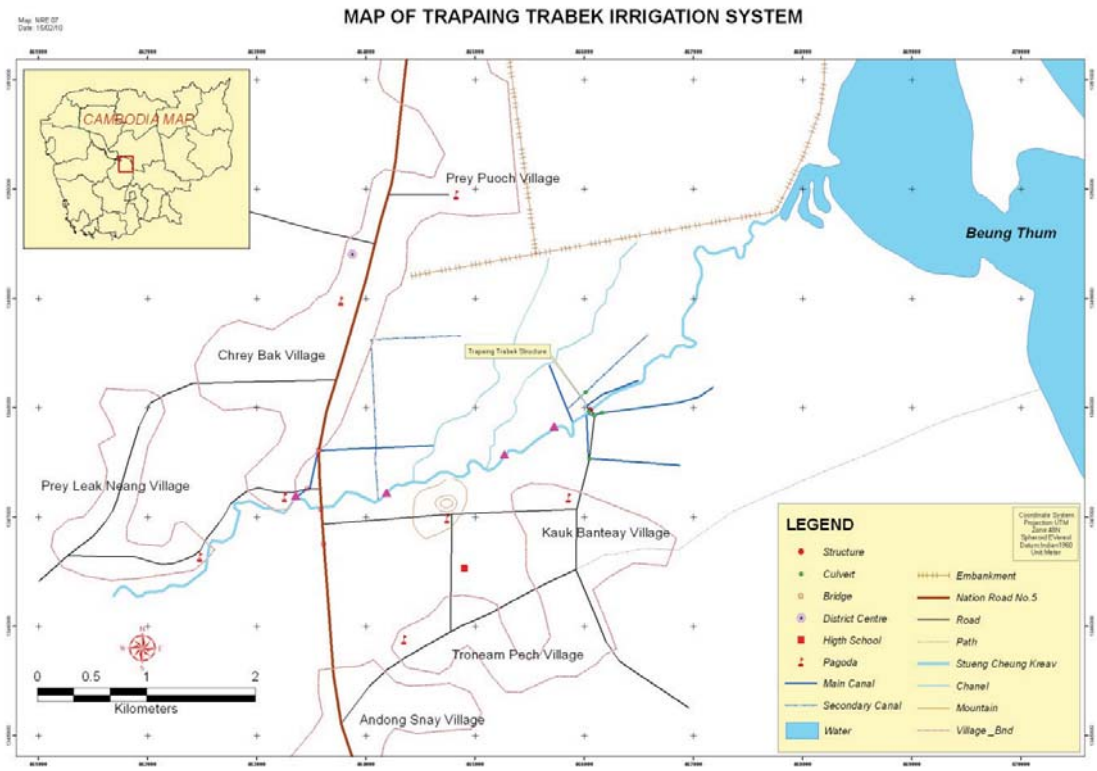
The schemes presented in section 4.1, 4.2, 4.3 and 4.4 extracts water Stung Chrey Bak catchment in Kampong Chhnang province, and are ordered from downstream to upstream respectively.

Trapaing Trabek is the scheme furthest downstream in the Stung Chrey Bak Catchment (Figure 4.1). Most of the scheme's command area is located in the flood plain of the Tonle Sap River. The scheme's command area lies in the lowest part of the district and is submerged under water for most of the wet season. Traditionally, local farmers could only grow floating rice, but due to the highly fluctuating nature of floodwater, the crops were often destroyed. The first attempt to mitigate the impact of floodwater was in 1987, when a water gate was built by an agriculture collective association or a cooperative known by the locals as *krom samaki*. The construction of the gate was accompanied by government assistance in the form of a ploughing service and pumping station. Local farmers recall that in 1987 the government agencies sent dozens of tractors to help local farmers plough their fields. At the same time, a pumping station was set up to pump water into the rice field when needed. These attempts at irrigation, however, were not successful. The pumping station could not supply water due to the poor management of the pumping stations (e.g. loss of petrol stolen by its operators). Without adequate water supply, the crops failed and the scheme was abandoned.

The picture on the left hand side as shown below shows the activities of researchers and FWUC leader while they were surveying the command areas of Trapaing Trabek irrigation scheme. The picture on right hand side shows the weir structure that built across the the Stung Chrey Bak stream. During the dry season, the weir's gates were always closed to store water in the stream and to raise water level in the reservoir high enough head to flow into the main canal then into the rice field. When too much water was extracted, water level in the stream becomes very low. For such condition, farmers need to pump water from the stream into the main canal.

Picture 1: Rice Field and Weir Structure of Trapaing Trabek Irrigation Scheme

Figure 4.1: Trapaing Trabek Irrigation Scheme, Kampong Chhnang Province



In 1991, with funds and technical support from the American Friends Service Committee (AFSC), the weir was re-built. The management of the scheme was the responsibility of a group of local farmers who were active in the community and who also owned farmland in the command area. In 2001 this group of farmers was formally recognised as Farmer Water User Community (FWUC). In the beginning, the community consisted of a committee with 15 members, 5 of whom were female and all of whom were nominated by the commune council and local people.

The concept of an irrigation service fee (ISF) was introduced in 2001 with the belief that it would help sustain the work of the community. The fees were divided into two categories. Farmers who got water through gravity irrigation paid 20,000 Riel per hectare annually and those who got water through gravity and pumping paid 10,000 Riel per hectare annually. In reality, however, farmers usually refused to pay the service fee to the FWUC on the basis of poor irrigation service provision. Currently, only some irrigation users pay the ISF of 10,000 riel per hectare to the FWUC.

Initially the rehabilitation did not result in a significant increase in dry season rice area and only 30 hectares of dry season rice was cultivated. However, the rehabilitation resulted in a significant increase in dry season rice yields - an average of three tons per hectare compared to one ton or less previously. Some farmers report an even higher yield of up to seven ton per hectare. This seemingly successful case of dry season rice cultivation encouraged local farmers to convert from floating rice to dry season rice farming, resulting in rapid expansion of the command area. Concerned by the excessive expansion, the FWUC's committee tried to control access by new farmers to the water in the scheme. According to the FWUC operation manual, the FWUC's committee is in charge of controlling access to the scheme. Farmers wishing to join any irrigation scheme have to apply for a permission to use water from the FWUC's committee, and the committee is supposed to make

a decision as to whether to grant permission or not based on the actual water condition of the scheme. But the reality is often quite different. The right of access to water is often thought to be associated with the right to land. That is land ownership is thought to ensure access to water sources near the land, and land transaction is the management of commune or village chief but not the chief of the FWUC's committee. As a consequence, the command area had reached 500 hectares by 2007, and more farmers were planning to join in.

The over-expansion of the command area resulted in a lack of water. This was particularly evident in 2005/06. Dry season rice cultivation generally starts in mid November and finishes in March. By the end of February 2006, however, when rice plants need water the most, the water level in the scheme fell rapidly causing a general panic. Farmers simply ignored the water allocation arrangements, and frantically tried to pump as much water from the scheme as possible to make sure their crop survived. According to members of the FWUC's committee, up to 40 pump engines were employed by individual farmers to pump water into their field.

By its statute, the FWUC's committee is in charge of allocating water and enforcement, but it does not have the mechanism or necessary support to carry out those tasks. One FWUC committee member said: "How can we do it, when they [farmers] have axes and long knives in their hands, so just let it be." Even intervention from a local authority, such as the Commune Chief does not always help. For example in 2006 at the peak of the water shortage, the competition for water was fierce, and the committee asked for intervention from the Commune Chief, who wrote a letter with the commune stamp requesting people to follow the allocation arrangement devised by the FWUC's committee; no farmer could take water unless it was their block turn to take water. According to the head of the FWUC's committee, the farmers tore the letter to pieces, saying: "we eat rice not paper." The competition for water continued until all of the water was gone and the scheme dried up.

With nothing left to compete for, the conflict ended and a sense of cooperation arose. Farmers worked together to find a solution. Farmers in Trapaing Trabek believed that the problem of water shortage was caused by people upstream who used all the water. Regardless of what the regulation on water sharing says, the farmers feel that it is acceptable for people upstream to take the water: "water flows through their village, so they can do anything to it." The solution they came up with was to negotiate with the upstream FWUC. According to FWUC committee's members, local farmers raised 1000 riel ($0.25 cent) each for their FWUC member to travel to negotiate with the FWUC upstream in Tang Krasang. The negotiation resulted in water being released from upstream, but water reached Trapaing Trabek only briefly. Farmers still suffered from lack of water and some of the crop was destroyed. But during the last 2 years (2008 and 2009), farmers in Trapaing Trabek did not face many water shortage problems, as they received adequate flows from upstream.

The head of the FWUC sees the long-term solution to the water shortage as an expansion of the scheme. There have been attempts to enlarge the river bank just before the scheme structure in the hope that it can store more water. However, these attempts have been met with many challenges. The expansion of the scheme requires land space which farmers currently occupy/cultivate. There is also no available budget for expansion. The FWUC's committee can barely collect enough revenue for the operation and maintenance of the scheme, let alone anything else. The head of the FWUC tried to integrate the scheme expansion plan into the Commune Development Plan but this attempt failed: An irrigation scheme is perceived to be semi-public property. That is once a scheme is built in a village, it is seen to benefit only people in the targeted villages. As a result, the commune development committee members who represent other villages vetoed the

proposal to use the commune development budget to finance the expansion of a scheme that will benefit only one area.

4.2 Tang Krasang Scheme, Kampong Chhnang

Tang Krasang is one of the four schemes built on the Stung Chrey Bak river (Figure 4.2). Although this scheme shares the same catchment with Trapaing Trabek scheme, it has a rather different characteristic in that it is geographically situated in a fairly upland area. Its command area is not subject to flood water from Tonle Sap river or lake, and the purpose of the scheme, to date, is for wet season supplementary irrigation. This scheme was built in 1976. It was later rehabilitated by American Friend Services Committee (AFSC) in 1985. It was renovated again in 2001 by European supported programme called the Rehabilitation and Support Programme for Cambodia's Agricultural Sector (PRASAC). The scheme consists of a dyke, main canal and five water gates. Unlike the Trapaing Trabek scheme, the Tang Krasang scheme was built on a wide part of the river, which acts like a reservoir to store extra water flowing from upstream. However, the reservoir does not do a good job of storing/regulating flow and water level, due to its relatively small water storage capacity, about 279,000 m^2 with an average depth of about 1 meter (compared to the spillway's crest elevation). In the wet season, due to the large amount of rainfall in the catchment, this scheme is often threatened by floods, and water sometimes overflows the scheme (before 2001). But in the dry season, there is barely any water in the reservoir, and there is only a small stream of water to replenish it.

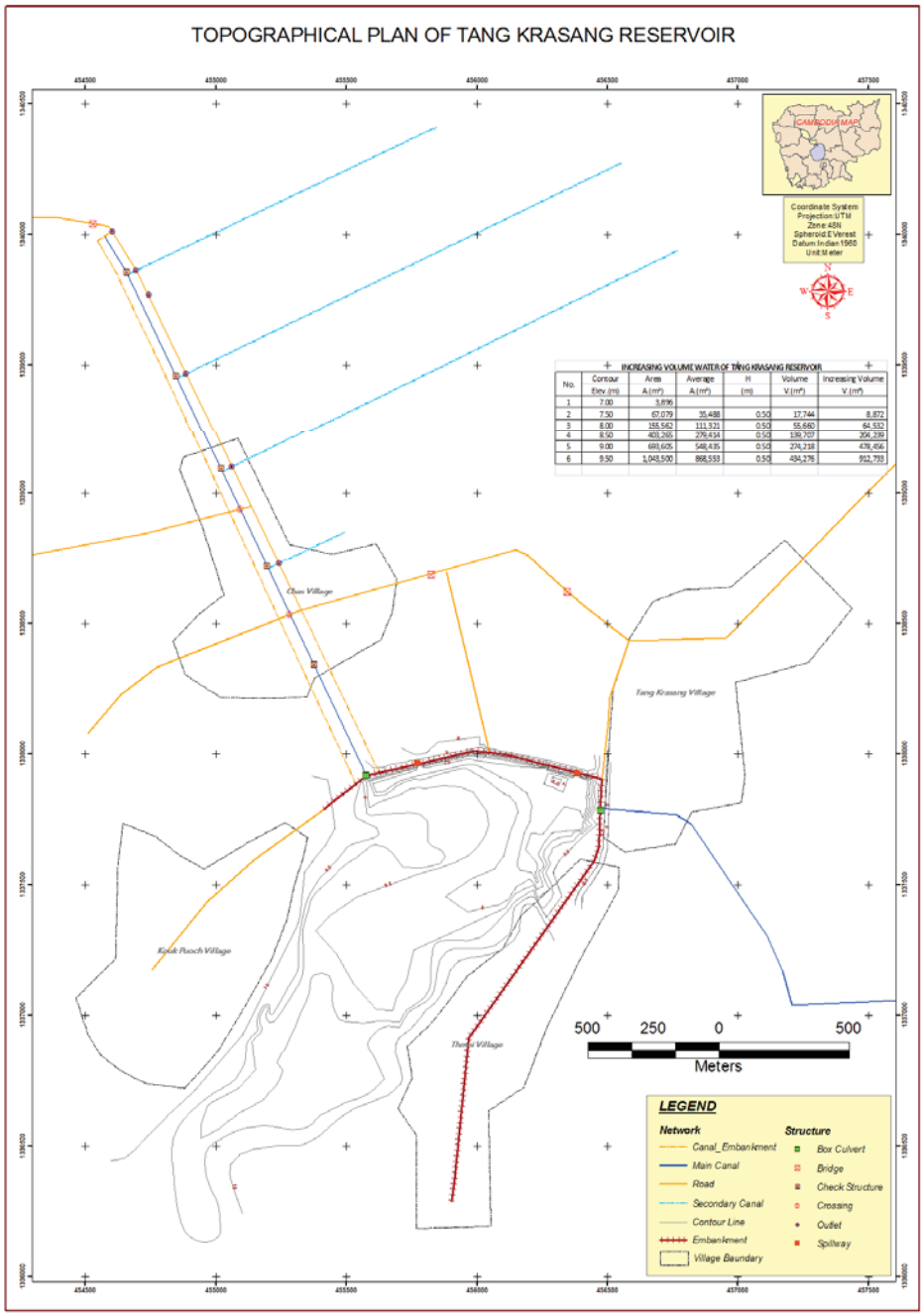
Farmers in this area do not grow dry season rice because they traditionally let animals roam freely on this land in the dry season. Farmers also believe that the cultivation of dry season rice does not result in good harvest as there is a high risk of insect attack, and thus crop destruction. It is also believed that dry season rice is more susceptible to insect destruction as the cultivation area is significantly less in dry season than the wet season. Therefore not many farmers cultivate their field in the dry season.

The FWUC committee consists of five members. These members were enthusiastic in the beginning, as they believed the restoration of the scheme would result in more dry-season rice farming. This in turn would be a source of revenue for the FWUC not just for their salaries, but also for operation and maintenance of the scheme. However, as in other cases, the FWUC is facing a situation of shrinking membership in the committee. By 2007, 2 of the 5 members had quit, as they saw no benefit in staying with it. The remaining members are those who already hold official positions in the area. For example, the head of the FWUC is the Commune Chief, and his reason for staying with the FWUC is because, as he explained, whether he wants it or not, it is "his duty as a commune official to have responsibility over the scheme located in his commune". Farmers in this area, like in others, are not willing to pay the irrigation service fees for wet season rice as they perceive water as a public good, and therefore it should be free.

For the committee members, running the scheme is not an easy task. Irrigation schemes are subject to damage by erosion and/or floods, and they require regular maintenance. In times of floods, the members have to patrol the dam to detect vulnerable spots where water could potentially breach the dam. When they find weak spots, the FWUC have to call for contributions, usually in the form of labour, from the villagers. In the dry season, the FWUC's committee has to open and close the water gate in response to the needs of the farmers in the area. Although this job does not sound big, it is made difficult by the poor physical condition of the scheme. For example, one of the gates does not work properly, and to open it requires 5 to 10 people.

On the conflict with the farmers in Trapaing Trabek, the FWUC's committee claimed that they did not intend to kill crops further downstream by using all the water upstream. It was simply a general lack of water that was the problem. In the dry season, the water from the scheme is used only for domestic consumption and livestock. Farmers do not grow dry season rice and even if they wanted to retain all of the water, they do not have the ability to do so. The reservoir can hold around 204,000 cubic meter of water, enough to irrigate around 10 hectares of dry season rice. In 2005 and 2006, when people from Trapaing Trabek came to request the release of water, Tang Krasang's FWUC claimed that they opened all of the gates and after a few hours the reservoir was completely empty. The Tang Krasang's FWUC members noted that there were a few makeshift dams on the river between the two schemes.

Figure 4.2: Irrigation Scheme of Tang Krasang, Kampong Chhnang Province



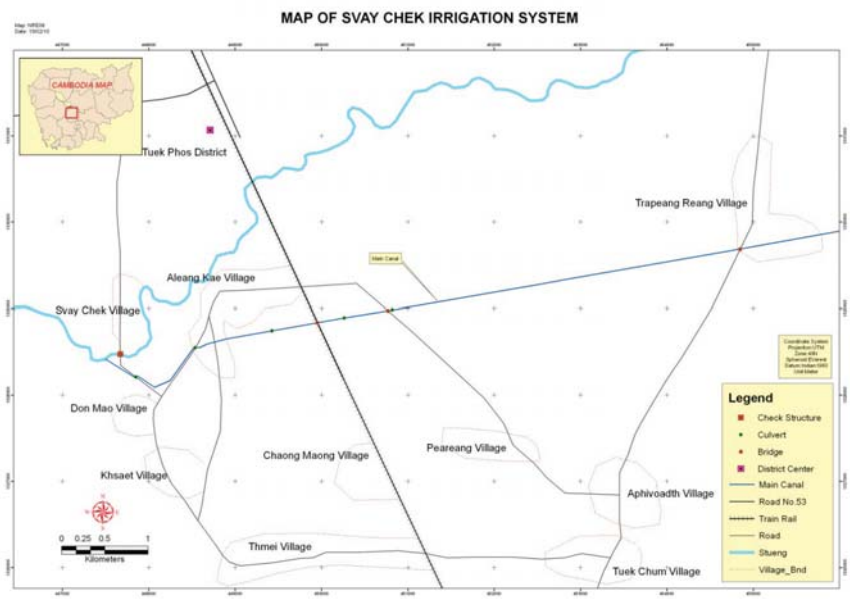
4.3 Svay Chek Scheme, Kampong Channang

Svay Chek scheme is the third irrigation scheme downstream in the Stung Chrey Bak Catchment (Figure 4.3). A wooden structure was first built in 1973. It is not known if the scheme was functional or what it was used for during that time. But farmers reported that about a hundred hectares of dry season rice was cultivated during 1975 and 1979. In 1981, a new wooden structure was put in place in the river. Local people were recruited to go into the forest to collect logs and build it. In 1989 it was rehabilitated again by AFSC. At that time the scheme could supply water for wet season rice supplementary irrigation. In 2005 a water gate was built by World Food Programme (WFP) and the commune development fund.

Although this scheme was designed for the purpose of wet season rice supplementary irrigation some farmers are not happy with it. Some local farmers complained that they became worse off after the scheme was built, with their paddy fields becoming dryer. This is due to the fact that most of the soil content in the area is of a sandy type. It does not hold water well, and the canal system in the scheme's command area was made in a way that results in the level of water in the scheme being lower than that in the rice field. This means in practice that water slips back into the canal after rainfall or after the farmers pump water into their field. Farmers report that it takes away the fertilizer that they apply to their field. After 1979, dry season rice has not been practiced in this area. In the dry season farmers resort to supplementary sources of income such as palm production, logging and collecting firewood. Some people also go to work in Pailin province or the garment factories in Phnom Penh.

Despite the fact the scheme has existed since 1973, there is no FWUC. One person is hired by PDOWRAM to manage the scheme. He is in charge of allocating water in response to the demand that mostly comes from those in Chvay Chet and Akphiwat villages. When people in Akphiwat village need water, they make a request to the Commune Chief for water to be released, who then informs the gatekeeper of their needs. Sometimes after notifying the Commune Chief and the gatekeeper, the people have to open the gate themselves as it is not done.

Figure 4.3: Irrigation Scheme of Svay Chek, Kampong Chhnang Province



Although the scheme controls the amount of water flow to Tang Krasang and Trapaing Trabek, the gatekeeper did not seem to be aware of what happened there. It appears the gatekeeper's main responsibility is to make sure that the people in the immediate locality have water for domestic consumption and livestock. In the dry season, the water gates are generally closed (especially between January and February) to maintain the desired level of water in the scheme. In the rainy season, more gates are opened to release the excess amounts of water, but to still maintain the desired level. However, the gatekeeper has to constantly monitor the rain in the catchments. "If it rains much in the catchments I have to open all of the gates; otherwise the flood water will wash away the scheme. Then I will be in big trouble because I am paid 10,000 riel per month to make sure that the scheme does not get destroyed by flood," said the gate keeper in Svey Chek.

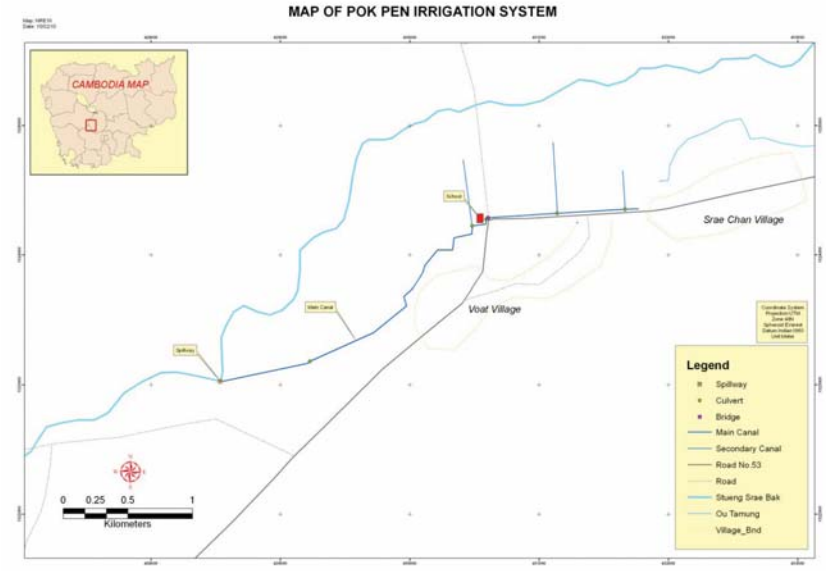
It should be noted here that the FWUC in Trapaing Trabek has accused people upstream of 'being mean'. They believe that when their rice needs water the most, at the end of February, the people upstream stock all of the water releasing water only to flood their own fields during harvest time. But it seems that what happens downstream is not the business of the people upstream. As suggested by the quote seen earlier, the gate keeper is accountable to keeping the irrigation structure working, but not to respond to the needs of the people downstream.

4.4 Pok Paen Scheme, Kampong Chhnang

Pok Paen scheme is the fourth scheme downstream in the Stung Chrey Bak Catchment. It was first built in 1969 but construction was not completed. Farmers used wood and stones to block water in the stream to divert water into the main canal.

The scheme was rehabilitated again in 2005 by PDOWRAM. The irrigation scheme consists of diversion weir, main canal and secondary canals. A FWUC was formed with a serving committee to take over responsibility of the scheme. Today, the scheme has witnessed an increase in the area of wet season rice cultivation from 250 hectares prior to 2006 to 620 hectares. The farmers in this area do not grow dry season rice as in dry season water levels run low in the canal. This is partly due to the fact that the scheme is situated in a relatively highland area, and it is also due the general lack of rainfall in the dry season in Cambodia.

Figure 4.4: Irrigation Scheme of Pok Paen, Kampong Chhnang Province



4.5 Damnak Ampil Scheme, Pursat Province

Stung Pursat stream is one of the few rivers in Pursat province. Like most other streams, Pursat stream has its catchment area in the upland and mountainous areas of the Cardamom mountain. This stream cuts through the province and empties into Tonle Sap lake.

Damnak Ampil is one of the large scale irrigation schemes in Pursat that has recently been restored. This scheme was built in 1978 and consisted of a diversion weir, a main canal, and some sub-canals (Figure 4.5). The weir was designed with wooden gates. The main canal stretched over irrigated areas some 30 kilometres to the north-west of the scheme. However, the scheme never functioned properly, and both the weir and the canal had been left to ruin. After a visit to the site in 2004 by the Cambodian Prime Minister, the scheme was rehabilitated. The automatic tilting gate weir was rebuilt in 2006 and seven kilometres of the 30 kilometres of the main canal was repaired.

In 2005, a Farmer Water User Community (FWUC) was set up. Members of the FWUC come from across the seven communes involved. The FWUC's committee proposed a monthly meeting for reporting activities and planning for water management and cropping. However, the meetings do not happen regularly as planned. The main reasons for this may include:

- Several members live far from the FWUC's office – the meeting venue. They have to travel for half a morning to get to the meeting place.
- Members must commute by their own means of transport, and bear travel expenses out of their own pocket;
- There is no financial mechanism to sustain the FWUC. The ISF was set in rice terms at a rate of 100 kg of rice per ha per season (gravity) and 60 kg of rice per hectare per season (pump). However, the FWUC has not been able to collect any fees so far. The wet season rice farmers strongly object to the fees, arguing that Cambodians, by tradition, have never had to pay for water to grow rice, and that they can get the rainwater for their field without having to rely on irrigation. This leaves the FWUC only one possibility of collecting fees. That is from dry season rice irrigation service. However, the likelihood of this happening is very low.

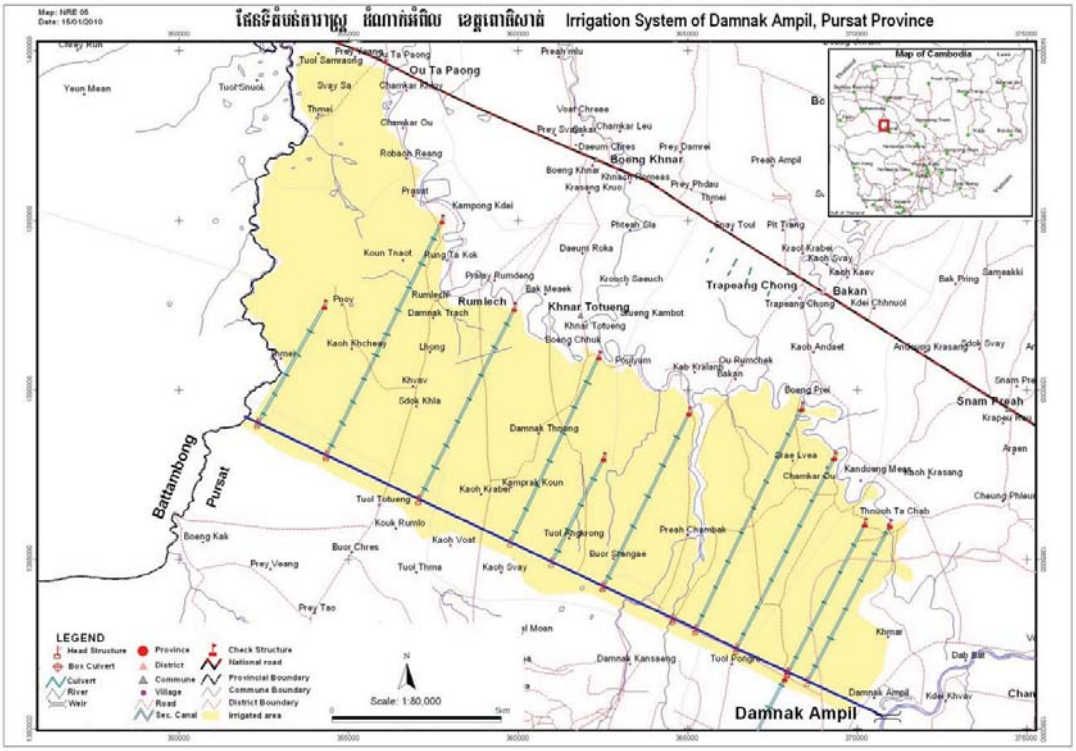
There seems to be a general inability on the part of the local farmers to benefit from the scheme due to the scheme incompleteness. According to PDOWRAM, the scheme is designed to irrigate some 20000 hectares of wet season rice and some 5000 hectares of dry season rice. But in actual fact, only plots located immediately next to the primary canal can access water in the scheme. Thus the system can only actually irrigate around 20 or 30 hectares of land along both sides of the main canal. Farmers explained that they cannot access water in the scheme because the scheme has only a weir and main canal. The remaining part of the main canal, as well as the secondary and the tertiary canals have not yet been repaired.

When farmers whose land is located along the main canal were asked if they would grow dry season rice in the coming season, most of them noted that they would not. The main reasons are economic and operational. To undertake dry season rice, they would have to have a way to pump water from the reservoir or main canal to irrigate their field. They then have to invest in a water pump and energy (oil or electricity) - an investment, most of them claimed, is beyond their financial capacity.

Another hindrance to using the irrigated water supply is the challenge of protection their rice fields and crops from free-roaming domestic animals (cows, buffalo etc). Traditionally farmers in this

area only keep a close watch of their animals in the wet season. In the dry season, the animals are allowed to roam free in the fields. The introduction of irrigation infrastructure has made it possible for farmers to adopt the practice of dry season farming, but there has not been any change in the animal control arrangements. This means farmers do not want to start dry season cropping for fear of getting into conflict with the animal owners.

Figure 4.5: Irrigation Scheme of Damnak Ampil, Pursat Province



4.6 Kampang Scheme, Pursat Province

Kampang scheme is located in the western part of the Pursat province, about 35 kilometres from the town of Pursat, and about 30 kilometres from the Damnak Ampil scheme (Figure 4.6)

Kampang scheme, unlike most schemes in Cambodia, was built in 2004 with a loan from the World Bank under its emergency flood response programme. The scheme is built on Svay Daunkeo river, one of the rivers in Pursat province. It consists of a concrete diversion weir with wooden stop-log.

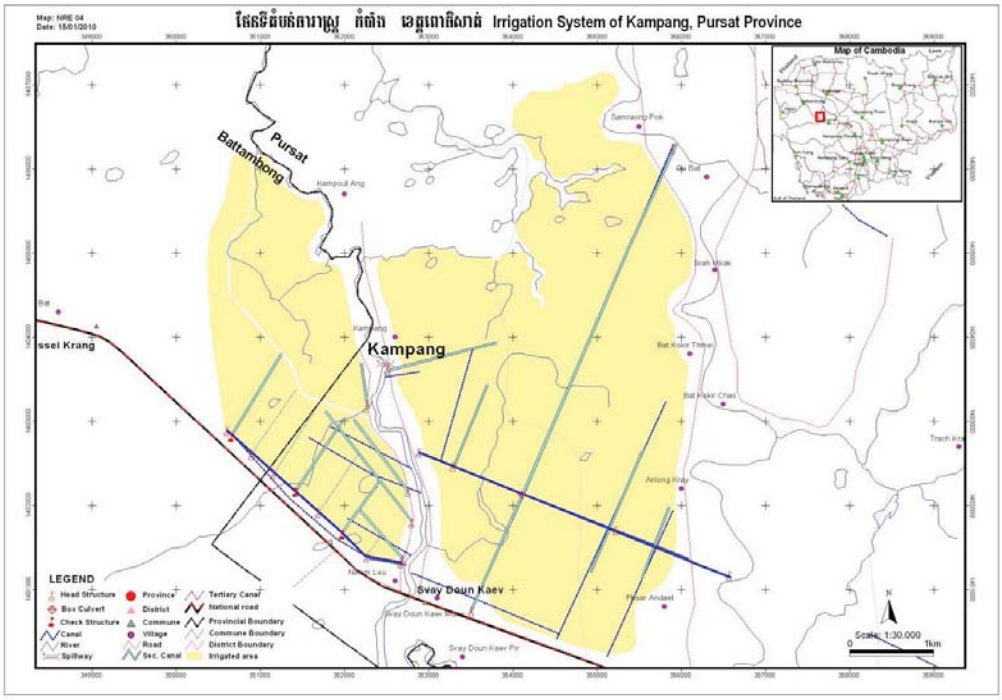
FWUC was set up in 2004 with committee members from two communes: Svay Daunkeo and Otapong. The FWUC is responsible for managing irrigation, including operation, fee collection and maintenance. Unfortunately, after the completion of the scheme, the area suffered from a series of droughts that lasted until 2006. The drought left a general shortage of water in the area. For those years, the wet season rice suffered from lack of water, and the river was dry. The operation of the FWUC was put on hold as the scheme became lifeless in the dry season.

However, in 2006, there was renewed interest in the scheme as there was plenty of water. Local farmers started to extract water to irrigate their dry season rice, and in that year some 70 hectares of dry season rice was cultivated. The success of the dry season rice farmers in 2006 and the recent

trend of increasing rice prices are attracting more farmers to dry season rice cultivation, increasing the demand for water. The FWUC's committee have thus revealed their plan to allow 400 hectares of dry season rice farming using water from the scheme. The benefit of irrigation was also realized beyond the originally intended area. The availability of water induced people in a fishing village to adopt dry season rice farming as an alternative way to earn income.

However, despite the seeming success of dry season rice farmers, a general sense of uncertainty was high. Local farmers believed that their scheme had plenty of water that year because there was good rainfall together with the excess water from the Damnak Ampil scheme. As mentioned earlier, only part of the 30 km of primary canal of Damnak Ampil scheme was rehabilitated, and the rest of it is still in a bad condition, making it possible for large amounts of water to escape the scheme and flow to Svay Daunkeo river.

Figure 4.6: Irrigation Scheme of Kampang, Pursat Province



Improved access to water in the area has strained relationships between upstream and downstream farming communities, where the vacuum of clear regulations on water allocation, means each community is competing for their share of water. In one incidence, the farmers from the village downstream experienced water shortages that threatened their crops. In an effort to save the crops, they travelled to the upstream scheme carrying with them knives and axes to request the release of water. There was little choice but to release the water, but this was at the possible detriment of the upstream users.

FWUC's committee did plan to apply the irrigation service fees that they set jointly with the farmers. The fees were divided into two types: 80kg of rice per hectare for gravity irrigation, and 60kg of rice per hectare of land for pumping irrigation. However, the ISF fee collection has never been successful.

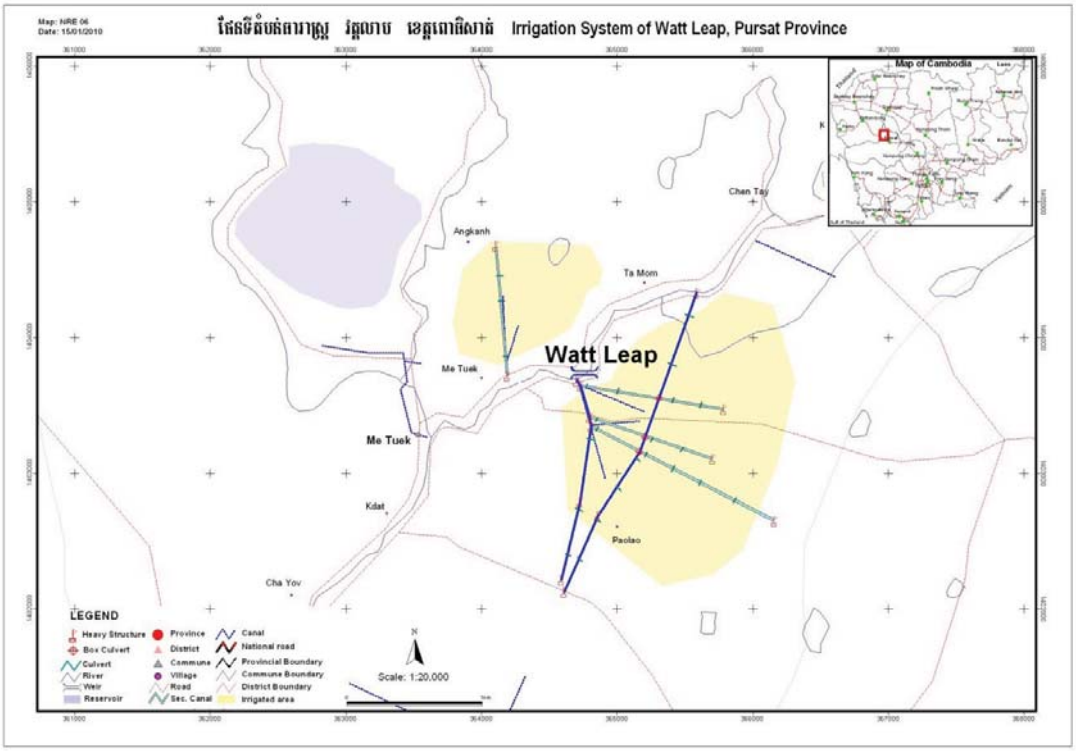
4.7 Watt Leap Scheme, Pursat Province

The Watt Leap scheme is located around 30 kilometres west of Pursat Town in the Tonle Sap floodplain area (Figure 4.7). During the wet season, this area is covered with flood water from the lake, making it only suitable for the cultivation of floating rice. In 1960, a make-shift dam was built in an attempt to store water for irrigation. Then in 1975, the Khmer Rouge put in place a wooden weir. However, the scheme did not result in any significant increase in production of dry season rice due to the inefficiency of the weir, which could not hold water. This structure was demolished in 1993 and rebuilt by American Friends Service Committee (AFSC). The scheme was restored again in 2003 by the Provincial Department of Water Resources and Meteorology (PDOWRAM).

A FWUC was established in 2003 with a committee of 20 members, but this number is shrinking due to the lack of financial reward for serving in FWUC and therefore farmers seeing no point in being part of it. There is no salary for the FWUC as the community cannot collect the irrigation service fees. The FWUC's committee planned to charge ISF from farmers who use water from the scheme to grow dry season rice at a rate of 120 kilogram per hectare, but this rate was fiercely challenged by the local farmers who argued that "they never heard of anybody having to pay for water to farm." The farmers also justify their decision not to pay citing inadequate water supply. The fee was then reduced to 80 kilograms, yet still nobody pays it. Now there are simply no fees charged.

When the scheme was last restored, PDOWRAM calculated the ability of the scheme to supply irrigation water and recommended that the FWUC limit the command area to 100 hectares. Historically, people in the area have not had a real interest in cultivating dry season rice, and have not grown it unless their wet season rice crop has been damaged and food security is threatened. Repeated failures of wet season rice crops and increasing rice prices have witnessed an increase in the number of farmers using and planning to make use of water from the scheme to cultivate dry season rice. This trend worries PDOWRAM. In 2005 dry season rice farmers in the area were successful due to the good amount of rainfall in the preceding wet season and the frequent irregular rainfall in the dry season. With the success of 2005 dry rice, farmers pinned more hope on dry season rice farming, which resulted in an increase in cultivation area to 170 hectares in 2006. The surge in the size of the cultivation area could have spelled disaster for farmers in the whole scheme (due to water usage), but disaster did not happen thanks whole or partly to the excess of water from the Damnak Ampil scheme. Yet, according to the local FWUC, farmers in the area plan to increase the cultivation area to 250 hectares, four times larger than PDOWRAM prescribes.

Figure 4.7: Watt Leap Irrigation System, Pursat Province



4.8 Kamping Puoy Scheme, Battambang Province

Kamping Puoy is one of the major irrigation schemes in Cambodia. It was built in 1977-78 and is estimated to be able to store up to 110 million m3. The main canal was built in 1986-87. The secondary and tertiary canals were built in 1988-1989. The most intensive rehabilitation was during 1998 and 2003 with funding from the Italian government and JICA via MOWRAM. The rehabilitation allowed the scheme to have a potential to irrigate 13,500 hectares of rice fields.

The functioning of the scheme is reported to have brought many changes. One change can be seen in rice varieties, from traditional to modern ones. It has also made possible an increase in yield and pattern from only wet season to both wet and dry season farming. According to tlocal farmers, yield has increased to up to 2.5 tons per hectare for wet season and 3.5 tons per hectare for dry season crops.

With funding support from FAO and ADB, an FWUC was established in 2001 with formal recognition by MOWRAM in 2003. However, the FWUC faces many challenges. The functioning of the FWUC depends to a large extent on the ISF collection, which has proven to be difficult. According to its rules, a farmer has to pay 40,000 riel per hectare if his or her rice yield is over 2.5 tons per hectare, and 30,000 riel if the yield is less than 2.5 tons per hectare. If yield is less than 1 ton per hectare, it is set at 20,000 riel. However, in reality, fee collection is subject to negotiation between individual farmers and the fee collectors with farmers trying to bargain to pay less. Farmers are generally only willing to pay the full amount if water is adequately supplied to their field, which more often than not fails to happen. Another factor is that farmers do not pay as other farmers do not pay too. In addition, some FWUC committee members complained that the fee collection is made difficult because it has been politicised, referring to the period mainly before the election in 2008 when candidates from various political parties discouraged people from paying the fees.

Besides the ISF collection, most of the FWUC committee members' day-to-day activities take place

around water allocation, which is a difficult task. Different preferences as to when to start the cultivation and the different varieties of rice in the same irrigation block have been observed to lead to conflict over water needs. That is in the same block, there are farmers who need water to irrigate their crops and at the same time there are farmers who ask for water not to be released as their crop is at the stage where it cannot take water yet. This problem is made worse by the lack of an effective tertiary canal system to allow individual farmers to control the amount of water supply to their field. Currently, most tertiary canals are shallow, and the downstream people have to take water through the rice fields of upstream people. The FWUC's committee has been trying to solve the problem by encouraging farmers to share the same secondary canal and to coordinate their cultivating time so as to coordinate the time that each field needs irrigation water, but the attempt has not been successful.

By rule, the FWUC's committee only responds to need for water if the request is made by a group of farmers, not an individual farmer. But it has proven to be difficult to expect a group of farmers to jointly request for water due to conflicting cultivation times. As a result, some farmers try to take water allocation into their own hands. It was reported that on several occasions, farmers went to the scheme at night and broke the padlock of the water gate and released water to the canal that led to their fields. But in doing so they flooded the fields of others and destroyed their crops. Unfortunately, the FWUC sees the solution as lying beyond their sphere of operation, although it is stated in their statute. The FWUC believes, and this belief is shared by local farmers, that the FWUC's committee is nothing but a civil and powerless association, therefore nobody respects it. The job of indicting water criminals is the job of the local authority, that is, the village chief, commune chief and police.

4.9 Trapeang Thmar Scheme, Banteay Mean Chey Province

Tapeang Thmor Scheme is located in Por Cha commune in Banteay Mean Chey. The scheme was built in 1976 by the Khmer Rouge. In 1998, part of the scheme was restored. The main water gate was rebuilt into a woodblock door that allowed the local people to control the level of water by adding or removing the woodblock. It was restored again in 2004 by a Japanese NGO. The woodblock door was replaced by a weir with an automatic door. The scheme now serves six villages.

In 2002, a FWUC was set up with the involvement of farmers from across five communes. At the beginning, members of this community had high expectations that the FWUC could function in a sustainable manner; that is, to supply enough water to the farmers in the areas to not only improve wet season rice yields, but to also grow dry season rice from which they could collect irrigation service fees to support the scheme's operation and maintenance. But the scheme cannot supply enough water as there are no tertiary canals, and the main canal is also broken. The community cannot collect the fees. At the same time, the members also live far from one another which makes travelling difficult. No one wants to turn up for the meetings and the membership is now shrinking. Most of the remaining members are those who are also serving as commune council members or village chiefs.

The other challenge for the FWUC in water resource management is the different timing of the rice growing season within the scheme. The FWUC came up with an arrangement to allocate water. The arrangement is that when the main water gate is opened and there is water in the main canal, the farmers downstream are entitled to use water first. The people upstream have to wait until rice plants in the downstream are big enough to withstand water. This is to mitigate the impact of floods on the crops downstream which tend to get flooded when people upstream try to irrigate

their fields. But the plan has so far failed. The farmers have ignored the arrangement and the upstream people build makeshift dams across the canal to divert water to their fields as soon as there is water available.

4.10 Por Pideum Scheme, Banteay Mean Chey Province

Por Pideum scheme is a part of a system or a sub-catchment, which consists of a diversion weir and a main canal, which leads the water through Por Pideum village and reaches Sras Srang village, located some 10 km downstream. This scheme has the potential to irrigate 5,000 ha of wet season rice.

The FWUC was established in 2002, with the involvement of 200 families, but it has not been operating effectively due to the lack of interest in making use of irrigation water for production. The water user fee is set at 700 Thai Baths for every two *rai* of rice (*rai* is local measurement equalling 40m x 40m). This fee is subject to negotiation mainly on the basis of yield. However, the local farmers never make use of water for dry season rice farming, which is the main source of revenue for the FWUC. Farmers in this village use this scheme mainly for wet season supplementary cropping. There were some attempts at dry season rice farming soon after the construction of the scheme, but it did not succeed due to rat destruction. Therefore, the local farmers do not practice dry season rice, but they instead grow cash crops the dry season, such as watermelon, which are highly profitable. For instance farmers can earn about 4 million (around $1000 US) riels from watermelons which are grown on a plot of land of 1,600 m2 (0.16 hectare).

4.11 Sras Srang Scheme, Banteay Mean Chey Province

The Sras Srang scheme is part of the Por Pideum scheme. It is the last scheme downstream and its ability to receive irrigation water is often affected by what happens upstream. This scheme has the potential to irrigate 1,114 hectares of wet season rice and 152 hectares of dry season rice. The cultivated area is located in the floodplain area of the Tonle Sap Lake, which is often affected by floods.

One farmer said that her wet season rice crop had been destroyed for four years in a row, making her poor and in debt. Despite the fact that there is unpredictability in wet season rice crops in this area, farmers still prefer to cultivate wet season rice rather than dry season rice, which is often affected by insects, rats, and a lack of water. Farmers will cultivate dry season rice as long as they are assured rats and insects can be controlled.

The FWUC was established in 2001 and involved people from six villages. According to the FWUC chief, the main canal of the scheme is too shallow and is broken at 13 places, making it non-functional. After farmers request water to their field, it can take up to 14 days for water to be supplied to the field. In addition, there are 63 makeshift dams in the upstream commune, which have significantly affected the ability of the FWUC's committee to respond to the people who need water.

Water user fees can be applied only to dry season rice. The fee is set at 250 Thai Baths per hectare (around $7 US). The problem of fee collection in this area, like other areas, is the problem of inadequate water supply. One FWUC member said that the dry season rice often suffers from water shortage which causes crop failure. Another farmer said that people in the area would be willing to pay double the current rate if there was enough water.

4.12 Thnal Dach Scheme, Banteay Mean Chey Province

The reservoir in the Thnal Dach scheme was restored during the Khmer Rouge era and rehabilitated in 2003. This scheme is used mainly for domestic water consumption such as washing, drinking and cooking, and for wet season supplementary irrigation. The FWUC was established in 2003.

Dry season rice is not preferred by the farmers due to major problems such as insects, rats, roaming animals, insufficient agricultural extension, and inadequate water availability. The FWUC explained that decisions for water allocation were made jointly by FWUC's committee and the village chief in consultation with farmers. Conflicting interests between farmers have been seen within this scheme. For instance, some farmers prefer the reservoir to hold as much water as it possibly can, while others want to maintain a certain level of water as they grow rice in the reservoir.

The water user fees are set at 20 baht per rai ($ 0.5 US). Last year, the FWUC collected 1,000 baht (around $ 25US), which they used for maintenance of the scheme. The scheme does not have sufficient canals to supply water to the fields.

4.13 West Baray Reservoir, Siem Reap Province

The water source for the West Baray Reservoir is Stung Siem Reap via an intake canal that runs from Phnom Kulen. In 1952-1953, a group of Americans excavated canals to irrigate secondary crops, and in 1979-80, farmers in Krom Samaki excavated secondary canals for irrigating recession rice. In between 1992-1993, organisation called Adventist Development and Relief Agency (ADRA) in collaboration with the local authorities established an informal FWUC. In 1994, the International Labor Organization (ILO) provided assistance to strengthen the FWUC. At that time, the water user fees were set at 30kg per hectare or 15,000 riels per hectare. In 1996-1997, ADDRA was back to assist strengthen the FWUC. In 2000, water user fees were reduced to 10,000 riels per hectare due to poor harvests. In 2003, a formal FWUC was established. In 2006, the irrigation fees were increased back to 15,000 riels per hectare and since then the number of farmers participating in the FWUC has decreased. In 2007, India through MOWRAM rehabilitated the regulators and canal.

The reservoir provides benefits to Puok and Siem Reap districts, covering 65 villages with a total command area of 4,500 ha. Some farmers in Puok districts pump groundwater for irrigation. IRR66, Kesar, and Sen Pidor are the major rice varieties under cultivation. The yield is very low (around 1 ton per hectare) due to factors such as inadequate water supply, infertile soil, and the lack of adequate agricultural techniques.

The FWUC's committee, with a mandate of five years, consists of 26 subgroups with five members per group. The irrigation service fee was collected in accordance with an agreement between FWUC and farmers. FWUC collected fees of 9,000,000 riels (around $2750US) in 2007.

Most beneficiaries of the West Baray reservoir receive gravity irrigation. It was reported that on average farmers own approximately one hectare, although at the time of the researchers' visit, most of those land plots were yet to receive official title.

Besides rice cultivation, the local farmers also grow some cash crops such as sugar cane, corn, cucumber, and watermelons. These crops get a good price on the market. In addition, some farmers, especially the young ones, leave the village to work in construction, or garment factories in Siem Reap. They can earn between $3 US to $5 US a day.

4.14 O'Mao Scheme, Siem Reap Province

O' Mao Irrigation scheme is located in Sot Nikume District, Siem Reap Province. It was built as a dam in 1975. In 1979, the scheme was repaired by the local farmer cooperative, *Krom Samaki* to store and divert water for irrigation. Like most other schemes in the country, this scheme did not function as well as was expected. In 2005, the Seila National Programme through PDOWRAM invested $10,000 US to rebuild the scheme. It was designed to provide wet season supplementary irrigation water to 300 hectares across five villages. Local farmers use the water from the scheme for their cash crops, namely sugar cane. Some conflicts of interests involving rice farmers, sugar cane growers and fishermen can be observed at this scheme.

4.15 Tbeng Scheme, Siem Reap Province

The Tbeng scheme is located in Tbeng Keut Village, Tbeng Commune, Banteay Srey District, Siem Reap Province. Built in 1950, it has been used mainly for wet season supplementary rice. At the end of the Khmer Rouge period in 1979, the scheme fell under the management of a farmer agricultural cooperative group called *Krom Samaki*. In 2005, an FWUC was formed assisted by technical support from PDOWRAM.

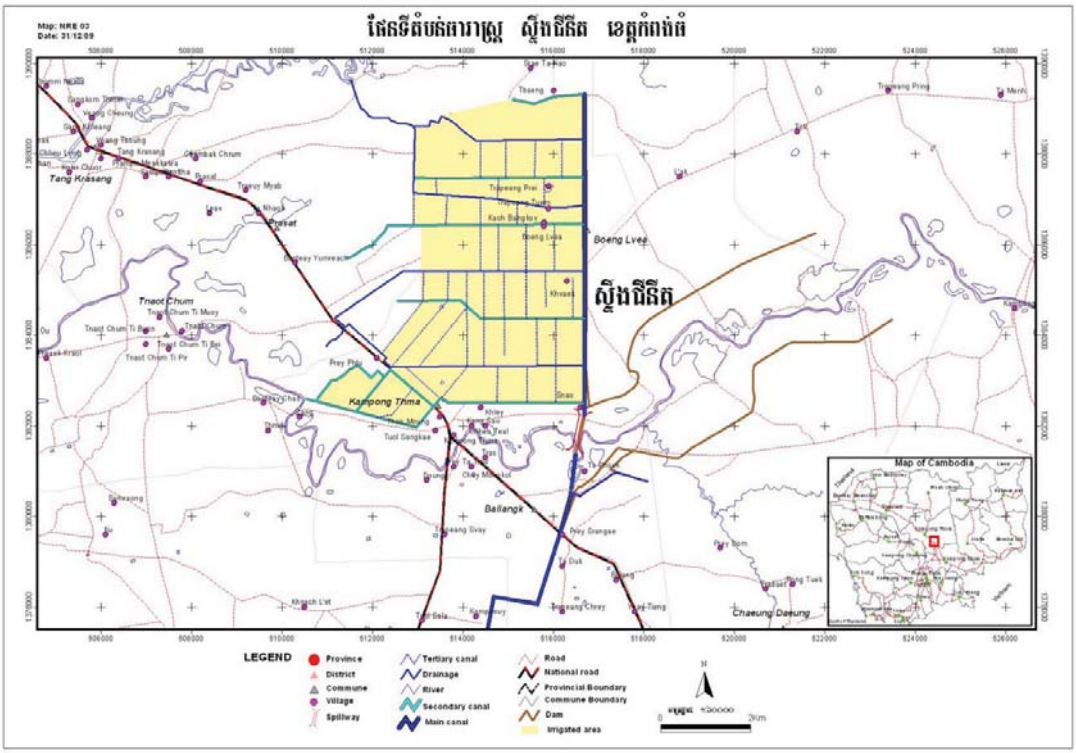
The scheme serves 3 villages: Tbeng Keut, Tbeng Lech, and Vatt with 225 households benefitting. The total supplementary irrigation command area is 210 hectares. Irrigation fees are set at between 3,000 riels and 5,000 riel per hectare. The actual fee collection began in 2006, in which time the FWCU could collect 600,000 riels per year.

The average rice yield was reported to have increased from 1.5 ton per hectare before rehabilitation of the scheme to 2 tons per hectare after rehabilitation. In addition to the increase in yield of wet season rice, the scheme is said to have made it possible for the local farmers to grow some cash crops such as corn, long beans and watermelon. The use of groundwater for crop cultivation was reported at the time of the researchers' visit.

4.16 Stung Chinit Scheme, Kampong Thom Province

This scheme, which is located in Santok district, was first built in 1978 (Figure 4.8). It was restored in 1992 and again in 1999. In 2001, there was a bold attempt made at expanding and modernizing the scheme. The Royal Government of Cambodia, with a loan from the Asian Development Bank (ADB), launched a project to transform this scheme into the country's most sophisticated scheme, with the main reservoir designed to store 23 million cubic metres of water to irrigate a command area of 2,500 hectares, benefiting 3,000 households across 24 villages.

Figure 4.8: Irrigation Scheme of Stung Chinith, Kampong Thom Province



Unlike any other renovation project in the country, this project involved land re-shaping. Before the start of the construction of the scheme and the canal system, the local farmers were asked to participate in a project to rearrange their plots into more organized, rectangular-shaped plots and to realign them to make way for tertiary canals. According to local accounts of the project, each farmer household was asked about their plot size and they were asked to devote a small portion of their land proportional to their total plot size. The logic was to use the land people devoted for the provision of the canal system. The plot rearrangement resulted in the whole scheme command area being divided into 48 blocks of rectangular shape. Each block has an irrigation canal and drainage.

The FWUC was formally established in 2002 and registered with MOWRAM in 2006. With financial support from CEDAC, the FWUC members are currently paid a salary of $ 40 US per month plus $ 30 US for transportation cost. But among the committee members, there is a general sense of uncertainty. One member said that he was not sure of what would happen to the community when the NGO withdrew its financial assistance, and he said he had already heard of plans by the NGO to withdraw.

Perhaps his concern is caused by the current situation regarding fee collection. The irrigation fees are set at 30,000 riels per hectare, but not many farmers are willing to pay. Like most other schemes in the country, this scheme has been use mainly for wet season supplementary irrigation, something the local farmers believe they do not need to pay for. Thus the hope of any fee collection has to come from irrigation provided for dry season rice. Initially there was a brief interest on the part of the local farmers in dry season rice farming, but it did not go as they had expected. The dry season crops were destroyed by insects, grasshoppers in particular.

But the problem of fee collection is not a problem of insect destruction alone. Local farmers report having difficulty irrigating their fields as their land is of a sandy type. This soil type does not hold

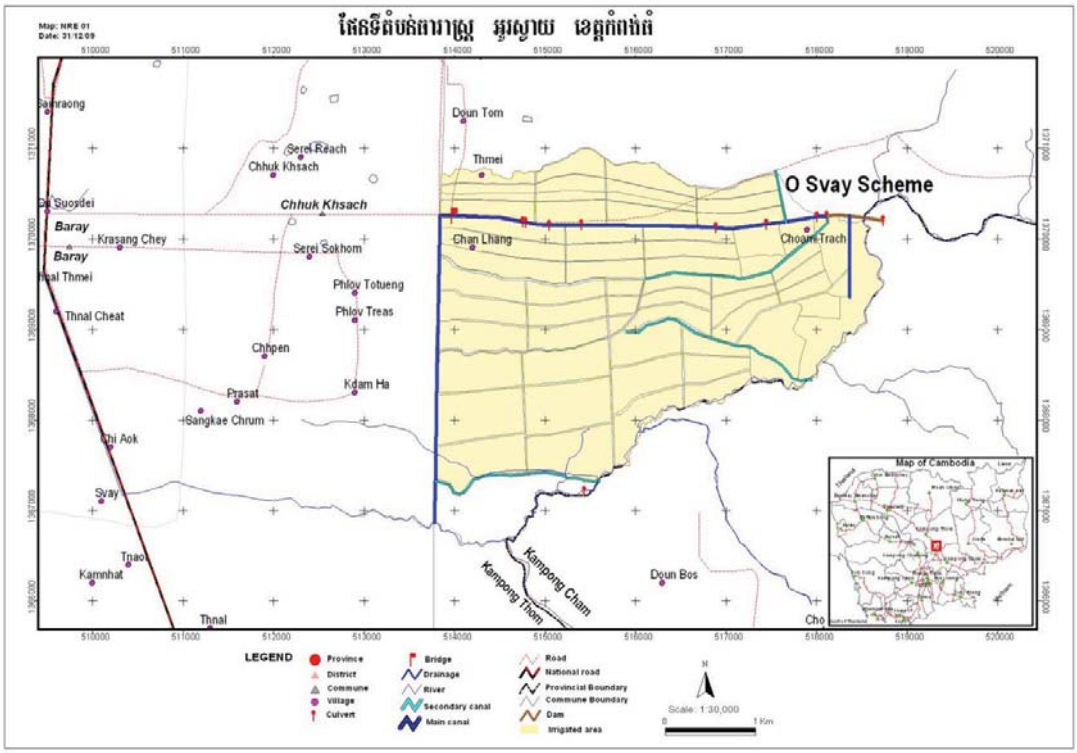
water well, so as soon as the farmers irrigate their field, the water seeps out into someone else's field. The same problem also causes problems for those who want to grow cash crops. Watermelon and cucumber farmers, for example, do not want their farm land to be water-logged as the crops would die, but water from their neighbouring fields tends to seep into their land.

4.17 O' Svay Scheme, Kampong Thom

The scheme is a reservoir, which was built on a river bank in O' Sray village. There are two main water canals with two main gates. One main canal flows through O'Sray village while another one flows along the border of the village to serve the people in the communes downstream.

In order to deal with the dual nature of the system, a water allocation arrangement was worked out. In the cultivation season, each one of the two gates is allowed to be opened for a period of three days so that farmers on each canal system can irrigate their land adequately. However, the water allocation is not effective. Three makeshift dams were built on one main canal to divert water resulting in obstructing the flow reaching the lower parts of the scheme. The FWUC's committee is legally empowered to monitor the activities in the system, particularly removing the makeshift dams.

Figure 4.9: Irrigation Scheme of O'svay, Kampong Thom Province



5 Key Issues arising from the Field Assessment

The findings of the social assessment raise many important issues pertaining to governance of irrigation in Cambodia. These issue areas are coordination, water scarcity, water allocation, participation, and evaluation processes. We expand on each of these in turn below.

5.1 Coordination

Effective water governance requires coordination among all stakeholders. Small-scale and local irrigation management has relied on collective action where people expect that they will benefit from coordinated action and then agree among themselves on the most appropriate means for establishing and sustaining such action. Coordination beyond local collective action requires more complex coordination when the group of actors reaches a certain size and/or the interests of actors become increasingly diverse.

The social assessment findings presented above show that the general degree of coordination is poor both within and between various schemes. At scheme level, coordination issues are seen in the relationships between farmer-farmer, farmer-FWUC, and within the FWUC. Different schedules for water demand create a problem of coordinating planting schedules. Such problems appear to be more pronounced in larger schemes, where the larger command area tends to contain different soils that involve different rice varieties. Coordination thus goes beyond the irrigation scheme to other collective decision making processes at the local level. There are also cases of farmers not wanting to let others have access to water, by not letting the farmers whose land is away from the water run the pipe through their land, revealing physical coordination of water distribution as a potentially important issue.

With the conflicting water demand schedule and water-related conflicts, the FWUCs may try to intervene, but this type of intervention often fails to achieve a satisfactory result. Farmers do not often cooperate with the FWUCs, as they do not view it as a body with legitimate authority to govern water management and conflict resolution.

Coordination within larger schemes is even more difficult, as the size of the schemes involves many different villages and FWUCs. For example, the FWUC at Kamping Puoy in Battambang is extremely complex, as it has 64 members divided into 15 groups, each of which covers about 400 households. The Stung Chinit scheme is also very complex in this regard, irrigating about 2,600 ha, benefiting 3,000 households in 24 villages. In the case of these larger schemes, FWUC members must travel long distances to participate in regularly scheduled meetings. After a period of time, attendance has tended to drop in the face of farmer apathy and the lack of incentives to convene and attend meetings.

5.2 Water Scarcity

Water scarcity is divided into two types: economic scarcity and physical scarcity. Economic scarcity is defined broadly as the lack of resources by the state and other players to mobilize finance and

materials to access, extract and utilise water while there are abundant resources. Physical scarcity is defined as the physical lack of water. The field assessment suggests Cambodia is faced mainly with the problem of economic scarcity. It is possible for people to extract more water resources than they can now by building and restoring the irrigation infrastructure in the country. While the building is seriously under way, the infrastructure is not up to the demand yet. Moreover, construction of more irrigation schemes does not mean that the supply meets the demand of water during the time of physical scarcity.

Cambodia faces the problem of physical scarcity during dry season. Farmers compete for water in order to irrigate their dry season rice fields. But often there is not enough water in the system. For example, in the Pok Pen scheme in Kampong Chhnang, farmers do not grow dry season rice simply because water levels in the canals run too low. In addition, a challenge faced by farmers and FWUCs is the appropriate management of water in different situations of scarcity in order to avoid or manage conflicts.

In certain cases, farmers create problems associated with physical scarcity by expanding the command area of a particular scheme. For example, in Trapaing Trabek and Pok Pen farmers have been expanding the area beyond what has been recommended. In Pursat, farmers in the Wat Leap scheme are planning to expand the command areas to an area four times larger than what PDOWRAM authorities have recommended. Wat Leap and Kampang schemes are benefiting from water flows from the Damnak Ampil scheme that may not be sustainable over the long term.

5.3 Water Allocation

Usually farmers release water as and when they need it, rather than adhering to any particular method for releasing water. This means farmers compete for water as much as they can in order to irrigate their rice fields. The FWUCs play little or no role in allocation. In addition, there are few or no rules or regulations regarding water supply to rice fields, and where they do exist farmers pay little attention to those rules. For example, in the Kamping Puoy scheme in Battambang, some farmers routinely break rules by breaking into stations at night and opening gates to irrigate their plots.

Another interesting observation is related to the operation of the scheme. It is generally observed that the operation of the scheme is a challenge that seems to be caused partly by technical problems whose origin is the way the schemes were designed and/or constructed. At the same time, part of the problem of operation is also the water flow regime. Some rivers either have too much water flowing in the rainy season or too little water, if at all, in dry season when water is needed the most for irrigation. In the Kampang scheme, for example, a series of droughts resulted in poor wet season production soon after the scheme was operational, and no dry season production at all as the river was left dry. Such problems are made worse by the lack of capacity to manage the resource. One serious management problem concerns makeshift dams that farmers put in place above the schemes. For example, key informants reported that in the Sras Srang scheme in Banteay Meanchey, there were as many as 63 makeshift dams constructed upstream of the scheme. The Tang Krasang scheme in Kampong Chhnang also reports problems associated with makeshift dams.

5.4 Participation

Participation is observed to be weak, not only in the project design and implementation phases, but also in the everyday operation of the scheme. There are many reasons for the lack of participation. Firstly, farmers are not familiar with the concept of participation -they they are used to being led rather than participating. Some believe that it is not their role to take part in scheme management and maintenance, as they believe it is the job of the government.

Of even greater importance is the fact that nearly all the schemes featured poor participation on the part of farmers in terms of paying the water service fees set by the FWUC or other authorities. In schemes such as Tang Krasang in Kampong Chhnang, farmers are not willing to pay irrigation service fees, as they believe water is a public good. In Damnak Ampil and Kampang schemes in Pursat, fees have not been collected since work on the project was completed in 2006. Secondly, many farmers are not satisfied with water allocation. In Sras Srang scheme in Banteay Meanchey, the fee is set according to the amount of land that is irrigated in the dry season. However, farmers are reluctant to pay the fee as frequent water shortages lead to crop failures. Some farmers said that they would be willing to pay double if the water was adequately supplied.

Participation is an issue not only among farmers, but also the FWUC members who are in charge of managing the scheme. A problem of shrinking membership has been reported in most schemes visited by the team. The FWUC members are deserting the committee, generally concluding that it is not worth their time and effort. The problems result from the following inter-related factors: (i) the schemes are not well operated and maintained; and (ii) the irrigation fees cannot be fully collected affecting the FWUC members. These problems are especially significant in the large schemes where size makes coordination even more difficult and inhibits attendance at meetings.

5.5 Evaluation and Planning

The four sets of issues pertaining to coordination, water scarcity, allocation, and participation are of course deeply inter-related. For example, the amount of water available would have direct implications on rules and procedures concerning the allocation of water. The degree to which water is effectively and fairly distributed, in turn, directly affect the degree to which farmers are willing to pay for water use. It is important to objectively consider these and other issues at the initial evaluation and planning (i.e. feasibility and design) stage for each project. Although this observation applies to all schemes, it is especially important for large-scale systems where the potential problems tend to be exacerbated by size and complexity.

Farmers are almost always enthusiastic about an irrigation project during the feasibility and design stages and often quite happy with the project soon after it is completed. The question of how much benefit farmers are likely to receive is, however, one that requires careful consideration. The indicator that is most commonly considered is economic returns to the investment over a given period of time. This raises questions about who conducts project assessment and the assumptions and approaches which they employ in terms of how costs and benefits are calculated. This also raises questions about who participates in making decisions about the project design and implementation. In other words, how are decisions to develop an irrigation project made and with what taken into consideration?

It is also important to consider the assumptions guiding decisions about which projects to build and how they are intended to be used. Many of the schemes have the potential to provide irrigation

to support dry season rice production and undoubtedly the economic benefits of dry season rice were included in the investment analysis of those schemes, especially the large-scale schemes that involved considerable investments. And yet, once the schemes are brought on line, many farmers choose not to invest time and resources in dry season rice production. The important question in this regard is why? It may help to consider why farmers in some schemes do not expand their rice production efforts to include dry season rice, even though the schemes may make such production entirely feasible.

One reason concerns the availability of water during the dry season, which touches upon issues pertaining to physical scarcity as discussed above. Other issues, however, pertain more to socio-economic contextual issues at the local level. For example, in several schemes, animal raising and grazing practices make it very difficult for farmers as a whole to move into dry season farming as it is customary for households that own livestock to herd them in open paddy areas during the dry season.

Other reasons may be categorized under the heading of technical constraints. One such constraint concerns the costs of pumping. For example, in Damnak Ampil scheme in Pursat, farmers would have to pump water from the reservoir in order to irrigate their fields. This would require them to invest in water pumps, an investment that many of the farmers claimed was beyond their financial capacity. Another type of technical constraint concerns the lack of support in the form of extension services. Farmers in Thnal Dach scheme in Banteay Meanchey indicated there was no technical support from the PDAFF. Part of the problem in this regard is that Thnal Dach is a remote farming community and it takes about two and a half hours by car to get there. Assuming that the PDAFF is operating with limited resources, they would tend to focus efforts on closer, easier to reach areas.

It is also important to consider the traditional sources of income and livelihoods that households in many of these schemes pursue during the dry season. In the Por Pideum scheme in Banteay Meanchey, people can actually do better with other crops and prefer not to grow dry season rice. In Svay Chek scheme, people traditionally undertake palm sugar production, logging, and produce firewood, while others migrate elsewhere to sell labour. In the West Baray reservoir, some farmers grow crops such as vegetables and sugar cane, while others may work in construction or other tourism-related jobs in nearby Siem Reap.

Finally, it is important to consider land tenure arrangements within the command area. Such arrangements appear to play a particularly significant role in at least several large schemes, albeit perhaps somewhat differently according to the size of the command area of the scheme. Land tenure arrangements can affect the functioning of the scheme in several ways. For example, in the Stung Chinit scheme in Kampong Thom, land had to be re-allocated before the construction of the scheme in order to create a more efficient plot arrangement that facilitates more efficient distribution and management of water resources. As noted above, farmland was converted into rectangular shapes and rearranged and realigned in order make way for tertiary canals. It appears, however, that many people are unhappy with the redistribution and as a result do not participate in the construction of tertiary canals.

5.6 Private Schemes

The issues above have been discussed in the context of projects supported by the public sector, often in collaboration with development partners. It is important to observe that the emergence

of privately owned schemes also raises important governance issues concerning evaluation and planning in terms of the state's role in approving and regulating such initiatives.

Many private irrigation reservoirs were constructed in the Tonle Sap floodplains, especially, in the once floating rice areas of the Tonle Sap floodplain. This area is submerged under Tonle Sap floodwater for most of the wet season. In the past, farmers grew floating rice, but the yield was low and often unreliable. After years of crop failures, farmers abandoned floating rice practices and left the land unused. Beginning in 2004, some businessmen converted the floating areas into dry season rice farming areas. They bought land in these areas from the local farmers and built retention reservoirs, some of which can be as large as 100 hectares or more in size. The conversion of the area into dry season rice farming was viewed as a success. The retention reservoirs, which retain the floodwater from the Tonle Sap and allow farmers to effectively control the water supply, has meant high yields of up to eight tons per hectare.

The success of the early developers attracted more investors, and by 2007 the number of private schemes had reached 80. Some of these schemes, however, have been built on protected land in the flooded forest areas, which has led to reactions from the Provincial Department of Environment, which has accused the developers of causing forest destruction. Meanwhile other private scheme owners also harvest fish from their ponds, and this has sparked negative reactions from the fisheries authority.

6 Conclusions

There is no doubt that the coordination, at scheme level, between farmers and farmers, farmers and FWUCs, and FWUCs and FWUCs needs to be strengthened. The coordination required goes beyond the scheme level to other collective decision making processes at the local level. PDOWRAM should play a critical role in achieving, through a *horizontal* approach, effective coordination not only between farmers and farmers, farmers and FWUCs, and FWUCs and FWUCs, but also between provincial department and provincial department; for instance between PDOWRAM and PDAFF and between relevant line agencies. The present mechanisms for *'vertical'* liaison should also be consolidated and should be carried forward and supported in connection with any catchment wide, integrated management efforts.

Farmers of the visited irrigation schemes are mainly facing a problem of water scarcity (or shortage) during the dry season. Because of the inappropriate technology used during the design and development of the schemes, the schemes cannot maintain enough water during the wet season, which reserves for using in the dry season. It is therefore essential to promote the rehabilitation and construction of irrigation, drainage, and flood management infrastructure, in order to provide sufficient water for agricultural production and to alleviate the adverse consequences of excess water.

To sufficiently and effectively provide farmers with the quantity of water they need, when and where they need it, and within the limits of available water resources and technology, it is necessary that introduction of necessary laws, regulations, and procedures be made to achieve the equitable sharing and allocation of water. Capacity building for the FWUCs should also be provided to strengthen and expand them to enable them to participate in water management and allocation and to maintain irrigation infrastructure with effectiveness and sustainability.

Account should also be taken of, and in association with, promotion of better collaboration among RGC institutions, private investors, stakeholders, and beneficiaries at all levels, in activities and programmes related to the management of investment, exploitation, protection and development of water resources.

Beyond these broad findings and conclusions, the social assessment has identified several priorities for further research. The framework for these more in-depth studies is set out in the final section of this paper.

7 Proposed Framework for the In-depth Studies

Three key themes have been identified to frame the research programme. These themes include governance, economic, and physical. Within these themes, a total of nine main research questions and a number of sub-research questions have been formulated. These main and sub-research questions are as follow:

7.1 Governance Component

1. What are the formal and informal arrangements for collective action and coordination around water at the local level?

- What are the challenges of coordination for both within and between schemes at the same catchment?
- What are the institutional arrangements for water management at scheme and at catchment levels?
- What are the challenges facing FWUC in water management?
- How is Irrigation Service Fee agreement set and how can this be done to ensure better use and enforcement of law across different stakeholders?

2. What kinds of conflicts exist around scarcity and water resource management, and how are these dealt with/resolved?

- What is the nature of scarcity, competition and conflict over water at different levels and what are the conflict resolution mechanisms?
- How is water currently allocated during the period of scarcity (within/between) schemes?
- What are the institutional arrangements (within/between) scheme to deal with water scarcity?
- Is water scarcity perceived as a problem?
- How do FWUCs manage scarcity of water and resources for scheme maintenance?
- What are roles of FWUC in water allocation (within/between) schemes?
- What are difficulties and conflicts that arise over water allocation and management of livelihood impacts?
- What is the current situation of water resources management approaches, policy regulation and methodology in Cambodia?
- What formal/informal rules exist for water allocation (within/between) schemes?

3. What conditions encourage or discourage participation in water resource management at the community level?

- Why do some farmers participate in digging tertiary/quaternary canals on their own land while others do not?
- Why do farmers not participate in irrigation-related water use?

7.2 Physical Component

1. In what respects is water scarcity an issue in irrigation development and catchment management?

- Is water scarcity an issue in each scheme?
- What are the practical solutions to scarcity problems?

- What is the seasonal pattern of water supply or demand to each scheme?
- How do spatial and temporal patterns in streamflow impact on the availability of water for multiple users?
- How can knowledge about the spatial and temporal patterns in streamflow improve management decisions on water use and sharing?

2. What are the physical potentials and constraints for irrigation development and operation and maintenance of wider catchment needs for water?
- How much water is required for each irrigation scheme?
- How much water should be released for each scheme?
- What are the current effects of water use on the physical system and on downstream users?
- Is there an equitable distribution of water within catchments (e.g., between all users along a system)?
- Are there physical and/or environmental barriers to further water resource development?
- To what extent does land use change impact upon ecological and hydrological processes within catchments?

7.3 Economic Component

1. What is the value of water when used in farming? Is water pricing an option or dealing with scarcity amongst scheme used by the rural poor?

2. What is the farming and non-farming impacts of irrigated farming?

3. What other factors related to production and opportunity costs, besides water availability, limit farmers' adoption of objectives such as double cropping?

4. What are the returns to investment in irrigation measured as extrapolated incremental net benefits from water use?
- What are the financial costs for farmers to invest in maintain tertiary canals?
- Can scarce capital be mobilised through irrigation service fee (ISF)?

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