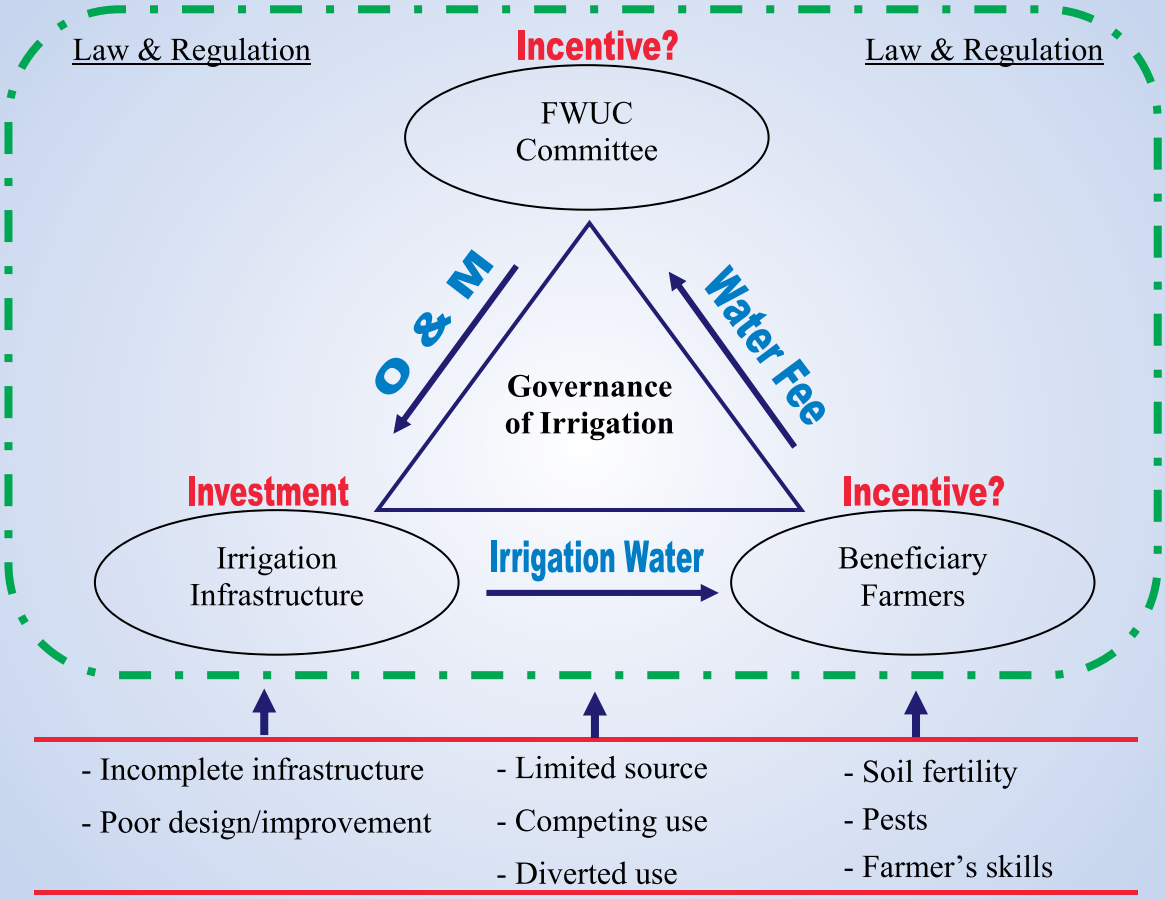
ផ្នែកនៃអង្គការមិនមែនរដ្ឋាភិបាល ស្តីពីកម្ពុជា
The NGO Forum on Cambodia
ធ្វើការរួមគ្នាដើម្បីការប្រែក្លាយ
Working Together for Positive Change

LEARNING FROM IRRIGATION PROJECTS IN CAMBODIA: BENEFITS AND CHALLENGES



Phnom Penh, Cambodia
October 2011

LEARNING FROM IRRIGATION PROJECTS IN CAMBODIA: BENEFITS AND CHALLENGES

Author: **Ngo Sothath**
Cambodian Economic Association (CEA)

Published by: The NGO Forum on Cambodia's Aid Effectiveness Project of the Development Issues Programme

Layout designed by: Mr. Phourn Yu, Information and Publication Officer

Table of Contents

List of Acronyms

ADB	Asian Development Bank
AFD	Agence Française de Développement
ASSDP	Agricultural Sector Strategic Development Plan
CAVAC	Cambodia Agricultural Value Chain
CEA	Cambodian Economic Association
CPP	Cambodian People's Party
KHR	Khmer Riel
CSF	Commune/Sangkat Fund
DOA	District Office of Agriculture
ECOSORN	An EU's programme named "Economic and Social Relaunch of Northwest Provinces in Cambodia
EU	European Union
FWUC	Farmer Water User Community
HH	Household
IMF	International Monetary Fund
kg	Kilogram
kg/ha	Kilogram per hectare
MAFF	Ministry of Agriculture, Fisheries, and Forestry
MOWRAM	Ministry of Water Resources and Meteorology
MTR	Mid Term Review
NCDD	National Committee for Sub-national Democratic Development
NRM	Natural Resource Management
NSDP	National Strategic Development Plan
O&M	Operations and Maintenance
PDWRAM	Provincial Department of Water Resources and Meteorology
RGC	Royal Government of Cambodia
SAW	Strategy for Agriculture and Water
t/ha	Tonnes per hectare
USD	United States Dollar

Acknowledgement

This study was commissioned by The NGO Forum on Cambodia, through which its Development Issues Programme (DIP) provided both financial support and ongoing consultations to make this report possible. Through collaboration with the Cambodian Economic Association (CEA), its President Mr. Chan Sophal provided useful comments on the approach, methodology and analytical framework for the study. The author gratefully acknowledges H.E. Veng Sakhon, Secretary of State, MOWRAM, for his valuable advice and guidance on the study design. The study benefits greatly from review and comments by Mr. Chea Kim Song, Manager of DIP, Mr. Va Sothy, National Budget Project Coordinator, and Mr. TE Duong Vathana, Aid Effectiveness Project Coordinator of The NGO Forum on Cambodia. The acknowledgement should also be extended to Mr. Chea Sarom and Mr. Phourn Yu of Research and Information Center of the NGO Forum for servicing excellent layout and design of the report publication.

The author owes a great deal to Miss. Thai Seangmean and Mr. Chhay Vannpoly, the research assistants at CEA, for their diligent work to handle the field interview administration, data collection, data processing, and other supports throughout the study including comments and proofreading of the research report.

Last but not least, the author would like to express sincere thanks to the staff of the visited irrigation projects, provincial authorities, commune councils, village chiefs, FWUCs, and all farmer respondents for their time and cooperation, without which this study would not have been possible.

Executive Summary

The aim of this study is to learn from irrigation projects in Cambodia. This study has a mission to assess the irrigation capacity, its impact on paddy production and to explore challenges in the irrigation sector. This will be achieved by inspection of existing literature and by conducting a field assessment of 12 irrigation schemes across 8 provinces in the plains of Tonle Sap Lake and Lower Mekong River. As part of the field assessment, four irrigation schemes were selected for conducting a rapid survey with 180 farmers to illustrate the benefit of irrigation on irrigated farm plots in comparison with non-irrigated farm plots.

The result of the investigation of existing literature shows that the irrigated area in Cambodia is inconsistent from one source to another. The RGC reported the irrigated area in 2010 was 1.16 million hectares which is 33% of the land under crops or 42% of the paddy area. This represents a 579,000 hectares increase from that in 2005. Such a leapfrog increase of irrigated areas was not practically supported by the average capital expenditure of about USD 34 million per annum for MOWRAM between 2006 and 2009. On the other hand, the WB (2009), which is based on CSES 2007, suggested that the irrigated area in Cambodia was about 25% of the agricultural land. Moreover, data available from the commune data showed that the irrigated area in Cambodia was 21% of the cultivated paddy area in 2008.

Through field assessment of 12 irrigation schemes across eight provinces, it was found that the irrigated area covers only 33% of the total cultivated wet season paddy area in 24 communes that have access to rehabilitated irrigation schemes. This suggests that the irrigation coverage for the nationwide cultivated wet season paddy area could be significantly less considering many communes without access to rehabilitated irrigation schemes. The assessment further showed that of total paddy lands in the communes, only 9% were producing early wet season rice (Apr-Aug) using irrigation water in supplement to the rainfalls and 3% were producing an extra crop in the dry season (Dec-Apr) that is fully dependent on the irrigation water from the schemes.

The rehabilitated schemes, especially ones financed by the development partners, could usually supply irrigation water to meet full command areas[1] during the wet season with supplement from rainfall, but there are some critical challenges attached to it including limited availability of irrigation, lack of distribution canals and diversion structures, and poor design of the system. Based on data available from seven schemes, 23% of the command area could have access to irrigation water from the improved schemes for cultivating the early wet season rice (Apr-Aug) with supplements from rainfall while another 13% had the possibility to cultivate an extra crop in the dry season (Dec-Apr) on the wet season paddy areas.

[1] In the irrigation sector, the "command area" refers the area designed to be irrigated by the irrigation system. In reality, often the system cannot supply enough water to irrigate all the command area. The reasons could be the lack of water source/rainfall and/or incomplete construction, among other things.

The irrigation schemes were observed to have yielded a range of benefits to farmers, which include supplementary irrigation water for wet season paddy, intervention in time of drought, production of an extra crop in early wet season or dry season, improved paddy yield, leisure sites, drainage systems to remove surplus water from the rice field when needed, expansion of vegetable production, access to towpaths for travel and transporting farm inputs and produce, household's and animal's use, and improved fish population. Despite all these benefits, the schemes functioning is subject to several challenges which include insufficient supply of water, incomplete system (particularly lack of tertiary canals and diversion structures), no or poor mechanism for the scheme management and maintenance, inactive FWUC, and low return on paddy production which is undermined by poor soil quality.

With regard to the impact of irrigation, the rapid survey found that the irrigation yields a considerable impact on the farmer's livelihoods. The majority of farmers who benefited from irrigation reported that the irrigation had made their livelihoods better, especially among farmers who could farm an extra crop in either early wet season or dry season. By comparison, a higher percentage of farmers with no access to irrigation than that of farmers with access to irrigation reported worsening livelihoods in the past year.

However, the field assessment found that the actual irrigated area from large-scale irrigation schemes that are rehabilitated by the RGC's funds is limited because the systems were not fully constructed or improved. Usually, the tertiary canals were not constructed or improved. The effort could only rehabilitate the headwork and/or main canals through several consecutive years of work. Yet, in some cases, the commune uses its CSF to rehabilitate some tertiary canals to harvest the irrigation water from the main canal into the paddy field.

The key challenge that undermines the effective functioning of the irrigation scheme is observed to be attributed to the lack of irrigation water. This is due to a number reasons, namely, incomplete infrastructure such as tertiary canals and diversion structures; poor design/improvement of the scheme; limited water source such as small river or rain-dependent reservoir; competing water harvest from other schemes farther upstream; and/or diversion of irrigation water for other uses.

1. BACKGROUND

The cropping area in Cambodia was 2.83 million hectares in 2005 (2.37 million hectares were paddy land). The irrigated area was estimated to be 588,000 hectares, which was 21% of the cropping land or 25% of the cultivated paddy area (RGC, 2005). Through SAW 2006-10 and the NSDP 2006-10, the RGC committed to not only increasing the irrigated area to 650,000 hectares by 2010, but also expanding the cropping area to 3.5 million hectares, of which 2.5 million hectares are for paddy production (MAFF and MOWRAM, 2007; RGC, 2005). If the cropping area expands over time, the increase in irrigated area will not necessarily be by the same proportion. If it does, it can be slower in percentage terms. For instance, if the RGC realises its commitment to increase the cropping and irrigated areas as mentioned above, the irrigation coverage should represent 19% of the land under crops or 26% of the cultivated paddy area in 2010.

In 2010, the irrigated area was reported to be 42% of the cultivated paddy area, which was approximately 1.16 million hectares. This indicates a leapfrog achievement if compared to the target set in the NSDP 2006-10 to achieve 650,000 hectare irrigated areas by 2010.

Moreover, the national expenditure for agriculture, particular MOWRAM, was limited during 2006-09. About 3% of the total national expenditure was allocated to MOWRAM during this period (Ngo and Chan, 2010). Low expenditure for MOWRAM was partly explained by delayed implementation of some big irrigation projects such as the Northwest Irrigation Sector Project and the ECOSORN Project (NGO Forum, 2009). Through an assessment effort, it was found that there were three key issues that caused the delay of the implementation of the 11 sub-projects under the North West Irrigation Sector Project: (i) the nature of the project, i.e. time needed for river basin and feasibility study; (ii) the tedious project procurement process; and (iii) the human factors, for instance, the reliance on external consultants and the change of responsible staff within MOWRAM (NGO Forum, 2009).

With the overall purpose to encourage poverty reduction in rural areas through increased public expenditure in related ministries such as MOWRAM, this study is challenged to further assess the irrigation coverage, the benefits of irrigation, as well as the strengths and challenges of irrigation schemes. Therefore, the study aims to:

1. assess the irrigation capacity and its impact on paddy production of direct beneficiaries in both wet and dry season; and

2. understand successes and challenges in irrigation systems as viewed by the local authorities and community people.

It is hoped that the study result will bring more concrete evidence for further discussion and consideration among policymakers, funders, practitioners, researchers, and other stakeholders on financing and delivering irrigation projects.

2. METHODOLOGY

With regard to the nationwide irrigation coverage, the study involves the review of various existing sources of literature including the national plan, sectoral plans and strategies, and other reports and documents. With an attempt to triangulate the national statistics, the study uses the data available from the commune database as a data source to compute the irrigated area for Cambodia.

To get more evidence from the ground, the study visited 12 completed irrigation systems in eight provinces across the plains of Tonle Sap Lake and Lower Mekong River. The field assessment tried to identify the schemes' potential and actual capacity to irrigate in both the wet and dry season. Out of the 12 schemes, four were selected for in-depth analysis on their direct benefits and direct effects on beneficiaries especially the effects on beneficiary farmers' income. The schemes were purposely selected by taking into account the geographic representation, funders, and age of projects.

Figure 2.1. Sites of visited irrigation schemes

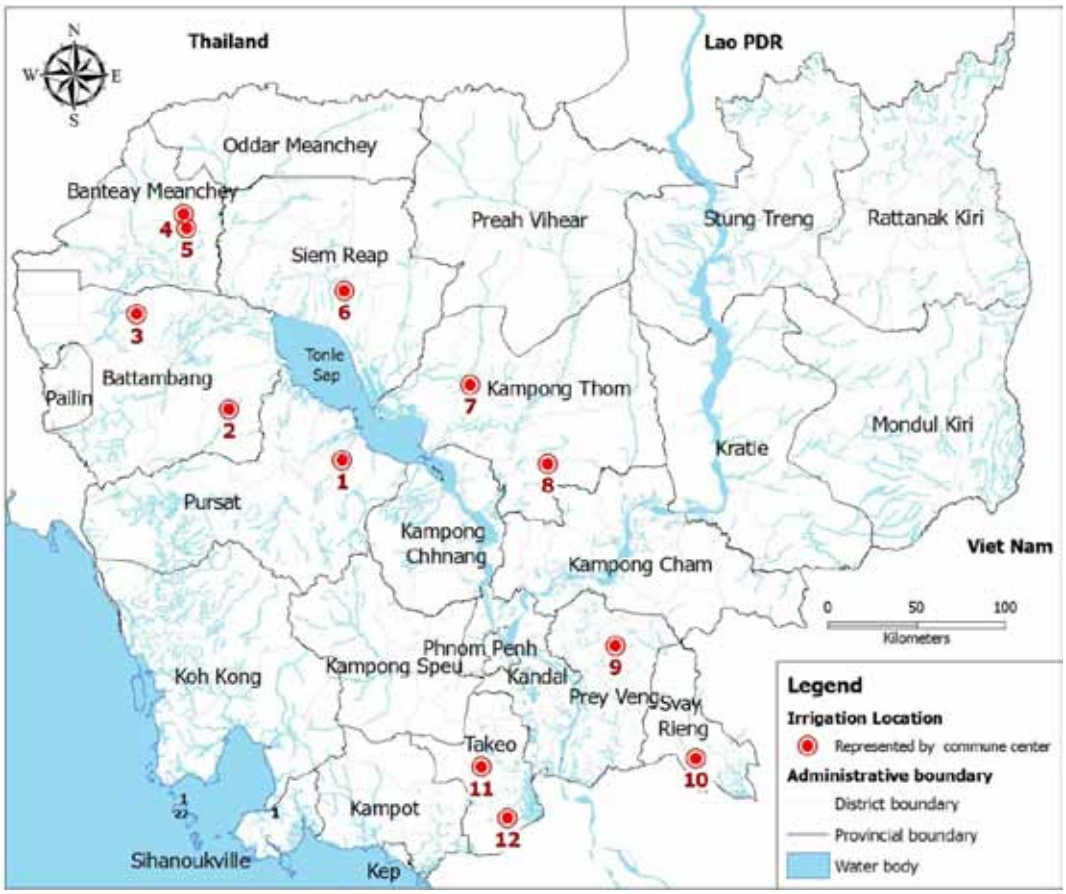


Table 2.1. Sites of visited irrigation schemes

No.	Name of Irrigation System	Major Funder	Commune	District	Province
1	Tram Mneash	ADB	Tnaut Chum	Krokor	Pursat
2	Chrey Cheung & Mareas Prov	EU	Chrey	Moung Russey	Battambang
3	Canal No. 1	ADB	Khnach Romeas, Roung Chrey, & Bansay Treng	Thmar Koul & Thmar Koul	Battambang
4	Punley	ADB	Punley & Phkoam	Phnom Srok & SvayChek	Banteay Meanchey
5	Tean Kam – Bantoit Boh	EU	Tean Kam	Preah Netr Preah	Banteay Meanchey
6	Tumnup Rumdeng	EU	Khnar Pur	Soutr Nikum	Siem Reap
7	Samseb Kanha	RGC	Damrei Slab	Kampong Svay	Kampong Thom
8	Stung Chinith	ADB	Brasat, Kampong Thmar, Boeung Lvea	Santouk	Kampong Thom
9	Canal Ruom Srok	RGC	Chea Klang & Chrey	Svay Antor	Prey Veng
10	Tradaet	IMF	Preah Ponlea	Kampong Ror	Svay Rieng
11	Dorng Khnhorm	RGC	Sror Ngae & Rokar Krav	Treang and Doun Keo	Takeo
12	Banteay Thleay	EU/AusAid	Kropum Chhouk, Prey Khlar, Prey Yuth Phkar, Rominh	Koh Andaeth	Takeo

For each irrigation system, a study team of 8 people interviewed i) commune councils, 2) farmer water user communities, 3) project staff if any, and 4) lead farmers to assess the actual capacity of the system in the dry season and its usefulness in the wet season. The field team spent one or two days to cover one system, depending on the size of the system. However, for an additional in-depth analysis, especially on the usefulness of the project, four irrigation schemes out of 12 were selected and about 45 farmers per scheme were interviewed. This comprises of 15 dry season rice farmers using water from the irrigation project, 15 farmers using water from the project in wet season and 15 farmers not benefiting from the irrigation scheme as their farms are not in the command area. The field team spent an additional day to conduct interviews with 45 farmers selected to represent their respective groups.

3. Review of Irrigation Coverage in Cambodia

This chapter aims to review the irrigation coverage in Cambodia based on data available from existing sources of literature which include government's documents such as the NSDP, SAW, and ASSDP. The Provincial Data Books available from the NCDD's website and which are based on the commune database were also used as reference for this review.

Through a study of the literature, the statistics on irrigation coverage in Cambodia are confusing as sometimes it is reported as percentage of land under crops while in other instances it is viewed as percentage of paddy lands. This is most likely explained by the lack of disaggregated data of irrigation areas. For example, the NSDP series keeps reporting the following: land under crops; irrigated area; and cultivated paddy area. Because the cultivated

paddy land is just part of the land under crops, the irrigated area as part of the land under crop should actually be different from that as part of the cultivated paddy land. But the statistics available from the literature lacks such disaggregation and thus is made confusing. The confusion further raises doubt on how the data of irrigated area was collected and compiled.

Given the lack of disaggregated statistics of irrigated areas, this review does not assume the reported irrigated area as part of either land under crops or cultivated paddy land in particular, but treats it as the only known statistic and tries to view it in relation to both aspects –land under crops and cultivated paddy lands. With regard to irrigated paddy lands, this report assumes that the cultivated paddy land in the dry season is all irrigated as there are no rains in the season. All these should help verify and establish the irrigation coverage in Cambodia's agriculture sector.

As indicated in the **Table 3.1**, the irrigated area was 588,000 hectares in 2005 as a baseline for the NSDP 2006-10 (RGC, 2005), representing 21% of the then land under crops or 25% of the then cultivated paddy area. Built on this, the RGC aimed to increase the irrigation coverage to 650,000 hectares by 2010, which should represent 19% and 26% respectively of the land under crops and cultivated paddy area in that year. This means the irrigated area should not contribute a significant change to irrigation coverage in percentage terms as the land under crops and cultivated paddy area would also expand during the NSDP 2006-10 period.

Table 3.1. Changes of irrigation coverage in Cambodia as reported at the national level

		Base &Target		**Progress**		
		NSDP 2006-10		NSDP MTR	NSDP Update	MOWRAM
	Year	2005	2010	2008	2008	2010
Land under crops	**(000ha)**	**2,835**	**3,500**	**3,300**	**3,211**	**3,547**
Cultivated paddy	(000ha)	2,374	2,500	2,600	2,615	2,795
Wet season paddy	(000ha)	2,062	2,160	2,240	2,255	2,391
Dry season paddy	(000ha)	312	340	360	360	404
Irrigated area	(000ha)	588	650	827	1,120	1,167
Irrigated wet season	(000ha)	276	310	467	760	763
Irrigated dry season	(000ha)	312	340	360	360	404
Irrigated area/ Land under crops	**%**	**21%**	**19%**	**25%**	**35%**	**33%**
Irrigated area/ Cultivated paddy	**%**	**25%**	**26%**	**32%**	**43%**	**42%**
Irrigated wet season	%	13%	14%	21%	34%	32%
Irrigated dry season	%	100%	100%	100%	100%	100%

Author's calculation
Source: NSDP 2006-10, NSDP MTR 2008, NSDP Update 2009-13, and MAFF's statistics.

Taking stock of the progress in 2008, the NSDP Midterm Review (RGC, 2008) showed that the irrigation coverage increased to 827,000 hectares (RGC, 2008), which is 25% and 32% respectively of the land under crops and cultivated paddy area. The increase seems largely driven by improved irrigation coverage of the wet season paddy lands. Although the cultivated paddy area in the wet season in 2008 experienced about 70% increase from that in

2005, 21% of the cultivated wet season paddy lands were irrigated, showing a 56% increase from that in 2005.

The irrigation coverage in 2008 appeared substantially larger when reported in the NSDP Update 2009-13 (RGC, 2010). It was reported that 1.12 million hectares was irrigated, which is 41% larger than that reported in the NSDP MTR in 2008. In percentage terms, it means the irrigation coverage became 35% of the land under crops or43% of the cultivated paddy area, a substantial difference from 25% and 32% respectively reported in the NSDP MTR 2008. Such significant discrepancy of the reported irrigation coverage in 2008 indicates mismatched statistics and deserves further examination and/or explanation from MOWRAM.

In 2010, the irrigated area was reported to have further increased to 1.16 million hectares, which is about 33% and 42% respectively of the land under crops and cultivated paddy land. The coverage became relatively smaller if compared to that in 2008 because the land under crops and the cultivated paddy area expanded faster during the same period. Corresponding to that reported irrigation coverage in 2010; irrigated wet season paddy should be 763,000 hectares which is about 32% of the cultivated wet season paddy area (if cultivated dry season paddy are all assumed irrigated) while the rest is fully rain-fed.

Table 3.1 demonstrates that the irrigated area of 1.16 million hectares in 2010 was doubled from that in 2005, indicating a 579,000 hectares increase or 80% above the set target. This indicates a remarkable achievement, but it deserves justification to explain such dramatic increase of irrigated areas. The evidence showed that the irrigated area increased just about 190,000 hectares between 2001 and 2005 (RGC, 2010). On the other hand, the public expenditure is not likely explaining the whole increase of irrigated areas over the period[2]. Ngo and Chan (2010) indicated that the total capital expenditure for MOWRAM (including donor's financing) was about USD 34 million per annum between 2006 and 2009.

Based on the national survey (CSES 2007), the WB (2009) showed that a village in Cambodia on average has 246 hectares of agricultural lands, of which 61 hectares were irrigated. This indicates that the irrigated area in Cambodia was about 25% of the total agricultural lands in 2007.

WB (2006) reported that only about 10 percent of the rice area, or 256,000 hectares were effectively irrigated because the irrigated capacity was undermined in general by the dilapidated status, poor initial design, and inadequate management of irrigation infrastructure. The report further noted that the irrigated areas were even smaller during the dry season. This estimation of irrigation coverage appears much less if compared to that reported by the RGC.

[2]Interviews with a PDWRAM's engineers indicates that the average cost for a headwork rehabilitation is about USD 600-800 per hectare and between USD 1,000 and 2,000 per hectare for a full system rehabilitation. Moreover, a China's Hegemonization of Irrigation System Strategy Project costs USD 1,200 per hectare. The average cost for ADB's projects is much higher, which may be explained by quality differences or the inclusion of other project's components such as FWUC formulation and extension services. The Northwest Irrigation Sector Project and Stung Chinith Irrigation Project cost USD 2,900 per hectare.

However, the discrepancy may be subject to the dissimilar views on the definition and measurement of the irrigated areas.

Table 3.2 presents the coverage of irrigated area in Cambodia in 2008 based on the data available from the Provincial Data Books posted on the NCDD's website[3]. It shows that only 8% of the cultivated paddy land in the wet season had access to irrigation. While all cultivated paddy land in the dry season was supposed to have access to irrigation system, the total irrigated area thus was about 21% of the total cultivated paddy area in 2008.

Table 3.2. Irrigation coverage in Cambodia, 2008

		Paddy Land (000ha)						
		Wet Season Areas			**Dry Season Areas**		**Total (Wet + Dry)**	
No.	Province	Available	Cultivated	Irrigated	Available	Cultivated*	Cultivated	Irrigated
1	Battambang	311	273	9%	8.8	6.3	279	11%
2	Banteay Meanchey	348	244	3%	2.9	2.4	246	4%
3	Kampong Cham	163	153	12%	71.0	57.2	210	36%
4	Kampong Chhnang	109	102	17%	23.8	22.0	124	32%
5	Kandal	45	41	29%	83.5	66.7	108	73%
6	Kep	3	3	9%	0.1	0.1	3	13%
7	Koh Kong	11	7	0%	0.4	-	7	0%
8	Kampong Speu	290	107	5%	2.5	1.1	108	6%
9	Kampot	113	113	3%	4.3	3.5	116	6%
10	Kratie	32	31	9%	15.2	13.4	44	37%
11	Kampong Thom	179	158	9%	25.0	18.2	176	18%
12	Mondulkiri	24	15	0%	0.0	-	15	0%
13	Otdar Meanchey	139	52	0%	0.1	0.0	52	0%
14	Pailin	4	2	14%	1.3	0.9	3	39%
15	Pursat	98	77	14%	4.1	2.8	80	17%
16	Prey Veng	221	207	13%	72.9	68.0	275	35%
17	Preah Vihear	36	35	0%	0.1	0.0	35	0%
18	Rattanakiri	34	26	0%	0.3	0.0	26	0%
19	Preah Sihanouk	15	14	0%	-	-	14	0%
20	Svay Rieng	152	177	0%	13.7	12.6	189	7%
21	Siem Reap	195	172	5%	16.5	14.2	186	12%
22	Stung Treng	24	21	0%	-	-	21	0%
23	Takeo	157	155	9%	79.7	75.2	231	39%
	Total	**2,703**	**2,183**	**8%**	**426**	**365**	**2,548**	**21%**

* All cultivated land are irrigated in the dry season

Source: Author's calculation based on NCDD's District And Provincial Data Books

Besides the irrigation coverage, **Table 3.2** also illustrates the under-utilisation of the paddy land both in the wet season and dry season. The data indicates that 3,129,000 hectares is available for paddy production (2,703,000 hectares in the wet season and 426,000 hectares in the dry season). However, only about 80% of these lands were under paddy cultivation in 2008 while the rest 20% (520,000 hectares in the wet season and 62,000 hectares in the dry

[3] www.ncdd.gov.kh (access 21 June 2011). The Provincial Data Books are based on the commune database that stores the data collected by village chiefs and commune clerks annually at each year-end.

season) were left unused. This indicates a potential for further expansion of paddy production areas in both seasons since 2008.

4. FIELD OBSERVATION OF IRRIGATION CASES

The chapter provides a summary of the benefits and challenges as observed across the visited schemes, then followed by the separate case study of all 12 irrigation schemes.

4.1. Benefits from Irrigation

In all visited schemes, the farmers as well as local authorities expressed their enthusiasm and satisfaction with the benefits from the improved irrigation system. Observation of irrigation cases across 12 schemes suggests that the rehabilitation effort has brought about a considerable range of benefits to farmers. Those benefits include:

- greater irrigated areas (supplementary to rainfalls in the wet season);
- intervention in time of drought;
- production of extra crop in early wet season (Apr-Aug) or dry season (Dec-Apr) on the wet season paddy area;
- improved paddy yield;
- drainage system to remove surplus water from the rice field when needed;
- increased vegetable production;
- access to towpaths for travel and transporting farm inputs and produces;
- sites for outdoor leisure;
- household's and animal's use; and
- Improved fish population.

Irrigated area vs. Command area: **Table 4.1** measures the irrigation capacity in relation to the scheme's command area. The table only presents the data from 7 schemes[4]. Of note, these 7 schemes were all rehabilitated with assistance from external development partners including the ADB, the EU, and the IMF. The table, in principle, shows that all the rehabilitated schemes could provide irrigation water to the full command area in the wet season with supplement water from rains. However, interviews with local authorities, FWUC committees, and key informants suggest that these command areas will only be all irrigated if: 1) there are considerable rainfalls to supplement; 2) farmers further pump into the paddy fields due to lack of tertiary canals in the system. In time of drought, without supplement from rain, it was estimated that the schemes would serve roughly one third of the command areas. Such limited supply of water is due to: 1) no supplement from rains; and 2) there is a high demand for water including competition for water from other schemes farther upstream.

[4] Other schemes are not included in the analysis due to incomplete data of command area as well as irrigated area of the schemes because the schemes are large-scale and the time was limited.

Table 4.1. Irrigation capacity of the rehabilitated schemes

			Irrigation Coverage (ha)			
No.	Irrigation Scheme	Command area	Irrigated wet season	Extra crop in wet season[5]	Extra crop in dry season[6]	Total extra cropping
1	Tram Mneash	1,212	1,212	0	450	450
2	Chey Cheung	506	506	250	0	250
3	Canal No. 1	1,061	1,061	720	0	720
4	Punley	750	750	0	60	60
5	Tean Kam-Bantoit Boh	250	250	0	0	0
6	Tumnup Rumdeng	362	362	0	20	20
7	Tradaet	240	240	30	60	90
	Total	4,381	4,381	1,000	590	1,590
Irrigation capacity as % of command area			**100%**	**23%**	**13%**	**36%**

Source: Fieldwork (June 2011)

The scheme rehabilitation often, though not always, enables farmers to grow an extra crop on their wet season paddy lands. Data from these 7 schemes shows that 36% of the command area is favorable for farmers to grow an extra crop – either in the early wet season or in the dry season. However, only 13% is cultivated in the dry season at a time when it is fully dependent on water from the scheme. Another 23% is producing paddy during early wet season with supplemental water from rainfalls.

However, the schemes that were rehabilitated by the RGC's funds (for instance Samseb Kanha[7] Reservoir in Kampong Thom and Ruom Srok Canal in Prey Veng) could not supply irrigation water to its full command area. This is because the intervention was only able to improve the headwork and the main canals. As the schemes are large-scale, the rehabilitation was only implemented through several consecutive years with only small funds available from the government's budget. Interviews with PDWRAM reveal that with that limited budget, no tertiary canals have been provided. The system also lacks diversion structures and thus its capacity to actually irrigate farmlands in the command areas remains limited.

Irrigated area vs. Paddy area: **Table 4.2**summarises the coverage of irrigated areas based on the interviews with the commune authorities (including the commune council and the commune clerk) in 24 communes across 8 provinces around Tonle Sap Lake and the plains of Lower Mekong River during the fieldwork from 31 May to 18 June 2011. All these 24 communes are covered by the 11 irrigation schemes that were rehabilitated in recent years[8]. However, it's important to note that the reported irrigated area in each commune is not limited to the 11 schemes but includes all other schemes that provide irrigation water to the communes. Thus, these 24 communes are targeted as being among communes with greater, though not greatest, access to irrigation water for the wet season paddy area. These 24

[5] Between April and August on the wet season paddy area.
[6] Between December and April on the dry season paddy area.
[7]Samseb Kanha is a sound in Khmer language which means 30 September.
[8]Banteay Thleay Irrigation Scheme, which is the 12th scheme locating in Koh Andaet district of Takeo province, is not included because this scheme is exceptionally for dry season paddy production.

communes are all wet season paddy producing[9]. Therefore, the data in this table is indicating both the irrigated paddy area in the wet season and the coverage of extra cropping in relation to the total cultivated wet season paddy area in the communes.

Table 4.2. Irrigation coverage in cultivated wet season paddy areas of communes with access to rehabilitated irrigation schemes

		Wet Season (ha)		Extra Cropping (ha)		
No.	Commune	Cultivated area	Irrigated area	Extra crop in wet season[10]	Extra crop in dry season[11]	Total Extra season
1	Tnaut Chum	2,645	1,212	0	450	450
2	Chrey	1,700	506	350	30	380
3	Khnach Romeas	4,842	1,072	1,072	0	1,072
4	Roung Chrey	4,750	2,360	2,000	0	2,000
5	Bansay Treng	3,742	2,060	1,650	0	1,650
6	Punley	5,787	1,880	0	250	250
7	Phkoam	5,141	32	0	20	20
8	Tean Kam	3,349	1,170	0	0	0
9	Khnar Pur	1,700	362	0	20	20
10	Chan Sor	2,200	376	0	120	120
11	Damrei Slab	4,964	1,041	0	200	200
12	San Kor	6,470	1,000	0	0	0
13	Roung Roeung	1,200	623	0	10	10
14	Preah Damrei	1,641	1,100	0	341	341
15	Brasat	4,310	3,040	0	0	0
16	Kampong Thmar	3,182	1,196	0	0	0
17	Boeung Lvea	510	384	0	32	32
18	Chrey	3,555	1,200	0	65	65
19	Chea Khlang	2,447	1,700	0	0	0
20	Brosotr	2,015	40	0	0	0
21	Svay Toeu	1,250	150	0	0	0
22	Preah Ponlea	1,500	210	32	62	94
23	Rokar Krau	1,922	500	112	0	112
24	Srongae	1,625	1,200	1,200	250	1,450
	Total	**72,447**	24,167	**6,416**	**1,850**	8,266
	Irrigation Coverage	**72,447**	33%	**9%**	**3%**	11%

Source: Fieldwork (June 2011)

Table 4.2 reveals that of all 72,447 hectares of cultivated wet season paddy area in all 24 communes with access to schemes that had been rehabilitated in recent years, only 33% (or one-third) is irrigated with supplement from rainfalls while the rest remain fully rain-fed.

[9]Communes that are largely producing dry season paddy are not included in the analysis as the study assumes that dry season paddy areas are all irrigated and thus wishes to only examine irrigated area for the wet season paddy areas.
[10] Between April and August on the wet season paddy area.
[11] Between December and April on the dry season paddy area.

This means the irrigation coverage appears rather limited despite existence of functional irrigation schemes in the area. In order words, it implies that the irrigation coverage of the cultivated wet season paddy must be far below 33% if taking into account the communes without access to rehabilitated irrigation schemes.

The statistic further illustrates that the irrigated area is becoming more limited at other times of the year. The irrigation water only allows extra cropping of paddy possible on 11% of total cultivated wet season paddy area of the communes, which is one third of the supplementary irrigation capacity in the wet season. Of these extra cropping, 9% are possible during early wet season paddy which is also supplemented by rainfall, and other 3% are working in the dry season which is fully dependent on the irrigation water.

Increase of paddy yield is reported by farmers and local authorities across all visited schemes. **Table 4.3**summarises all interviewees' perception on paddy yield following the scheme rehabilitation compared to pre-rehabilitation years. It shows that the irrigation has improved the paddy yield in the wet season by 34% on average. However, it's important to note that the increase is not limited to the effect of irrigation itself, but complemented by other irrigation-motivated factors such as improved seeds and fertilisers and agricultural extension services provided as part of the rehabilitation project.

Table 4.3. Perception on yield improvement for wet season paddy when accessing irrigation

		Paddy Yield (t/ha)			
No.	Irrigation Scheme	Yield before rehabilitation	Yield after Rehabilitation	Yield Increase	% Yield Increase
1	Tram Mneash	2.5	3.0	0.5	20%
2	Chey Cheung & Mareas Prov	2.5	3.0	0.5	20%
3	Canal No. 1	3.0	3.5	0.5	17%
4	Punley	1.5	2.0	0.5	33%
5	Tean Kam – Bantoit Boh	1.5	1.8	0.3	20%
6	Tumnup Rumdeng	1.8	2.3	0.5	28%
7	Samseb Kanha	1.4	2.4	1.0	71%
8	Stung Chinith	1.2	2.5	1.3	108%
9	Canal Ruom Srok	1.5	2.0	0.5	33%
10	Tradaet	1.0	1.5	0.5	50%
11	Dorng Khnhorm	3.2	3.7	0.5	16%
12	Banteay Thleay	2.5	4.0	1.5	60%
	Average	**1.9**	**2.6**	**0.7**	**34%**

Source: Fieldwork (June 2011)

Access to towpaths is among the chief benefits of the irrigation scheme improvement. The field assessment found that the irrigation scheme improvements always resulted in improved conditions for travel and transport through access to towpaths along the side of the canal and reservoir. Farmers and local authorities did value and appreciate such benefits from the scheme.

The rehabilitation of the irrigation schemes is also observed to create some disadvantages to the community people. The rehabilitation was inevitably affecting the people's lands while

compensation was not always forthcoming. In some schemes, farmers were compensated in cash for their affected lands. In other schemes, farmers were asked to voluntarily donate their affected lands otherwise the canal would not be constructed or improved. In the latter option, local authorities played a key role in coordination, negotiation, and lobbying with affected farmers. In most instances, farmers agreed to donate their lands while some others strongly refused. Moreover, the scheme improvements sometimes caused floods on some farmlands or made it more difficult for farmers to transport their farm inputs and produces as no bridges or culverts were built for crossing the canal.

4.2. Challenges in Irrigation System

While success of the irrigation scheme improvement is largely evidenced by the benefits as described above, several factors were reported to have contributed to it, for instance, constant availability of water from the source, consultation with local authorities and community people, awareness programme on water use and management for beneficiary farmers, provision of agricultural extension services, and FWUC formation. These factors were reported as strengths of the rehabilitation project. Nevertheless, a number of major challenges were observed as follow:

- **Insufficient water supply**: One of the prime challenges in irrigation is limited availability of water to supply the systems' command area. Such undersupply of water can be explained by two major factors: 1) the availability of water has become scarcer due to less rain; and 2) more demand for water harvest by other competing irrigation schemes farther upstream. Of 12 visited schemes, 10 are reliant on water from the river and other two depend on rain catchment in the reservoirs.

- **Incomplete system**: Many systems were incomplete as they lack diversion structures and tertiary canals, especially RGC-funded projects. The assessment found six out of 12 visited schemes were provided with tertiary canals. The other six were without tertiary canals. All 3 visited schemes rehabilitated by the RGC's funds were incomplete – only the headwork and main canals were rehabilitated. Moreover, in many cases, farmers, local authorities, and FWUC agreed that the schemes lack diversion structures to control the water in the system.

- **Scheme management**: A FWUC is established in all donor-funded rehabilitation projects with duty to operate, manage, and maintain the scheme. In contrast, none of RGC-funded projects visited were found to have a FWUC established. Nonexistence of a FWUC made the water coordination difficult. For instance, only two stewards were assigned by the PDWRAM to be in charge of the water management and control in the Samseb Kanha Reservoir in Kampong Thom. The stewards only control the water in the reservoirs but do not either inform farmers when they release the water or coordinate water demand from farmers. In the cases of Chrey commune (Ruom Srok Canal in Prey Veng) and Rokar Krav (Dorng Khnhorm Reservoir in Takeo), farmers

managed to form small groups by their own initiatives to coordinate water distribution and look after the scheme.

- **FWUC functioning**: Although the FWUCs were set up in many of donor-funded rehabilitation projects, not all of them are actively functional. Out of nine FWUCs established, only two managed to collect appropriate fees from farmers. The rest could just collect very small fees[12]. The FWUC functionality was observed to vary from one case to another but in general it seems to be explained by: 1) low capacity of the FWUC committee; 2) shortage of irrigation water supply; 3) incomplete system; 4) lack of farmers' participation and their unwillingness to pay the water fees; and 5) lack of incentives for FWUC committee members.

  In some instances, the FWUC committee is not active and lacks good leadership to coordinate and encourage the farmers' participation. In some other cases, the FWUC does not dare to enforce the FWUC's regulations and collect water fees because the scheme does not supply sufficient water for farmers. Incomplete systems are another factor undermining FWUCs ability to collect water fees. Due to lack of tertiary canals, farmer's spend considerable sums to pump the water into their farms. For this reason, farmers often make complaints to the FWUC thus making them feel uneasy to go and collect the water fee. Additionally, most schemes provide irrigation water to supplement the rains in the wet season and thus farmers are not really willing to pay the fee as they think most of the water comes from rainfall, especially when the season has plentiful amounts of rain.

  The functioning of the FWUCs seems to be largely due to the incentive scheme for the FWUC committee members. The incentive system is unclear across irrigation schemes visited where the FWUC were established. In some cases, FWUC committee members were reported to have worked on a voluntary basis which is fully unpaid. In other cases, they were paid with some very small amount. This poses the question whether FWUC members should be reasonably paid so that they do their jobs well. Further questions relate as to whether the water fee could be increased, and whether the scheme could supply sufficient irrigation water so that farmers gain appropriate return from their cropping.

- **Construction and design**: The challenges in irrigation were also observed to have been caused by their construction and design. In the cases of Canal No. 1 and Chrey Cheung & Mreah Prov schemes, both the authorities and villagers confirmed that they were consulted by the projects but their comments were not taken into account. As a result, the rehabilitation of the Chrey Cheung & Mreah Prov scheme made 30 hectares of paddy land flooded and thus uncultivatable in the wet season. On the other hand, it required 130 hectares upstream of the system now be irrigated by pumps, rather than gravity flow, which was the case before the rehabilitation.

[12]This is also echoed by interview with PDWRAM in Takeo. The interview shows that there are 26 FWUC in Takeo (11 of which were registered with MOWRAM) and about 20% of them are functioning fairly good but the rest are not good or even not functional.

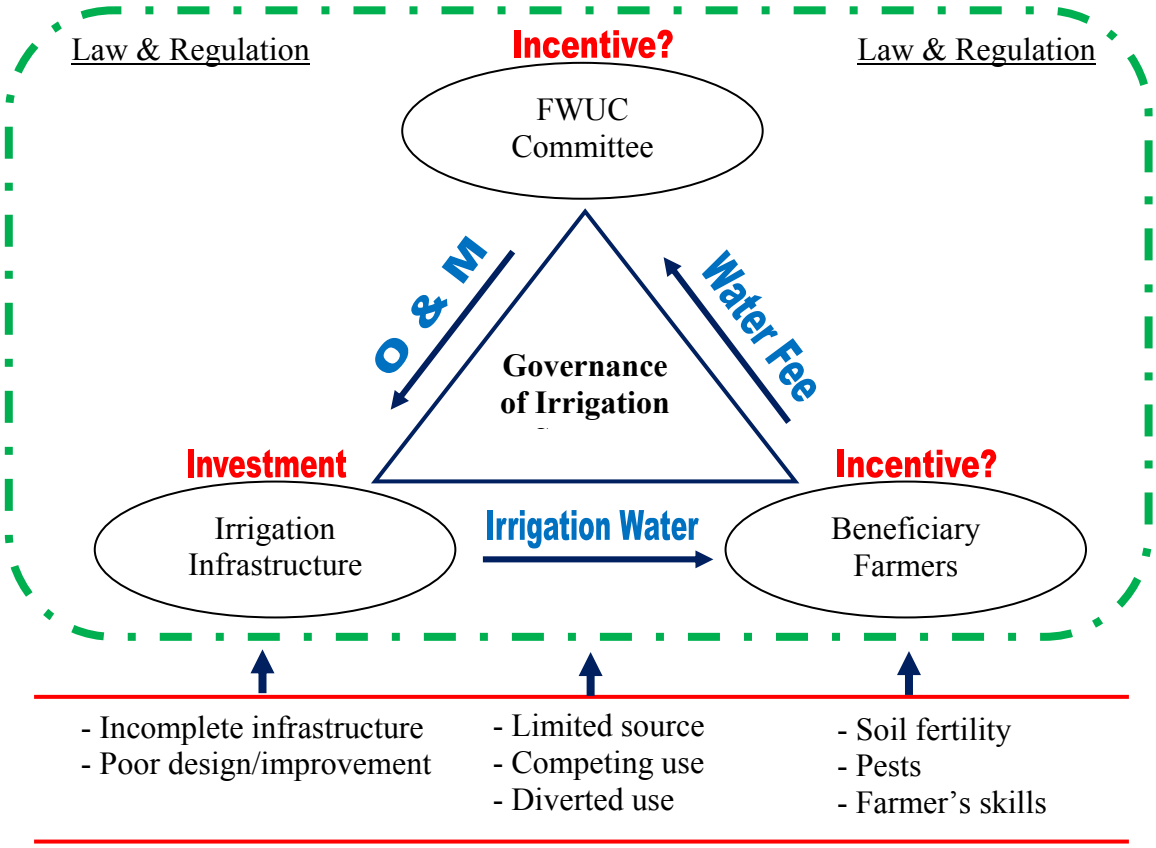
For the case of Punley Irrigation Scheme, FWUC affirmed that the sub-contractor did not construct some of the tertiary canals in accordance with plan and given limited monitoring of the project, the sub-contractor was not held accountable. FWUC confirmed that while that particular tertiary canal was supposed to facilitate the water on a gravity flow, it is now a dug canal where farmers need to further pump. Moreover, the improvement of the Bantoit Boh Irrigation Scheme has provided benefits to the large-scale and rich farmers rather than smallholder famers.

- **Conflict of interests**: The field assessment noted that authoritative people had abused their power to use the irrigation water to serve their own benefits. In the case of Canal No. 1, villagers alleged that the water was diverted to irrigate paddy fields outside the system where considerable farm areas of an official of DOWRAM were located. In the case of Samseb Kanha, villagers also alleged that the scheme steward did not release the water from the reservoir during the dry season, but kept it for supplying his own farm which is close to the reservoir.

- **Low return**: The return from irrigation may go someway to explain the functioning of FWUC and fee collection system. Farmers in Takeo are willing to pay up to KHR 639,000 (USD 156) per hectare in the Banteay Thleay Scheme and KHR 300,000 (USD 70) per hectare in the Dorng Khnhorm Scheme. But the water fee is far less in other visited schemes where the water fee could be as low as KHR 20,000 (USD 5) per hectare. On the one hand, cheap water fee could be undermined by limited supply of irrigation water from the scheme; on the other hand low return on agricultural production could be influenced by infertile soil, pest infestations, and farmers' lack of technical knowledge. As demonstrated by the case of Stung Chinith in Kampong Thom, where low return on irrigation is attributed to infertile (sandy) soil and pests.

With all these challenges in irrigation/water management based on the observation across 12 visited schemes around the plains of Tonle Sap and Lower Mekong, the concept as well as inter-relationship among these challenges could be visually summarized as presented in **Figure 4.1** below. Moreover, the figure should also serve as an indicative framework to guide the way toward effective governance of irrigation scheme in Cambodia.

Figure 4.1: Schematic framework for effective governance of irrigation schemes



Source: The author

5. Rapid Household Survey

This chapter presents the findings from a rapid survey that the study conducted with aims to illustrate the benefit of the irrigation scheme by observing the behavior of farmers in cropping when their farms have access to irrigation. The survey is not meant to summarize the benefit or impact of irrigation as a whole, but to observe and understand the influence of irrigation water on farmers' agricultural production within the sample areas.

5.1. Sample Selection

As part of the rapid assessment fieldwork, four irrigation schemes were selected for a rapid survey of farm households. Each of the four schemes was selected from different funders – ADB, EU, IMF, and RGC. The selected schemes are limited to ones that were rehabilitated in recent years and that have been providing irrigation water to farmers. In total 180 farm households[13] were selected for personal interviews – 45 farm households were selected, 15 of which were identified from the following three groups:

[13] These households were selected from 7 villages of 5 communes.

1) rain-fed wet season farmers: farmers with a wet season paddy plot that is fully dependent on rains;
2) irrigated wet season farmers: farmers with a wet season paddy plot that is irrigated by the studied scheme; and
3) Irrigated extra crop farmers: farmers with a wet season paddy plot that is re-used for a second paddy crop production in either early wet season (Apr-Aug) or dry season (Dec-Apr) with access to irrigation water from the studied scheme.

Table 5.1. Distribution of the sample (# of farmers)

Funder	Rain-fed wet season	Irrigated wet season	Irrigated extra crop[14]	Total
RGC	15	15	15	45
IMF	15	15	15	45
ADB	15	15	15	45
EU	15	15	15	45
Total	60	60	60	180

Source: Rapid survey of farm households (June 2011)

As such, 60 farmers from each group of irrigation access modes were interviewed. The selection of these farmers was done through consultation with the village chiefs. In interviews with each farmer, the enumerators asked about the general information of the household and the paddy area. Then, the enumerators together with the farmer chose a paddy plot that corresponds to the determined mode of irrigation access (rain-fed, irrigated wet season, irrigated extra season) for further in-depth interview about that particular plot. As such, findings generated from this survey are essentially describing or discussing the characteristics of the paddy plot, rather than the household.

5.2. Profile of the Sample

Of the 180 interviewed farmers, their average age is 45 years old and 45% are female. In terms of types of interviewed households, 12% are female-headed ones whose heads are 47 years old on average. 62% of the interviews were conducted directly with the household head; other 31% were interviews with the spouse of the household heads while the rest 7% were responded by the child and parent of the household head who have engaged in and are knowledgeable about the farm cultivation.

[14] Between April and August or December and April on the wet season paddy areas

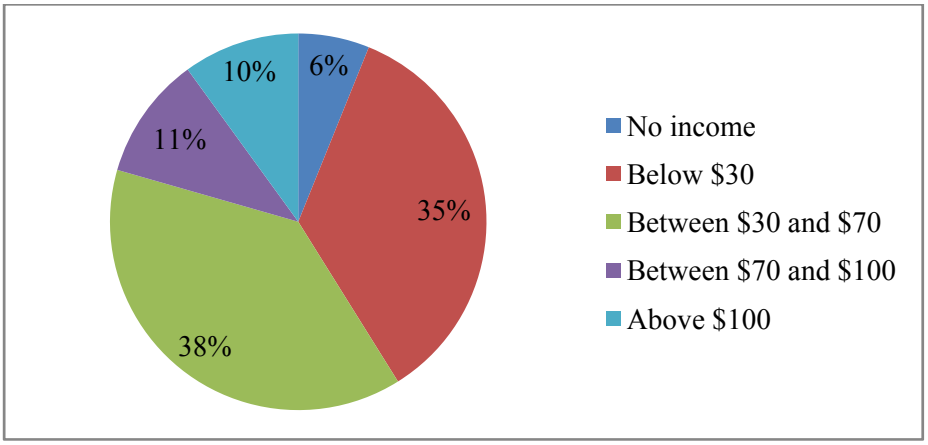
Table 5.2. Characteristics of the sample

	Rain-fed wet season	Irrigated wet season	Irrigated extra crop	Total
N	60	60	60	180
	Gender			
Female respondents	43%	50%	42%	45%
Female-headed HH	13%	17%	7%	12%
	Mean age (years old)			
Mean age of respondents	47	45	44	45
Mean age of HH heads	47	46	49	47
	Education attainment of HH heads			
No schooling	7%	13%	8%	9%
Primary school	57%	52%	60%	56%
Lower secondary school	28%	25%	25%	26%
Upper secondary school	3%	7%	7%	6%
Other	5%	3%	0%	3%
Total	100%	100%	100%	100%

Source: Rapid survey of farm households (June 2011)

Majority of the household heads have low education attainment. 9% of them had no schooling, 56% attended primary school, 26% attained lower secondary school and other 6% used to study in upper secondary school.

Figure 5.1. Average monthly cash income per household (% of HH)



Source: Rapid survey of farm households (June 2011)

Figure 5.1 shows that most of the interviewed households do not earn cash income of more than USD 70 per month on average – 6% has no cash income at all, 35% earn less than USD 30 per month, and 38% earn between USD 30 and USD 70 per month. Other 11% earn between USD 70 and USD 100 per month in cash while the rest 10% can earn more than USD 100 in each month.

5.3. Findings of the Rapid Survey

5.3.1. Farmers' Behavior and Farm Characteristics

Table 5.3 shows that the size of the paddy plot for rain-fed wet season paddy is generally largest, with an average size of 0.76 hectares per plot. The average size of paddy plots for irrigated wet season paddy is 0.58 hectares per plot, compared to 0.45 hectares for irrigated extra crop.

The survey shows that the application of farm inputs is significantly different among groups. The use of tradition seeds remains high among rain-fed farm plots. Improved seeds are only observed in 37% of these plot types, which is significantly lower if compared to 42% in irrigated wet season plots and 90% in irrigated plots of extra crops. The amount of seeds used is also significantly different. For instance, the farmers used on average 80 kg/ha for rain-fed plots and 92 kg/ha for wet season plots with access to irrigation. The use of seeds appeared significantly higher for production of extra crops, which was 150 kg/ha. However, anecdotes from interviews with farmers illustrates that a lot more seeds were used for irrigated extra crops because farmers usually adopt broadcasting methods for extra cropping while transplanting remained commonly practiced for wet season paddy, both rain-fed and irrigated ones.

Application of chemical fertilisers appeared most intensive in plots of extra crops. On average, farmers applied 272 kg per hectare, which is significantly higher when compared to 151 kg/ha for irrigated wet season plots and 127 kg/ha for rain-fed plots. However, the pattern of fertilizer application is not significantly different between rain-fed plots and irrigated wet season plots, though availability of irrigation water tends to encourage farmers to apply relatively more fertilisers.

Table 5.3. Farm characteristics (% of farms)

No.	Variables		Rain-fed wet season	Irrigated wet season	Irrigated extra crop	Total
		N	**60**	**60**	**60**	**180**
1	Average size of paddy plots	[ha]	0.76	0.58	0.45	0.60
2	Improved seed***	[yes]	37%	42%	90%	56%
3	Seed***	[kg/ha]	80	92	150	107
4	Fertilisers***	[kg/ha]	127	151	272	184
5	Compost	[yes]	63%	65%	52%	60%
6	Flat paddy field	[yes]	62%	47%	53%	54%
7	Drainage system*	[yes]	60%	83%	88%	81%
8	On-farm irrigation	[yes]	5%	5%	5%	5%
9	Pest problem**	[yes]	77%	73%	97%	82%
10	Pest control*	[yes]	67%	75%	88%	78%
11	Successful pest control	[yes]	77%	76%	78%	78%
12	Weed problem	[yes]	91%	77%	83%	84%
13	Weeding	[yes]	91%	77%	90%	86%

** indicates significant level < .05, ** significant level < .01, *** significant level < .001*

Source: Rapid survey of farm households (June 2011)

As indicated in **Table 5.3**, the irrigation seems to have no influence on the behavior of farmers in application of composts, land leveling, and weeding. Despite this the, application of composts was found in about 60% of the surveyed plots and 54% of the farm beds are flat while other 46% need leveling. The data shows that the weed problem is common across farm plots – 84% of the surveyed plots encountered weed problem. Weed problems appear more widespread among rain-fed paddy plots but not significantly different from the other two plot types.

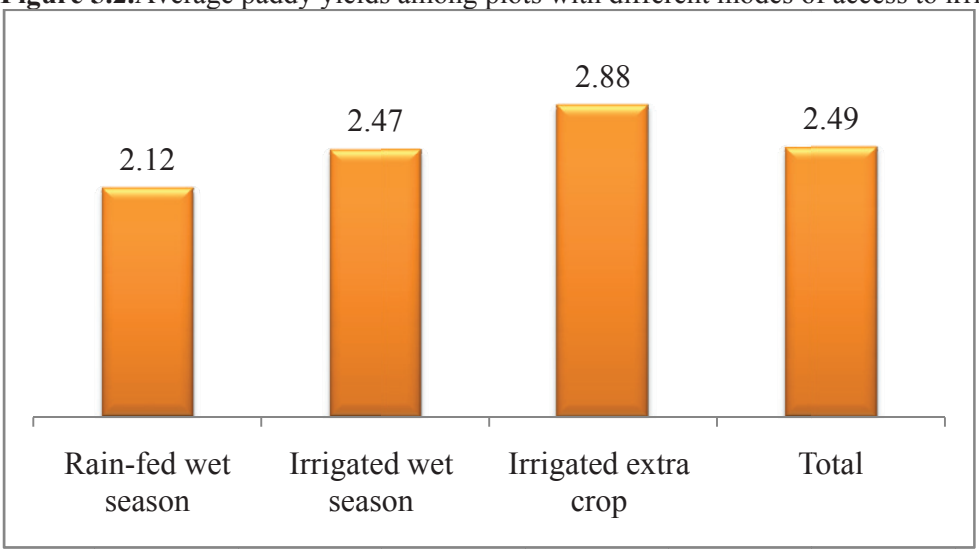
Pest problems are also commonly observed across all types of farm plots but appear highest among plots of extra crops – 97% of the plots reported to have been affected by pests, which is significantly higher when compared to 75% in irrigated wet season paddy plots and 77% in rain-fed plots. In response, it is found that farmers were trying to control pests in 78% of the affected plots and 78% of these plots experienced successful pest control.

The incidence of on-farm irrigation such as ponds or wells is very limited among farmers in this survey. Despite having no access to irrigation schemes, only 5% of the rain-fed plots were found to have on-farm irrigation. This figure is very low and confirmed by the similar proportion of plots with access to irrigation scheme either in wet season or for extra crop were also observed to have on-farm irrigation.

5.3.2. Yield Improvement and Challenges

As indicated by yield data, the irrigated extra crop production provides highest yield (2.88 t/ha), which is 17% higher than irrigated wet season plots and 36% higher than rain-fed wet season plots. The statistical analysis confirms that the average yield of the extra crop is significantly higher if compared to that of the rain-fed farm, but not significantly different from the average yield of irrigated wet season paddy which is 2.47 t/ha. The data further indicates that the availability of irrigation water seems to bring about 17% higher yield for wet season paddy if compared to farms that are fully dependent on rains. However, the statistic finds the yield difference is not statistically significant.

Figure 5.2. Average paddy yields among plots with different modes of access to irrigation (t/ha)



Source: Rapid survey of farm households (June 2011)

The contribution of irrigation to improvement of paddy yield is unclear. In the survey, farmers were asked to report whether the yield of the surveyed plots has been better following the scheme rehabilitation. The result shows that not all irrigated plots experienced the yield increase[15] and the percentage of irrigated plots that yielded higher is not significantly different from rain-fed plots. The data shows that the yield has been better in 61% of extra crop plots, but similar proportion of plots that are either rain-fed or irrigated in the wet season experienced improved yield, 56% and 55% respectively if compared to pre-rehabilitation of the irrigation scheme. This raises doubts as to whether rain-fed plots would still have gained the yield increase if the rehabilitation effort was absent in the locality. Nevertheless, it indicates that irrigation may further extend its benefits indirectly to rain-fed farm plots through dissemination of farming techniques and/or other input factors such as improved seeds and application of fertilisers so that farm yield improved.

Farmers who experienced the yield increase in the surveyed plot were further asked to share their views on factors contributing to the increase of their paddy yield. Farmers were asked to identify the influencing factors and were further asked to rate the degree of effect of each particular factor based on their perception. Their perceptions were then rated on 1-3 scale (1=little effect, 2=medium effect, and 3=strong effect).

The result shows that the degree of the influencing factors contributing to better yield is different among types of plots with different access to irrigation. For irrigated extra crops, the most influencing factor is irrigation/water management, followed by chemical fertilisers and pest control. The contribution of irrigation/water management to improved yield is also perceived as most important for irrigated wet season paddy plots, followed by good weather/rainfalls. Good weather/rainfall is perceived to have most influence on yield increase among rain-fed wet season plots, followed by chemical fertilisers. All this suggests that the role of irrigation is most important for the production of extra crop while good weather/rainfall is, on the other hand, perceived to play a crucial role in rain-fed wet season plots and both irrigation water and good weather/rainfall are respectively regarded as most important factors contributing to yield improvement in irrigated wet season plots.

Table 5.4. Farmers' perception on factors influencing their paddy yields

No.	Influencing factors		Rain-fed wet season	Irrigated wet season	Irrigated extra season	Total
		N	27	33	17	77
			Degree of effect*			
1	Irrigation/water management		1.7	**2.6**	**2.7**	2.6
2	Good weather/ rainfalls		**2.7**	**2.4**	2.0	2.5
3	Chemical fertilizers		**2.5**	1.9	**2.5**	2.3
4	Compost		2.4	2.2	1.0	2.3
5	Improved Seed		2.4	2.0	2.1	2.2
6	Pest control		1.8	1.9	**2.4**	2.0
7	Land improvement		2.0	2.1	1.7	2.0
8	Weeding		1.9	1.9	1.8	1.8

** Degree of effect is measured on 1-3 scale with 1=little effect, 2=medium effect, and 3=strong effect*
Source: Rapid survey of farm households (June 2011)

[15] Plots that do not experienced yield increase could be ones that also benefited irrigation water before the rehabilitation or ones that could be affected by pests or other factors.

Farmers who did not experience yield increase in the surveyed plots were also asked to report the reasons undermining the yield improvement. Based on their observation and perception, the farmers referred to the following as factors limiting the yield improvement:

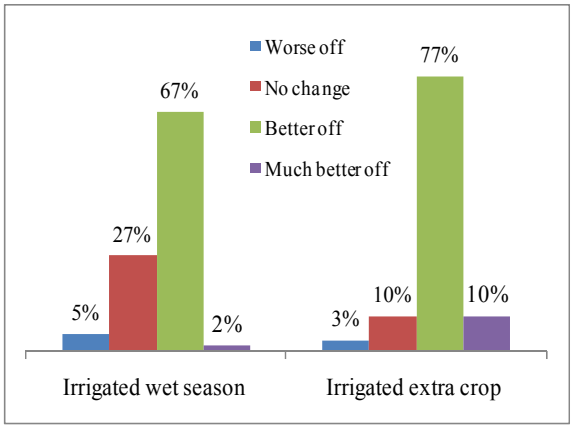
1. Flood / too much rains
2. Pest problem
3. Traditional seeds
4. Drought / lack water
5. Low application of fertilisers
6. Traditional / lack farming techniques
7. Poor soil quality
8. Labour shortage / lack nurture
9. Eroded soil quality

Among plots with access to irrigation water from the scheme, the farmers were asked to report whether they have any problems with the irrigation/water management. In response, 22% of the interviewed farmers reported they have problems with it. Major problems among other issues include: lack water; lack diversion structures and tertiary canals; expensive water fees; and discrimination of use/ access. About 55% of farmers who reported as having problems with the irrigation water said they faced water shortage and about 25% said the scheme lacks diversion structures and tertiary canals to direct water into their fields.

5.3.3. Irrigation Impacts

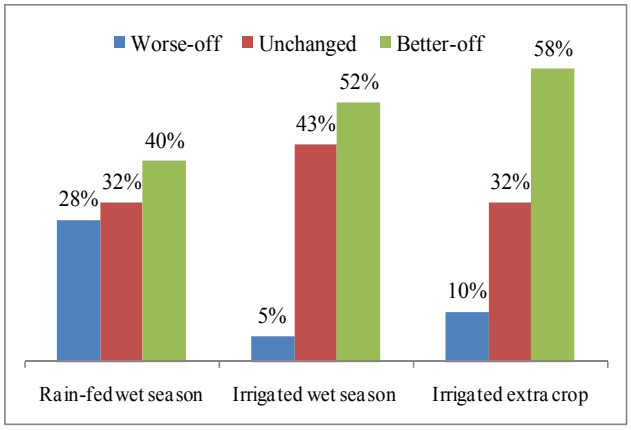
Figure 5.3 and **Figure 5.4**illustrates the indication of irrigation impacts on the farmers' livelihoods. **Figure 5.3** builds on the responses from farmers whether the irrigation has made their livelihoods better. Thus, this question was applicable to irrigated wet season farmers and irrigated extra crop farmers only. The result shows that 67% and 77% respectively of irrigated wet season farmers and irrigated extra crop farmers reported the irrigation made their livelihoods better while another 2% and 10% respectively experienced stronger impacts by saying that the irrigation made their livelihoods much better. Statistical analysis indicates that the irrigation has significantly stronger impacts on farmers whose plots are irrigable for extra crop production.

Figure 5.3. Irrigation and livelihoods



N=120, Significance level <0.05
Source: Rapid survey of farm households (June 2011)

Figure 5.4. Livelihood dynamics



N=120, Significance level <0.01
Source: Rapid survey of farm households (June 2011)

Figure 5.4 constructs the farmers' responses on how their livelihoods had changed when compared to a year before and this question is applicable to all farmers included in the survey. The result illustrates that 40% of farmers whose plots are rain-fed found their livelihoods better, but the proportion appears significantly higher among farmers whose plots having access to irrigation – 52% and 58% respectively of the irrigated wet season famers and irrigated extra crop farmers experienced improved livelihoods compared to a year ago. While these farmers saw their livelihoods improve, others experienced no change or even lower livelihoods. 28% of farmers whose plots are rain-fed reported their livelihood were lower. This proportion is significantly high if compared to 5% and 10% respectively of irrigated wet season farmers and irrigated extra crop farmers.

In an attempt to illustrates the relationship between the irrigation access and farmers' livelihoods, the enumerators were tasked to rate the livelihood level of the interviewed households based on information provided by the respondents and the enumerator's observation during the interview, taking into account the level of income, debt, shelter, and assets. As a result, it indicates that 17% of the households are better-off, 55% enjoy medium living standards, and other 28% are considered as poor.

Table 5.5. The farmers' living standard (% of farmers)

		Rain-fed wet season	Irrigated wet season	Irrigated extra crop	Total
	N	60	60	60	180
Better-off		17	13	22	17
Medium		53	55	57	55
Poor		30	32	22	28
Total		100	100	100	100

Source: Rapid survey of farm households (June 2011)

When trying to understand whether the irrigation has some correlation with poverty, the data, as indicated in **Table 5.5**, shows that the association is unclear. The incidence of poverty seems relatively less among irrigated extra crop farmers (22%), but it is not statistically significant if compared to 30% among rain-fed farmers. Furthermore, the poverty incidence among irrigated wet season farmers (32%) is not necessary low compared to among rain-fed farmers.

6. CONCLUSION AND WAYS FORWARD

Based on the investigation of existing literature and the field assessment including the rapid survey with farmers in communities with access to irrigation, the following conclusion could be drawn.

The national irrigated area appeared inconsistent through statistics and data available from existing literature and data sources. The government's reported figure is substantially higher when compared to other sources. While RGC noted the irrigated area reached 1.16 million

hectares in 2010, which represented 33% of lands under crop or 42% of cultivated paddy area, data available from national survey (CSES 2007) indicated that 25% of the agricultural lands were irrigated in 2007. The commune database, on the other hand, suggests that only 21% of total cultivated area in Cambodia was irrigated in 2008. For all these reasons, it may require further examination or explanation from MOWRAM to confirm the irrigation coverage in Cambodia.

The evidence from the field assessment found that the irrigated area is even limited in communes that have access to rehabilitated irrigation schemes. It showed that only 33% of paddy lands in these communes have benefited from irrigation water while the rest remained dependent on rainfall. Moreover, only 9% of the total wet season paddy area in the communes benefited from the irrigation water for the production of early wet season rice (Apr-Aug) with supplementary water from rainfall. The paddy area that benefit from irrigation water for rice cultivation in the dry season (Dec-Apr) accounted for only 3% of the total wet season paddy lands. This clearly indicates that the irrigation capacity in the dry season is very limited even in areas where there are rehabilitated projects.

The findings continue to demonstrate that the improved irrigation schemes generate a considerable benefit to livelihoods. As farmers were asked whether the irrigation had made their livelihoods better, the findings demonstrate a considerable relationship between the farmers' livelihood dynamics and access to irrigation. The majority of farmers who benefited from irrigation reported that the irrigation had made their livelihoods better. The survey further reveals that the proportion of farmers who found their livelihoods better compared to an earlier year is significantly highest among irrigated extra crop farmers, followed by irrigated wet season farmers. On the other hand, the proportion of farmers reported their livelihoods became worse off compared to earlier years is significantly higher among rain-fed farmers if compared to farmers in other two groups who have access to irrigation. Despite such positive effect on livelihoods, it does not necessarily mean the irrigation investment is cost effective as cost benefit analysis is not employed in this study.

The effect of irrigation on yield improvement is rated highest by farmers compared to other yield factors including chemical fertilisers, improved seeds, farming techniques, pest management, and good weather/rainfalls.

The irrigation impact may become more visible in the longer run as it may accumulate over time. Although farmers reported a positive impact of irrigation on their livelihoods, the relationship between irrigation access and living standard appears unclear. The poverty incidence is not significantly different between rain-fed farmers and farmers who benefit from irrigation. Nevertheless, this does not necessarily mean the irrigation does not generate significant impacts on the farmers' livelihoods. The impact may accumulate over time and thus be more visible in later years because the assessment is just a couple of years after the rehabilitation. On the other hand, the livelihood is not solely subject to irrigation, but its dynamic could be hampered by other non-irrigation factors.

The benefit of irrigation is evidenced by the farmer's willingness to pay the water fee up to USD 75 and USD 156 per hectare respectively for the two irrigation cases in Takeo: 1) Dorng Khnhorm Reservoir for wet season paddy area and 2) Banteay Thleay Irrigation Scheme for dry season paddy area. The assessment found that the irrigation scheme improvement has yielded a range of benefits for farmers, which include supplementary irrigation water for wet season paddy, intervention in time of drought, production of extra crop in early wet season or dry season, improved paddy yield, drainage system to remove surplus water from the rice field when needed, expansion of vegetable production, leisure sites, access to towpaths for travel and transporting farm inputs and produces, household's and animal's use, and improved fish population.

Despite all these benefits, the scheme functioning faces critical challenges. The operation and maintenance of the scheme is weak. Some scheme does not even have the FWUC established to operate and maintain the systems, especially ones funded by the RGC. Others managed to establish a FWUC but its effective functioning is in question. Very limited numbers of famers pay the water fee and the water fee itself is too low.

While limited fee collection could be the result of low capacity and weak leadership of the FWUC committee, the limited farmer's participation in paying the fee was observed to have been explained by insufficient supply of irrigation water from the scheme and low return to paddy production. Limited supply of irrigation water was further revealed to be subject to: incomplete infrastructure such as tertiary canals and diversion structures; poor design/improvement of the scheme; limited water source such as small rivers or rain-dependent reservoirs; competing water harvests from other schemes farther upstream; and diverted use of irrigation water due to abuse of power. Furthermore, the fee collection is also challenging if the irrigation scheme only supplements the rainfall in the wet season. In such cases, farmers are not willing to pay the fee because they think irrigation water only supplements rainfall, particularly the irrigation is thought of as useless if the season is endowed with good rainfall. On the other hand, the farmer's unwillingness to pay was also explained by their low return on paddy production due to infertile soil, pest affect, and lack of farmer's technical skills.

Based on the lessons learned from these visited irrigation schemes, it is suggested that farmers noted the significant effect of irrigation on their farm production as well as livelihoods. Farmers rated the effect of irrigation highest in relation to other factors including chemical fertilisers and improved seeds as to have contributed most to the yield increase. Nevertheless, the assessment also noted that the irrigation's effectiveness is undermined by poor design/improvement of the scheme; insufficient supply of irrigation water; and no/weak FWUC committee. The study, therefore, suggests the following issues are taken into account to further improve the effectiveness of the irrigation sector in Cambodia.

- Irrigation scheme should be built or rehabilitated with complete infrastructure, proper design, and follow-up of the construction or rehabilitation. The absence of tertiary canals and diversion structures were found as major obstacles in the irrigation/water management. Moreover, proper design and follow-up of the schemes construction or rehabilitation will help to ensure that the scheme will not undersupply the water to its

command area and that the water management will not be undermined by the scheme structure.

- Efforts should be made to explore and document cases of successful irrigation/water management or FWUCs so that good lessons could be drawn for replication purposes. Meanwhile, experiments of other mechanisms to implement effective irrigation/water management should also be tried, for instance, private-led or NGO-nurtured ones. While private-led irrigation/water management would allow private sector (individuals or companies) to run the scheme through bidding process; the NGO-nurtured one is meant to have competent and credible NGOs to assist the institutionalisation of the established FWUC during the early years. In any case, appropriate incentive systems must be put in place.

- A further in-depth cost and benefit analysis of existing irrigation schemes in different locations and soil types would provide clearer evidence for decisions on where or which projects should be prioritised so that the resource is better planned and used. Moreover, because the evidence has shown the irrigation scheme could provide a range of benefits other than irrigation water, multiple use/function of the irrigation scheme should be taken into account in the project design and incorporated in the cost and benefit equation so that the project's cost-effectiveness could be enhanced.

- Given consistent reports of national irrigation coverage from different sources, a way to clarify or identify the irrigation capacity of Cambodia is needed. This may require a robust review or survey to validate the statistics with agreement among key stakeholders including the government institutions and development partner agencies. At the same time, efforts to improve the method of data collection among relevant and/or competent institutions are required.

7. REFERENCE

MAFF and MOWRAM (2007). Strategy for Agriculture and Water 2010-13, Phnom Penh: Ministry of Agriculture, Forestry and Fisheries (MAFF) and Ministry of Water Resources and Meteorology (MOWRAM).

MAFF (2011). Annual Report for Agriculture, Forestry, and Fisheries 2010-11, MAFF Conference 05-07 April 2011. Phnom Penh: Ministry of Agriculture, Forestry and Fisheries (MAFF).

MAFF and MOWRAM (2010).Programme Design Document for Strategy for Agriculture and Water 2010-13, Phnom Penh: Ministry of Agriculture, Forestry, and Fisheries (MAFF) and Ministry of Water Resources and Meteorology (MOWRAM).

NGO Forum (2009). The Status of the Northwest Irrigation Sector Project – a review by an independent consultant: unpublished.

Ngo Sothath and Chan Sophal (2010). Agriculture Sector Financing and Services for Smallholder Farmers, Phnom Penh: NGO Forum on Cambodia.

RGC (2005). National Strategic Development Plan 2006-10, Phnom Penh: Royal Government of Cambodia (RGC).

RGC (2008). Mid Term Review 2008 on National Strategic Development Plan 2006-10, Phnom Penh: Royal Government of Cambodia (RGC).

RGC (2010). National Strategic Development Plan Update 2009-13, Phnom Penh: Royal Government of Cambodia (RGC).

WB (2006). Cambodia: Halving Poverty by 2015? Poverty Assessment 2006, Phnom Penh: World Bank.

8. ANNEXES

Scheme 1: Tram Mnois Irrigation Scheme [Pursat]

Overview: The scheme locates in Tnaut Chum commune of Krakor district. The scheme was completely inactive before the rehabilitation. The rehabilitation was completed in 2010 with assistance from the ADB and AFD through the Northwest Irrigation Sector Project. The rehabilitation includes the reservoir with a weir across Tram Mnois River, a main canal of 5.4 km, 5 secondary canals of 10 km, a main drain of 3.4 km, and 2 secondary drains of 8.8 km. The scheme was meant to provide benefit of irrigation water to 1,212 hectares of farmland in 6 villages[16] of Tnaut Chum commune.

Benefits: The benefit that the rehabilitation has brought about includes:

- Supplementary irrigation water
- Drought intervention
- Production of extra crop in the dry season
- Improved paddy yield
- Drainage system
- Vegetable production
- Access to towpaths
- Outdoor leisure outlet
- Use in the households, and for animal's use

Before the rehabilitation, all the paddy fields in the system as well as other part of the commune were fully dependent on rainfall. Now people can utilise irrigated water from the rehabilitated scheme when there is not enough rain. The FWUC estimated that the whole command area would benefit from the scheme with supplement from rainfall but in times of drought it may help secure only about 650 hectares which is half of the command area. Because the rehabilitation of the scheme was just completed in 2010, not all farmers have benefited from the irrigated water in the last wet season. However, farmers who had access to it observed that their paddy yield seemed to have increased from 2.5 t/ha to about 3 t/ha, an indication of 20% increase.

The water is also available from the scheme during the dry season, but not many farmers have tried the paddy cultivation yet as they preferred to observe the water capacity and establish if a sufficient head of water was available. As such, the paddy production was only tried by some farmers on about 50 hectares between January and April. Through observation of the water capacity in the last dry season, the FWUC committee estimated that the scheme would be able to irrigate about 450 hectares, which is about 37% of its capacity in the wet season. The trial suggests that the second crop in the dry season should yield about 4 t/ha on average.

[16] Sen Pen, Tbaeng Chrum, Cheuteal, Kandal, Chambak Thom, and Dorng Toek Leach villages

With provision of drain canals in the system, the commune council and key informants expressed the view that farmers could easily remove floods or surplus water from their farms when needed. As the agricultural extension service was provided as part of the project, farmers have started adopting but not yet widespread across the farmer community. Moreover, the system rehabilitation allowed people to have access to lateral towpaths of the canals, which are much more convenient for traveling and transporting farm inputs and produce. The headwork of the system also provides an outlet for community people to enjoy their outdoor leisure.

Maintenance: With aim to ensure the sustainable management and use of water from the scheme, the project organised farmers in the system into a FWUC, which comprises 926 farmers. A FWUC committee was also established with 4 members (1 female) to take up the responsibility in management, operation, and maintenance of the scheme. The FWUC committee collects water fees from the farmers. According to FWUC, the fee is currently not yet applied to farmers in the wet season, but to ones cultivating paddy in the dry season. The fee is KHR 20,000 per hectare if irrigated through gravity flow and KHR 5,000 per hectare if irrigated through pumps. FWUC further explained that the water fee will increase annually during the first 5 years with a target to reach KHR 40, 000 per hectare. FWUC reported that about 45% of the command area is irrigable through gravity flow while other 55% need pumps.

Successes and shortfalls: The commune council, FWUC committee, and key informants indicated that the success of the rehabilitation project could be counted at 80% as farmers now could rely on irrigation water when there isn't enough rain or when there is drought. According to local authority and key informants, farmers in the commune face drought almost every year over the past 5 years.

What remains a challenge for the scheme is farmers lack tertiary canals and water diversion structures. The tertiary canals are designed by the project but it is left to farmers to build the system by themselves. According to FWUC, majority of the farmers with lands affected by the tertiary canal design are willing to offer to their lands but they lack the labour and capital to construct the canals.

Conclusion: The scheme is not properly functioning yet as it was just completed. Thus, farmers were able to observe and test the capacity of the system in the last wet and dry season. From such observation, the scheme is likely to provide enough water for the system in supplement to rainfalls; it could rescue half of the command area during drought, and enable extra cropping in the dry season on about 37% of the area. Besides other benefits, the availability of water tends to encourage yield increases in paddy production. Despite all these benefits, farmers have difficulty in harvesting the water from the system due to lack of water diversion structures in some locations and lack of tertiary canals to extend the water into the paddy fields.

Scheme 2: Chrey Cheung &Mreah Prov Irrigation Scheme [Battambang]

Overview: The scheme locates in Chrey commune of Moung Russey district, Battambang province. The rehabilitation of the scheme was completed in 2009 with assistance from the EU through the ECOSORN project. The rehabilitation includes, but not limited to, 2,978 meters of main canal, 4,000 meters of secondary canals, 11,077 meters of tertiary canals, and 100 meters of drain canal. The scheme is mainly reliant on water from Moung River and was meant to irrigate 506 hectares of paddy fields.

Benefits: The rehabilitation of the scheme offered benefit to farmers in Chrey Cheung and Mreah Prov villages (Chrey commune). The benefits include:

- Supplementary irrigation water
- Drought intervention
- Production of extra crop (early wet season)
- Improved paddy yield
- Access to towpaths

The rehabilitation has not resulted much in the expansion of irrigated area in the wet season. Before rehabilitation, the scheme was also functioning to benefit about 60 hectares in the system. Following the rehabilitation, the command area of 506 hectares could be irrigated. However, about 30 hectares of these areas are flooded in the wet season. The flood made paddy production impossible in the wet season, but available in the dry season instead. The rehabilitation has also increased the irrigated area for extra crop in early wet season from 60 hectares to 250 hectares. Key informants reported that the yield of wet season paddy remains about 2.3 t/ha while the yield of extra crop during early wet season seems have increased from 2.5 t/ha to about 3 t/ha, if compared to pre-rehabilitation years. This denotes a 20% yield increase, though access to irrigation water is not the only explaining factor. Of note, all beneficiary farmers need to pumps irrigation water from the main canal. Besides all these benefits, the improved canals were reported to have provided better road access through the towpaths of the canals, which are usable for traveling and transporting the farm inputs and produce.

The assessment found that the scheme rehabilitation generated some negative effects. About 30 hectares of paddy fields in the system were flooded in the wet season due to three reasons: 1) low topography of the land itself; 2) wrong design and construction of the drainage pipe; and 3) lack of diversion structure to block or divert the water direction. However, these 30 hectares are possible for two crops – early wet season and dry season. The disadvantage of the rehabilitation scheme was reported that about 130 hectares of paddy fields outside the system that were used to receive irrigation water through gravity flow for paddy production in early wet season and wet season is now irrigated by pumps instead.

Maintenance: An FWUC was established to undertake the operation, management, and maintenance of the scheme. 220 farmers (70 women) are members of the FWUC, 10 of

whom were recruited as the FWUC committee. However, the FWUC committee hasn't functioned yet. Only the chief was reported to have been active so far while other members of the committee do not participate. The water fees were not collected because: 1) FWUC committee are not active enough with the scheme and irrigation water management; 2) the supply of irrigation water for paddy production in early wet season was limited; and 3) use of irrigation water from the scheme has been minimal due to sufficient rains in the wet season and there have been no drought over the past 4 years.

Successes and shortfalls: Local authority and community people rated the success of the scheme's rehabilitation to be 70% as it expands the irrigated area for both wet season and extra season during early wet season, and provides road access on the dikes of the main canal. The success of the rehabilitation is undermined by some shortfalls. The topography of the secondary and tertiary canals is higher than the main canal. This is because the main canal was a dug canal while the secondary and tertiary ones were purposed to facilitate irrigation water on a gravity flow. On the other hand, the system lacks a structure to divert irrigation water from the main canal into the secondary canal. For this reason, irrigation water could not flow from the main canal into the tertiary canals and farmers thus need to pump. Moreover, it makes the paddy fields in the downstream area of the main canal flooded due to low topography of the paddy area.

Conclusion: The rehabilitation has improved the capacity of the scheme to irrigate 506 hectares in the wet season and about 250 hectares for extra crop in early wet season, in supplement of rainfalls. The availability of irrigation seems encourage growth in farm production as the paddy yield improved. Despite all these benefits, the scheme improvement also imposes some negative effect such as some area becoming flooded due to lack of diversion structures and drainage system. With regard to the functioning of FWUC, it is not promising as the FWUC committee is inactive and the collection of water fees has not been started yet.

Scheme 3: Canal No. 1 Irrigation Scheme [Battambang]

Overview: The scheme is located in three communes[17] of two districts of Battambang province. Bavel River is the source of water for the irrigation scheme. The rehabilitation of the scheme completed in 2010 with assistance from the ADB and AFD through Northwest Irrigation Sector Project. The rehabilitation includes but not limited to a main canal of about 1,300 meters, a secondary canal of about 7,400 meters, a main drain of about 2,600 meters, and two secondary drains of about 1,500 meters. The scheme was aimed to provide irrigation water to 1,061 hectares within the system. The project redesigned the old tertiary irrigation canals into tertiary drain canal and suggested a new construction of tertiary irrigation canals in parallel with the old ones to be built by the farmers' collective funds.

[17]Khnach Romeas commune of Bavel district and Roung Chrey and Bansay Treng communes of Thmar Koul district.

Benefits: Interviews with stakeholders at the commune and community levels revealed that the scheme rehabilitation provided benefits to farmers both in the system[18] and also outside the system. The benefits from the scheme include:

- Supplementary irrigation water
- Production of extra crop in early wet season
- Drought intervention
- Spillover benefit to outside system
- Improved paddy yield
- Drain-off capacity
- Road access and towpaths
- Outdoor leisure outlet

The rehabilitation allows the scheme to have improved irrigation infrastructure to facilitate the irrigation water into the paddy fields in supplement to the rainfall in the wet season. Before rehabilitation, the scheme was functioning and had the capacity to irrigate about 600 hectares of paddy production in each season – early wet season and wet season. The rehabilitation effort then expanded the irrigated area to 1,061 hectares in the wet season, which is about 77% increase.

The scheme improvement encouraged more farmers to cultivate the early wet season paddy. According to FWUC, 1,031 hectares of paddy were cultivated within the command area of the system, but farmers encountered short supply of irrigation water from the scheme this year. From this experience, the scheme is estimated to be able to supply water to just about 720 hectares for paddy production in early wet season, which is 70% of the system's area or 20% increase if compared to pre-rehabilitation year. The field assessment confirmed that the command area in the system was not fully irrigated and it is explained by three inter-related reasons: 1) the topography of the non-irrigated part is higher and farther from the headwork; 2) irrigation water is diverted to supply paddy fields outside the system that are located in a lower topography (about 1,200 hectares of paddy fields[19] outside the system were reported to have benefited from irrigation water through main drain canal); and 3) the supply of water from Bavel River is less due to competition from other 3 irrigation schemes[20]farther upstream of the scheme.

Because the scheme rehabilitation was just completed in 2010, most farmers have only just started the cultivation of early wet season paddy and thus it is not possible to report whether their paddy yield will increase. However, there were some farmers who benefited from irrigation water from the scheme in 2010, in rehabilitated part of the scheme. Responses from these farmers indicate a yield increase from 3 t/ha to 3.5 t/ha for both early wet season and wet season paddy.

[18]Khnach Romeas village (Khnach Romeas commune); Brokeab, Kork Khpos, and Balangk Kroam villages (Roung Chrey commune); Thmey, Prey Leav, and Koang Kang villages (Bansay Treng commune).
[19]The paddy areas are possible for both wet season and extra crop in early wet season
[20]Putrea, DounAuv, and Prek Sangha

The scheme rehabilitation includes the improvement of about 8 km roads that crosscut the scheme. Furthermore, farmers also benefit from the towpaths of irrigation and drain canals covered by laterite over about 20 km that are passable by even cars and hand-tractors. Farmers very much expressed their satisfaction with the road access, especially for transporting their farm inputs and produce.

Maintenance: With assistance from the rehabilitation project, an FWUC was established – 513 farmers with paddy fields in the system are members of the FWUC, 30 of whom (1 female) were recruited to be FWUC committee with tasks to undertake the operation, management, and maintenance of the scheme. Interviews with FWUC committee suggested that the project will assist the maintenance over five years by sharing 80%, 60%, 40%, 20% respectively of the maintenance cost over the first four years following the rehabilitation while FWUC will contribute the rest and be fully responsible over the maintenance cost from the fifth year. FWUC's financial resources must come from the collection of irrigation water fees.

The fee of irrigation water is charged as follow – KHR 10,000 per hectare for pumped irrigation; KHR 20,000 per hectare for combination of pumped and gravity flow irrigation; and KHR 30,000 per hectare for gravity flow irrigation. However, FWUC committee reported that though the scheme was mainly meant to provide gravity flow of irrigation water, 80% of the paddy field in the system is irrigated by pumps. It was explained that pump irrigation was used because the gravity flow was slow and thus could not irrigate as much from the release of irrigation water from the upstream in four days of every two weeks. In relation to fee collection, FWUC committee complained that it's a real challenge to demand people to pay as supply of water is limited for them. For such reason, roughly 30% of the FWUC's members paid their fees.

Successes and shortfalls: Local authority and community people rated the scheme's rehabilitation to be 80% as successful because it has expanded the irrigated areas both within the system and outside the system and provided better road access for farmers. Nevertheless, farmers reported the following shortfalls:

- No provision of tertiary canal, except its design. As perceived by the FWUC committee, farmers are not willing to build the tertiary canals by their collective funds because they find using the old tertiary canals and water pump is a better choice.
- Undersupply of irrigation water for paddy fields in the system due to competing interests both from other irrigation systems father upstream.
- Undersupply of irrigation water is also due to competing interests from farmers outside the system. It was alleged that farmers outside the system pay informal fees to water authority.
- Farmers outside the system benefit from irrigation water without having to pay fees while farmers in the system face undersupply of irrigation water.

Conclusion: The rehabilitation of the scheme resulted in improved irrigation systems including irrigation and drain canals that helped expand the irrigated area for paddy production in wet season and early wet season both in and outside the system. Farms outside the system benefit from the scheme through the drain canal and are reported to be as large as the size of command area in the system. Also, the rehabilitation provided road access for farmers to travel and transport their farm inputs and produce. Nevertheless, the scheme lacks tertiary canals, faces undersupply irrigation water for paddy in early wet season due to competing demand of water by other schemes farther upstream, and conflicting interests for irrigation water by farmers outside the system. All these shortfalls have resulted in only 70% of command area in the system is actually irrigated for early wet season; 80% of paddy fields in the system are irrigated by pumps rather than gravity flow as intended, and only 30% of the FWUC's members paid their fees.

Scheme 4: Punley Irrigation Scheme [BanteayMeanchey]

Overview: The scheme locates in Punley village, Punley commune, Phnom Srok district. The reservoir of about 3 million m^3 was rehabilitated while the irrigation canals were newly designed and constructed by the Northwest Irrigation Sector Project, funded by the ADB and the AFD. The reservoir extends on the area of 645 ha[21]. The rehabilitation and construction of the scheme was completed in 2009 and was meant to irrigate 757 hectares of paddy field of 765 households in 4 villages of two communes – Punley commune of Phnom Srok district, and Phkoim commune of SvayChek district. This suggests that a hectare of reservoir could supply the irrigation water for about 1.2 hectares of paddy field.

Benefits: According to FWUC committee, Punley Irrigation Scheme was built on a gravity model and provides the following benefits:

- Supplementary irrigation water
- Drought intervention
- Production of extra crop in the dry season
- Drain-off capacity
- Improved paddy yield
- Road access for transportation
- Other benefit such as fish

FWUC committee elaborated that about nearly 800 hectares of paddy field benefit from the scheme. Before the rehabilitation, the reservoir stored less water and could irrigate about 350 hectares, which means 450 hectares or about 130% more of paddy field has access to irrigation water. Furthermore, the presence of drainage system also allows farmers to easily remove flood or surplus water from their paddy field when needed. For instance, about 250 hectares of paddy were saved from flood in the wet season. Of note, the average paddy yield

[21] Northwest Irrigation Sector Project Document

in the wet season was roughly reported to have increased from about 1.5 t/ha to about 2 t/ha, representing a 33 percent increase though irrigation is not the only explaining factor.

An additional crop in the dry season is also possible with the existence of the irrigation scheme. However, due to limited availability of water in the reservoir, only about 60 hectares of paddy field can be irrigated in the dry season. This proportion of land represents just about 8% of the scheme's irrigated capacity in the wet season. To spread the benefit among members of the FWUC, farmers rotate their turn to cultivate dry season paddy from one farm block to another every year. The paddy yield of extra dry season was reported to be about 2 t/ha. FWUC committee pointed out that field demonstration of Phkar Rumduol variety as part of the project's agricultural extension service yielded 4 t/ha.

The rehabilitation of the Punley Irrigation Scheme also allowed the people to use the reservoir dam and the canal dikes as road access. In this regard, the scheme provided 8.5 km of laterite roads on the dam of the reservoir that are accessible by motorbikes and cars. Moreover, the reservoir supports more fish as source of food for local people.

Despite all these benefits, the scheme rehabilitation also imposed some cost to the local people. For instance, about 100 households used to benefit from wet season paddy production on some 140 hectares in the reservoir, but it is now no longer possible due to flood by the reservoir's water storage.

Maintenance: A FWUC was established following the rehabilitation and construction of the scheme and was tasked to undertake the operation, management, and maintenance of the scheme. However, FWUC is only obliged to take care of the downstream of the system which include the canal and drain systems while the MOWRAM is responsible for the maintenance of the headwork which includes the reservoir and the water gate. Furthermore, the project will share with FWUC 80%, 60%, 40%, 20% respectively of the maintenance cost over first four years following the rehabilitation while FWUC will be fully responsible over the maintenance cost from the fifth year.

The FWUC is divided into 3 main groups and 12 sub-groups with a total of 438 member households. The FWUC committee collects the water user fees from its members at KHR 40,000 (USD 10) per hectare of extra dry season paddy production. Over the last 2 year, more than KHR 3 million of water fees were collected and deposited in the bank. Water fee for wet season hasn't been implemented yet, but FWUC plans to collect in the coming season at KHR 10,000 (USD 2.5) per hectare.

With regard to the scheme and water management, FWUC face several challenges. Overall, FWUC committee reported that members do pay the water fees, but they don't pay all of them while some do not pay any at all. Other challenges include conflicting demand for irrigation water from different blocks, lack of participation from FWUC members, and limitation in implementing the FWUC's internal rules and regulations.

Successes and shortfalls: The level of success of the irrigation scheme is rated to be about 80%. This is because the rehabilitation of the scheme was not limited to just the reservoir itself, but together with the provision of water gates, water diversion structure, full irrigated canals (primary, secondary, and tertiary) and drainage system. The strength of the project also stems from consultation with and training for local authorities and beneficiaries. The lands that were affected by the scheme rehabilitation and construction were paid cash compensation at about USD 0.16 per m^2. However, what people find as shortfall of the scheme is the quality of the scheme. FWUC committee and local authority referred that the contractor did not deliver their work at the intended standard and was not held accountable. For example, while the tertiary canals were meant to be as high as the bed of paddy field, the contractor delivered a dug canal and thus the water flows slowly to irrigate the paddy field.

Conclusion: Following the improvement, the scheme was equipped with full system: water gates, water diversion system, secondary and tertiary canals, and drain canals. The scheme rehabilitation improved the reservoir's storage capacity, expanded the irrigated by about 450 hectares, but resulted in 140 hectares flooded by the reservoir's catchment. Thus the net gain of irrigated paddy field is about 400 hectares, which is roughly 115% of the irrigated capacity before the rehabilitation.

Scheme 5: Tean Kam-Bantoit Boh Irrigation Scheme [BanteayMeanchey]

Overview: The scheme locates in Bantoit Boh village of Tean Kam commune. The reservoir extends on the area of about 300 hectares with a water storage capacity of about 5 million m^3. The scheme was rehabilitated in 2009 with 2,500m of main canals, and 3,500m of drain canals with assistance from the EU through the ECOSORN project. Tertiary canals of about 5,000m long were newly constructed by the project. The scheme was designed to irrigate 250 hectares in the wet season in supplement to the rainfall. Of note, the water from catchment of the rehabilitated reservoir is not only used to irrigate the 250 hectares in the system, but also used to irrigate another 200 hectares of paddy fields in Tean Kam village. Interviews with local people revealed that the said 200 hectares in Tean Kam village benefited from irrigation water from the reservoir even before the rehabilitation. This means rehabilitation effort improved the water storage to expand the irrigated capacity. Thus, the scheme in total provides irrigation water for about 450 hectares, in other words, 1 hectare of the reservoir can irrigate about 1.5 hectares of the paddy field.

Benefits: Field assessment suggests that the rehabilitated irrigation scheme was meant to provide benefits to 2 villages in Tean Kam commune – Bantoit Boh and Ou villages. However, the benefits have been limited as follow:

- Supplementary irrigation water
- Drain-off capacity
- Increase in paddy yield
- Access to towpaths (bikes and motorbikes)

Before the rehabilitation, the scheme also provided irrigation water for about 170 hectares through pumps as the basin of the canal was lower than the bed of the paddy field and also due to lack of irrigated canals. Then, the rehabilitation effort improved the existing main canals into a gravity irrigation model with newly constructed tertiary canals. The scheme's improvement has increased the irrigated area to 250 hectares, which means additional 80 hectares or about 45% more of paddy field has benefited from the irrigation water. The existence of the drain canal also allows farmers to drain off surplus water from their farm if needed. Responses from FWUC committee and other stakeholders at the community level indicates that the paddy yield in the wet season is now about 1.8 t/ha compared to about 1.5 t/ha before the rehabilitation, indicating a 20% increase as a result of the irrigation water and other factors.

Local people further elaborated that the irrigation scheme is only useful to supplement the rainfall, especially during early wet season. The drought intervention capacity is unlikely because when there is drought the water storage in the reservoir is also low and thus could not be diverted to irrigate paddy fields in the scheme that is characterised by higher topography.

Of note, the benefit of the irrigation scheme largely goes to the rich who possess most of the paddy land. The field assessment revealed that nearly 200 hectares or about 70% of the paddy field within the scheme's coverage are possessed by about 10 rich households living outside the village and at the district town including a former district governor and other traders. Some of these people even possess 20-30 hectares each. The rest 70-80 hectares are shared by about 125 households who are residents in Bantoit Boh and Ou villages.

Despite a rough gain in 80 hectares of irrigated paddy fields whose benefit mainly goes to the rich, the scheme's improvement had negative effects on other 80 hectares. Due to high topography of the scheme, there is a need to block the water to reach a certain level so that it is irrigable. For this reason, about 20 hectares of paddy became flooded while another 60 hectares no longer receive the irrigation water from the reservoir and became rain-fed.

With regard to the road access, people view it as both advantages and disadvantages. What is good is the people can ride the bikes and motorbikes on the towpaths of the canals. However, people complained that transportation of their farm outputs by oxcarts and other means become more difficult as there were no provision of bridges or culverts to go across the newly constructed tertiary canals.

Maintenance: A FWUC was established following the scheme's improvement with a duty to ensure the operation, management, and maintenance of the scheme. There are 125 farmers who members of the FWUC and 16 people are members of the FWUC committee, none of whom are women. According to FWUC committee, about 30% of the paddy field in the system needs to be further irrigated by pumps. For such reason, the water fees are charged differently – KHR 5,000 per hectare for paddy fields within the system irrigated by gravity flow; KHR 3,000 per hectare for paddy fields within the system irrigated by pumps; and

KHR 10,000 per hectare for paddy fields outside the system which is possible through pumps only.

The FWUC committee admitted that the fees collection hasn't been successful. The availability of irrigation water has been inadequate for even paddy fields inside the system, thus never reached those outside the system. Because the reservoir mainly stores rainwater, it could at most irrigate the paddy fields in supplement to rainfall. In time of drought, the reservoir itself lacks water, thus irrigated capacity become limited. As such, the FWUC did not dare to collect the water fees from its members. The chief of FWUC committee reported that fees were collected from some members last year, but the supply of irrigation water was insufficient, FWUC then returned all fees to the payees. Given all these facts, FWUC committee perceived that the existence and functioning of FWUC will likely fail.

Successes and shortfalls: Local authority and community people do not regard the scheme's improvement as having been successful. When asked to rate the level of success of the scheme, they roughly said 40% success, mainly attributable to improved canal and drainage systems while irrigation water largely benefits the rich who never pay the water fees to FWUC. Other shortfalls include: 1) the improved scheme makes the transportation of the farm outputs more difficult due to no bridges/culverts for going across the canals; and 2) lack of irrigation water in reservoir due to deterioration of canals to channel water from the Trapaing Thmor Reservoir into Tean Kam-Bantoit Boh Reservoir.

Conclusion: Overall the rehabilitation of the scheme has been successful in terms of improving the irrigation system including construction of new tertiary canals, improving the primary canals into gravity model, and provision of drain canals. However, the rehabilitation has not necessarily improved the irrigated area overall – the increase of irrigated area in the system is offset by the fact that some area becomes flooded and other areas no longer receive water from the improved scheme. Furthermore, most of the beneficiary paddy fields are under possession of several rich people living in the district town, rather than smallholder farmers in villages. On the other hand, the scheme's irrigated capacity is limited to the water storage in the reservoir while the reservoir itself is much reliant on rainfall. As such, irrigation is only possible in supplement to rainfall, thus not at all for drought intervention.

Scheme 6: Tumnup Rumdeng Irrigation Scheme [Siem Reap]

Overview: The scheme locates in Khnar Pur commune, Soutr Nikum district, Siem Reap province. With assistance from the EU through the ECOSORN project, the scheme was rehabilitated in 2009. The rehabilitation had improved the main canal larger of 1,600 meters. The tertiary canals of about 2,000 meters were newly constructed by the project (about 120 meters were not constructed because the landlord of the affected land did not agree to sacrifice their land). The rehabilitation also improved the water gate of the headwork to harvest the water from Koulen Mountain, installed a pipe system, and constructed the water

diversion structures for irrigation water distribution in the system. The scheme is a gravity model and was aimed to irrigate 362 hectares of paddy fields in the system.

Benefits: The field assessment suggests that the rehabilitation of the scheme provides the following advantages and disadvantages:

- Supplementary irrigation water
- Some production of extra crop in the dry season
- Drought intervention
- Spillover benefit to outside system
- Improved paddy yield
- Vegetable production
- Access to towpaths (bikes and motorbikes)
- Other benefits (fish, water for animals and households)

Before rehabilitation, it was reported that the scheme was able to irrigate about 150 hectares of paddy in the system. The effort to improve the system increased the irrigation capacity to irrigate all 362 hectares of 330 farm households in 4 villages[22], representing a 212 hectares or 140% increase. The paddy yield in the wet season was reported to have increased from 1.8 t/ha to 2.3 t/ha, suggesting about 30% increase as a result of irrigation water and other contributing factors. The scheme improvement has motivated farmers to grow second crop in the dry season. However, due to limited water in the dry season, only about 20 hectares were cultivated with an average yield of 2.1 t/ha.

The scheme does not have drain canals, but farmers have no problem to drain off flood or surplus water from their field when needed because the paddy fields are on the watershed topography. With regard to drought intervention, people estimated that the scheme would be able to serve all paddy fields in the system with water available from the river if there is drought. However, there have not been a drought since 2006.

The scheme extends its irrigation water to benefit wet season paddy fields of about 370 hectares in 5 villages[23] of Chan Sor commune. 'Without rehabilitation, farmers in this commune would never benefit from the irrigation water,' said the commune chief of Chan Sor.

Availability of irrigation water enabled farmers to grow more vegetables. Among 4 villages in the system, the number of households engaging in vegetable production was reported to have increased from about 25 to 95. The irrigation water also enabled the number of households growing vegetables outside the system (in Chan Sor commune) to increase from about 15 to 40. More importantly, the irrigation water does not only encourage more households to grow vegetables, but also allow farmers to expand their farm size and grow more crops per year.

[22]Rumdeng, Bos, Chub, DameiChhlang villages
[23]Chan Sor Cheung, Chan SorTbong, Thnal, Sanlaong, and DounDiev villages

Maintenance: After the scheme improvement, 330 farm households who possess paddy land in the scheme's system were formed into a FWUC. The FWUC committee consists of 4 members (1 chief, 2 vice chiefs, and 1 accountant/cashier). The scheme is divided into 4 blocks and others members of FWUC were assigned to be chief and vice chief of each block. The FWUC is tasked to have overall responsibility on the operation, management, and maintenance of the scheme while its members have the obligation to pay the fee for their use of irrigation water at a set rate of 30 kg of paddy rice for a hectare of wet season paddy field. The water fee does not apply to farmers who cultivate extra crop in the dry season due to limited availability of water. According to the FWUC, farmers in the system paid their water fees. However, the challenge is that they usually pay less than what is required and some do not pay at all.

Successes and shortfalls: Local authorities and beneficiary farmers very much appreciate the effort to improve the irrigation system. The scheme is rated to be 100% successful as it has provided multiple benefits. All paddy fields in the system could be irrigated by gravity flow of irrigation water from the scheme and farmers paid their water fees. Despite being so successful, shortfalls were referred to, for instance, the scheme lacks diversion structures in 4 locations. Also, about 120 meters of tertiary canals were not constructed, but that is farmers did not voluntarily donate their affected lands.

Conclusion: The improvement of Tumnup Rumdeng Irrigation Scheme has contributed a lot of benefit to farmers both in the system and outside the system. Farmers have full access to irrigation water through gravity flow and thus feel secure about their paddy production even through times of little rain or drought. Farmers in general see their paddy yield increased. Availability of irrigation water from the improved scheme also encouraged more farmers to grow vegetables. The FWUC that is responsible for the scheme maintenance has been functioning. Members in general paid the water fees though in some case an incomplete amount.

Scheme 7: Samseb Kanha Irrigation Scheme [Kampong Thom]

Overview: The reservoir of Samseb Kanha was rehabilitated by MOWRAM in 2008 with the main source from Stoung River. The reservoir located in the border of three districts (Stoung, Kampong Svay, and Balaingk) of Kampong Thom province. According the PDWRAM, the reservoir is storing about 19 million $m^3$of water which is about 35% of the plan. It was explained that if the water storage increases, more residential and paddy area will be flooded. PDWRAM further elaborated that the government's funds were only able to rehabilitate the main canals in stages. This is because: 1) availability of disbursed funds from the national government is limited; and 2) the scheme itself is a large-scale one which requires big funds. Over the past years, 15 diversion structures and 3 main canals of about 44 km in total were rehabilitated.

Benefits: From interview with PDWRAM, the command area of the scheme was reported to be about 12,000 hectares and is supposed to benefit farmers in 17 communes[24]in the 3 districts. However, because the rehabilitation of the scheme hasn't been completed and due to lack of data collection, PDWRAM could not report the actual irrigated area of the scheme at its current stage. To further investigate the benefit of the scheme, the study team visited four communes (2 in Kampong Svay[25] district and 2 in Stoung[26] district) that are crosscut by the main canal and were recommended by the PDWRAM.

Damrei Slab commune (Kampong Svay district): The commune is adjacent to the reservoir. The total paddy land in the commune[27] is 8,760 hectares. About 12 km of the main canal crosscuts the commune, plus about 2 km of secondary canal. Along this length of canals, there are 5 water diversion structures[28]. The canals can in total irrigate the paddy fields of about 680 hectares in supplement to rainfall. According to the commune council, the secondary canal can irrigate about 200 hectares while the main canal provides irrigation water to about 480 hectares of paddy fields along both sides of the canal. The commune council confirms that usually the irrigation water could not reach paddy fields that are located more than 200 meters away from the main canal. Availability of irrigation water from the scheme also allows an extra crop in the dry season which is possible on about 200 hectares along the main canal. In terms of yield, the commune council noticed the improvement if compared to pre-rehabilitation. In areas with access to irrigation water, the paddy yield increases from about 1.7 t/ha to about 3 t/ha. With regard to means of irrigating the paddy, the existence of the diversion structures allows 80% of the paddy fields irrigable through gravity flow while other 20% needs pumps. The council added that if there are more tertiary canals, a lot more paddy fields would benefit from the scheme.

Sankor commune (Kampong Svay district): The commune extends from Damrei Slab commune. The length of the canal that crosscuts Sankor commune is about 10 km and provides irrigation water to about 1,200 hectares along both sides of the canal, which is about 18% of the total wet season paddy area in the commune. In the dry season, farmers grow the second crop on about 250 hectares of these lands. The commune council observed the change in paddy yield following the rehabilitation of the scheme. The yield was reported to have increased from about 1.5 t/ha to about 2.2 t/ha on average, indicating about 45% increase. The benefit of irrigation water further extended to make the cultivation of paddy possible in the dry season on about 2,700 hectares in the plain that is flooded during the wet season and that were left unused in the past. These lands provide the paddy yield of about 4.5 t/ha on average. The commune council reported that most of these farmlands receive irrigation water through gravity flow. Despite all these benefits, the commune council also reported a number

[24]**Stoung distinct**: Rung Roeung, BanteayStoung, Trea, Kampong Chen Cheung, Kampong Chen Tbong, Preah Damrei, Chamnar Leu, Chamnar Kroam, Msar Krang, and Samprouch; **Kampong Svay district**: Damrei Slab, Sankor, and Tbeng; **Balaingk district**: Doung, Samaki, PhanNhoeum, and Kraya.
[25]Damrei Slab and Sankor communes
[26]Preah Damrei and Rung Roeung communes
[27] The land locates in the administrative territory of the commune, but many of them belong to people in other neighboring communes.
[28] 3 were constructed by the Military Engineering, 1 by the people's contribution fund, and 1 by PDWRAM.

of challenges which include: 1) lacks of diversion structures (3 were constructed during the rehabilitation, but were destroyed as they were not technically right); 2) farmers struggle to receive water and thus compete with one another due to lacks of tertiary canals.

Preah Damrei commune (Stoung district): The commune is adjacent to the reservoir and consists of 9 villages with 1,509 households. The total paddy land of the commune is 1,641 hectares, all of which are wet season land. The commune council explained that the commune has used the CSF and Danida's NRM fund in the past years to rehabilitate the tertiary canals in the commune in order to extend the irrigation water from the main canal into the paddy fields. In total, about 3,300 meters of tertiary canals were rehabilitated. As a result, about 1,100 hectares of the paddy land could be irrigated by the irrigation water from Samseb Kanah Reservoir in supplement to rainfall in the wet season and about 340 hectares were available for extra crop in the dry season (between January and May). The small area for extra crop is explained by the limited availability of water from the reservoir in the dry season. In the wet season, the paddy yield was reported to have increased from about 0.9 t/ha to about 2.5 t/ha while extra crop in the dry season yields about 1.5 t/ha. The commune council estimated that about 40% of irrigated paddy fields can receive irrigation water through gravity flow while pumps are needed for other 60%.

Rung Roeung commune (Stoung district): The commune is located about 15 km away from the reservoir, further extended from Preah Damrei commune. It consists of 9 villages with 1,103 households. The total wet season paddy area is about 1,200 hectares. The commune council reported that about 4,600 meters of the main canal crosscut the commune and provided irrigation water to about 620 hectares in supplement to rainfall in the wet season. These paddy fields are irrigated through gravity flow from the main canal. However, because there are no diversion structures to block and switch the water direction, farmers have to block main canal by their manual means such as the wooden boards and earth. With regard to paddy yield, it was reported to have increased from about 1.5 t/ha to about 2 t/ha, representing a 33% increase. Due to limited water in the dry season and long distance from the reservoir, farmers could only cultivate extra crop on about 10 hectares in the dry season.

The rehabilitation of the scheme imposed some costs to the community people. Besides some affected lands along the dam and canals, the increase of water storage in the reservoir made paddy and residential lands flooded. PDWRAM reported that about 750 households are affected by the flood and the government is trying to find alternative lands for relocation of these people.

Maintenance: Since the rehabilitation of the reservoir in 2008, no FWUC has been established because the whole system is not competed yet. Thus, there are no systems in place to collect water fees from the users and the system to maintain the system is not clear and unknown among commune authorities. Currently, there are two persons assigned by the PDWRAM to be in charge of the water gates and safeguard the reservoir.

Reports from visited communes suggested that farmers in all communes face the challenges of irregular release of water from the reservoir. To improve the coordination of the water demand and management, the communes requested the formulation of a FWUC so that farmers are better coordinated. According to interviews with local people, the person in charge of the reservoir and water gate was alleged to have released the water from the reservoir so that some hundreds of paddy fields inside the reservoir which belongs to him and his villagers are cultivatable in the dry season. As such, less water storage remains in the reservoir and farmers outside the reservoir lack irrigation water in the dry season.

Successes and shortfalls: The overall judgment on the success of the scheme improvement is not conclusive from this rapid assessment due to large-scale nature of the scheme and limited time of the assessment itself. However, evidence from 4 communes that are benefiting most from the scheme and that were recommended by PDWRAM indicates that the benefit is considerable but not huge. **Table 4.3** denotes that the scheme assists 3,600 hectares in the wet season in supplementary with rainfalls, enables extra crop in the dry season on 800 hectares of wet season paddy fields, and irrigates 2,700 hectares of dry season paddy fields that are flooded in the wet season.

Table 4.3. Irrigated areas in 4 visited communes as benefited from Samseb Kanha Irrigation Scheme

			Irrigated area (ha)		
No.	Commune	Wet season paddy area (ha)	Irrigated wet season	Extra crop in dry season	Dry season paddy area
1	Damrei Slab	4,964	680	200	0
2	Sankor	6,470	1,200	250	0
3	Roung Roeung	1,200	1,100	340	0
4	Preah Damrei	1,641	620	10	2,700
	Total	**14,275**	**3,600**	**800**	**2,700**

Source: Interviews with commune councils and clerks (June, 2011)

Based on responses from interviewees in 4 visited communes, the scheme should have provided a lot more benefits to farmers, but it was hampered by 1) incomplete rehabilitation (incomplete main canal, lack diversion structures, and no tertiary canals); 2) weak water management partly due to non-existence of FWUC to coordinate the water demand and release; and 3) lack of water for extra cropping in the dry season. Nevertheless, the assessment also proves that the scheme has high potential to benefit farmers in its command area, especially to supplement rainfall in the wet season because: 1) the reservoir has large catchment area; 2) the reservoir has access to good water source (Stoung River); and 3) the command areas are largely on the watershed topography which is favorable for gravity flow that should eventually impose less cost on farmers.

Conclusion: Due to large-scale of the scheme and as limited by time in the field, the study is not confident to judge over the whole system. The evidence from the rapid assessment in the field suggests that the scheme seems to have a lot of potential to provide irrigation water to paddy in the reported 17 communes of three districts. However, till now the rehabilitation

effort is still incomplete and thus the benefits are currently limited to just several communes crosscut by the rehabilitated main canals. Evidence from the field also suggests that the paddy yield has increased in area where irrigation water reaches and that the scheme has large potential to irrigate the paddy fields through the gravity flow as endowed by the watershed topography, but is currently constrained by lacks of diversion structures and tertiary canals.

Scheme 8: StuengChinith Irrigation Scheme [Kampong Thom]

Overview: The rehabilitation of the scheme started in 2002 and became functional in 2006 through the assistance from the ADB and AFD. The rehabilitation includes the reservoir on the upstream of Chinith River and the canal system. The scheme provides benefits to 3 communes[29] in Baray district and 3 communes[30] in Santouk district. As part of this study, 3 communes in Santouk district were chosen for observation of the benefits from the rehabilitation. The scheme has a main canal of about 7 km and 5 secondary canals of about 18 km. The system is divided into 48 blocks with 48 tertiary canals and 49 tertiary drain canals. Main drain canals were also equipped to drain the water off from the system. According to FWUC committee, the reservoir could store the water 23 million m^3 and the scheme was designed to irrigate 2,400 hectares in the system.

Benefits: Interviews with stakeholders across the scheme indicated that the scheme improvement has brought about the following benefits and disadvantages:

- Supplementary irrigation water
- Drought intervention
- Drain-off capacity
- Extra crop in dry season
- Improved paddy yield
- Vegetable production
- Access to roads and towpaths
- Outdoor leisure outlet
- Other benefits (fish, water for animals and households)

As reported by the FWUC, commune authorities, and villagers, the improvement of Stueng Chinith Irrigation Scheme provide lots of benefits to farmers, especially irrigation water for their wet season paddy in supplement to rainfall. Before the improvement, only some paddy fields benefited from the deteriorated scheme while most of the farmland in the system was fully dependent on rainfall and yielded about 1.2 t/ha. Now, all farmlands in the system (except some on high topography) have access to irrigation water whenever they need it and farmers no longer fear drought or even flood, but feel a lot more confident to predict farm outputs at an average yield of 2.5 t/ha. The availability of water encouraged more farmers to grow vegetables.

[29] Chong Doung, Chhouk Khsach, and Balaingk communes
[30] Boeung Lvea, Kampong Thmar, and Prasat communes

The availability of water from the reservoir is plentiful and it can provide irrigation water to the whole system in the dry season. However, very few farmers grow extra crop in the dry season due to: 1) water seepage thank to sandy soil; 2) low yield thus not profitable; and 3) pest infestation. The field assessment suggested that the production of an extra crop in the dry season was tried in 2007 on about 40% of the system's irrigated area, but was not successful due to pest affectation and low yield. On the other hand, farmers had difficulty in taking care of their farms due to seeping soil (water seeps out of the field quickly). Farmers thus abandoned the cultivation in the following years. In order to promote the cultivation of extra crop, H.E. Chan Sarun tried the production in 2009 but failed due to pests and low yield. Then, the DOA in Santouk district also tried the experiment in 2011 and the outcome was the paddy was growing but low yield rendered it not profitable. However, in that same year (2011), there were also trials by individual businessmen, which showed a dissimilar result – the paddy yielded being about 3.5 t/ha on average.

Maintenance: The scheme has been run by an FWUC since 2007 following the completion of the rehabilitation. The FWUC consists of 2,800 farmers who possess paddy fields in the system while the FWUC committee has 5 members. The management of the scheme is assisted by 25 village representatives, and hired 7 staff. In 2011, the water fee is charged at KHR 40,000 per hectare per annum. The fee is charged on a per-year basis, regardless how many crops are farmed and how much water is consumed. The FWUC committee elaborates that the water fee was agreed by farmers and thus set at KHR 60,000 per hectare per annum, but was charged in the first year (2007) at KHR 20,000 while the project contributes the rest and FWUC will increase the charge to farmers year by year so that it can take full responsibility of fee collection and maintenance by 2013. The maintenance responsibility was divided so that PDWRAM is responsible for the upstream structures which include and reservoir and main canal while FWUC takes care of the downstream which includes the secondary and tertiary canals, drain canals, and other structures.

The success of the FWUC to date is evidenced by farmers' participation in paying the water fees. The FWUC committee estimated that 99% of the farmers paid their fees for 2010 or about KHR 89 million, which is about 98% of the fees, were collected. The FWUC committee complained that some farmers underpay pay their fees while other pay late, and despite such revenue from fees collection, it is not enough to cover the maintenance cost. It was stated that the sophisticated design of the scheme makes the maintenance costly. For example, the proposed budget for expenditure in 2010 was KHR 175 million but only KHR 89 million was collected from water fees. The FWUC showed its concerns that although the water fee will be collected at KHR 60,000 per hectare in the next two years, the revenue will not be sufficient to cover the then maintenance costs, thus exposing fears about the FWUC sustainability.

Conclusion: The scheme is equipped with sophisticated structures and has the capacity to hold large volume of water in the reservoir and thus provide no shortage of irrigation water to the intended command area for the whole year round. It improved the farmers' confidence in the paddy production and encouraged the yield enhancement and should thus strengthen the

farmers' livelihoods through improved food security and more income. However, despite availability of irrigation water in the dry season, farmers do not cultivate extra crop as it is constrained by seeping soil, pest affectation, and low yield in the dry season. Furthermore, the sophisticated structure of the system imposes costly maintenance to the scheme while the water fee is rather low and partly limited by uncultivable paddy lands in the dry season.

Scheme 9: RuomSrok Canal Irrigation Scheme [Prey Veng]

Overview: Based on interviews with commune authorities in Chrey and Chea Khlang communes in Svay Antor district, the rehabilitation of the scheme started since 2007 with financial support from MOWRAM. The table below indicates the rehabilitation effort since then but the study team managed to visit two communes (Chea Khlang and Chrey) where the rehabilitation took place in 2008 and 2009. Each commune benefits from about 6 km of the canal. It is the main canal type with a catchment of 12 meters wide and 3.5 meters depth. The canal receives the water from flood of Mekong River through Sithor Kandal district (Prey Veng province) and the rainwater.

Table 4.4. Overview of rehabilitation of Ruom Srok Canal

Step	Year	Location	Length (km)
Step 1	2007	from Chong Ampil to Sieng Khvieng	8
Step 2	2008	from Sieng Khvieng to Prey Kklar and Chea Khlang	10
Step 3	2009	from CheaKhlang to Chrey	12
Step 4	2010	from Chrey to Angkor Treth and Pean Roung	12
Step 5	2011	from Pean Roung to ToekThlar	12

Source: Interviews with commune authorities in Chea Khlang and Chrey communes

Benefits: The rehabilitation of the Ruom Srok Canal has brought about the following the following benefits and disadvantages:

- Supplementary irrigation water
- Drought intervention
- Drain-off capacity
- Production of extra crop in dry season
- Improved paddy yield
- Vegetable production
- Access to roads and towpaths
- Other benefits (fish, water for animals and households)

Ruom Srok Canal is a large-scale scheme and thus observing advantages and disadvantages of the whole scheme is not achievable by this rapid assessment. Instead, the factual findings from each visited commune are presented as follow:

Chea Khlang commune: The commune comprises 8 villages with about 2,200 households, about 1,400 of which are farm households. The total paddy land of the commune is 2,447

hectares, all of which are wet season paddy lands. The commune council reported that the canal can supply water in supplement to rainfall to irrigate farmlands at about 300 meters distance on both sides of the canal. With 6 km of the canal crosscutting the commune, about 360 hectares should benefit from the canal, but with the availability of some deteriorated secondary canals connected to it, the benefit has expanded to about 510 hectares in total. In time of drought, the commune council estimated the canal could only irrigate paddy fields within 100 meters, which is about one third of its capacity in supplement to rainfalls.

Irrigating the paddy fields through gravity flow from the canal is not possible, but through pumps, which is costly for farmers. Following the schemes rehabilitation, the yield of paddy along the canal was observed to have increased from about 1.5 t/ha to now about 2 t/ha, indicating a 33% increase though other factors should be counted rather than irrigation water alone. Because the canal is large and deep, farmers can also drain off surplus water in the fields into it, which is another benefit of it to secure paddy from floods. However, irrigation water could not be harvested for extra crop in the dry season due to lack of water gate/diversion structures to block the water, thus the water just flows off downstream of the canal.

Chrey commune: The commune comprises 16 villages with about 3,100 households, all of which are farm households. The commune has the total paddy land of about 3,550 hectares and no dry season paddy land. Together with other secondary canals, the main canal of 6 km crossing the commune provides benefits to farmers in 5 villages[31]. The benefit is more concentrated in 3 villages – Prey Tanann, Kork Roveang, and Svay Kun.

As reported by the commune authority, the canal's irrigating capacity is, in supplement to rains, limited to paddy fields within 300 meters on each side. At its length of about 6 km crossing the commune, Ruom Srok Canal can supply irrigation water to about 360 hectares. However, the commune managed to use the CSF for 3 years in the past to restore a total of 7.7 km secondary canals while other 2.4 km were rehabilitated by PDWRAM. Complemented by these secondary canals, Ruom Srok Canal further extends its irrigating capacity to benefit some 350 hectares more. This means about 700 hectares in total receive irrigation water from Ruom Srok Canal, in supplement to rains in the wet season. In time of short drought, it was estimated that roughly one third of the irrigated paddy fields supplemented by rains be rescued by the canal.

The irrigating means for these paddy fields are all by pumps, which also imposes costs to farmers. According to the commune authority, the rehabilitation of the main canal has had some positive impacts on the paddy yield. The yield is reported to have increased from about 1.5 t/ha to about 2 t/ha, indicating a 33% increase which is similar to the case in Chea Khlang commune. Provided with a water gate to control the water, the water is blocked and stored in the canal and is used for the production of 65 hectares extra crop in the dry season. Of note,

[31]Krosaing Kory, Prey Tanann, Kork Roveang, Svay Kun, and Prohear

the extra crop provides less yield – about 1.7 t/ha. Another benefit of the canal is that it serves as a drain canal to remove surplus water from the field.

The availability of water from the canal helped encourage farmers, particularly in Kork Roveang and Svay Kun villages, to grow fruits and vegetables such as water melons and cucumbers.

Maintenance: According to interviews with both communes, there are no efforts to establish a maintenance mechanism of the scheme at the community level as part of the rehabilitation effort. That's why there are no FWUC in the two communes to collect the water fees or to take care of the maintenance. However, the study found that farmers in villages benefited from the canal arranged themselves into group in their own villages. When there is damage on the system, they collected contributions from beneficiary households to restore it.

Successes and shortfalls: The rehabilitation has brought irrigation water to farmers and encouraged better yield of paddy but the effort seem very much constrained by limited resources. The canal is restored step by step from one year to another with incomplete structures – lacks secondary and tertiary canals, water gate/diversion structures, and so on. As such, the canal can only provide limited water to just farmlands adjacent to it. In Chrey commune, the CSF was used to improve the secondary canal to further extend the main canal to more paddy area, but its small-scale fund could not expand the irrigated area to ant great extent. Furthermore, there was no effort as part of the rehabilitation project to ensure the operation and sustainability of the scheme by establishing an FWUC or other means to take care of management and maintenance of the scheme.

Conclusion: The rehabilitation of the scheme allows farmers to have access to irrigation water for their farmers and thus grow their paddy with confidence. The canal seems to contribute to a better yield of wet season paddy and enable farmers to grow extra crop in the dry season and cultivate fruits and vegetables. However, the irrigation water could just reach farmlands adjacent to the canal through pumps which suggest that the benefits are not shared to widely among farmers in the community.

Scheme 10: Tradaet Irrigation Scheme [Svay Rieng]

Overview: The scheme locates in Preah Punlea commune of Kompong Rou district. The scheme was rehabilitated in 2009 through the IMF's debt relief funds. Totally, the scheme is composed of 3 primary canals of 1,700 meters long (with an average 3 metre depth and 11 metre width), 18 tertiary canals of 14,350 meters long (constructed mainly based on gravity model), and 53 structures for water control and diversion. The reservoir was constructed with a bridge and weir across Prasoutr River to harvest the water for irrigating the command area of 240 hectares.

Benefits: Based on the field assessment, the irrigation scheme is able to provide various benefits to people in the community as follow:

- Supplementary irrigation water
- Drought intervention
- Production of extra crop in dry season
- Drainage system
- Increase in paddy yield
- Access to towpaths for traveling and transportation
- Outdoor leisure outlet

Following the rehabilitation, the scheme can supply irrigation water to all 240 hectares in command area in the wet season. It benefits farmers in 4 villages[32]; most of them are residents of Tradaet village. According to the FWUC and key informants, all 240 hectares could be rescued by the scheme in time of drought. Of these 240 hectares, 100 hectares could be irrigated through gravity flow of water from the scheme. The other 140 hectares is irrigated by a pump station run by PDWRAM. The water from this pump station runs directly into all 140 hectares through gravity flow, but the challenge is the pump does not permanently stay there and is not managed by the FWUC. It will only be brought to the station when there is drought and considerable requests from farmers. Community people explained that when there is little rain in the wet season, they cannot use the pump station to supplement water from scheme. The pump station is only used for drought intervention.

According to reports from interviews, the paddy yield seems to have improved substantially, though irrigation is not the solely attributable factor, among those paddy plots having sufficient access to irrigation water. For instance, before the rehabilitation, a one hectare paddy field could yield only about 1 tonne of paddy, but now within the same plot of land the yield has increased to approximately 1.5 tonnes, an indication of 50% increase. In addition, with the improved scheme farmers in the community right now started to use improved seeds (such as Phkar Rumdual and Sen Pidao), which may be attributable to the confidence among those farmers on the availability of water from the scheme.

The availability of water from the scheme enables farmers to grow the second and third crops in the dry season. According to the FWUC and key informants, the second crop is cultivated on about 60 hectares (from January to April) and the third crop is possible on about 30 hectares (from May to July) with an average yield of 3.5 t/ha. The scheme improvement also provides the towpaths along the main canals which are passable even by cars. With access to towpaths, farmers can travel or transport their farm inputs and produces more easily.

Besides all these benefits, the reservoir is reported to cause flood on about 40 hectares of the farmlands in the nearby villages.

[32]Tradaet, Troak, PreahPunlea, and Trabek villages

Maintenance: An FWUC has been established to manage the irrigation scheme. It is composed of one management committee and eleven subgroups, totally 53 people. The FWUC has a role to collect water fees, which is KHR 40,000 per hectare, from the farmers but the fee is only applied to farmers who cultivate extra crop in the dry season. The chief of FWUC reported that the fee collection has not been successful, and it is very difficult to collect the fee from farmers as some of them deny using the water from the scheme to supply their crops, and as a result, very little money has been collected so far (CR 780,000 were collected). However, there has been a suggestion from the PDWRAM to collect the fee from all the farmers in the system in the next crop season regardless they use the water from the irrigation system or not.

Successes and shortfalls: The local authority and villagers, including ones with their farm lands affected by the scheme, expressed their satisfaction with the scheme thanks to the improvement in access to irrigation water, towpaths, and other benefits such as extra cropping and increased paddy yield. Some farmers whose lands were affected by the scheme said that their farm outputs are still better than in the pre-rehabilitation years provided their lands are smaller. Moreover, the rehabilitation project not only built the reservoir and main canals, but also enough tertiary canals across the scheme to direct the water right into the fields. However, the weakness is the farmers of 140 hectares in the scheme could not access irrigation water as they want to because the pump station is not run by the FWUC but PDWRAM. The station will only work when there is drought and considerable joint requests from many farmers.

Conclusion: The scheme rehabilitation has proved to be a considerable success as it made irrigation water available for all paddy fields in the command area in the wet season, enabled some farmers to cultivate an extra crop in the dry season, improved access to towpaths, and provided other benefits. However, farmers encounter difficulty to have access to irrigation water for about 140 hectares in the system when there is little rain or drought because the pump station is managed by the PDWRAM. On the other hand, FWUC is not running well and may not be successful as farmers do not pay the water fee and there is low capacity among the FWUC itself.

Scheme 11: Dorng Khnhorm Irrigation Scheme [Takeo]

Overview: Dorng Khnhorm is the name of the reservoir. It was improved in 2009 by MOWRAM. The rehabilitation of scheme was once in early 2000s. Its location is between Sangkat Rokar Krav (Krong Doun Kaev) and Srorgnae commune (Traing district). The rehabilitation was mainly the reservoir itself (including the dam and water gates) and a main canal of about 660 meters long. The benefit goes to five villages of Sangkat Rokar Krav (Prech, Trapaing Sala, Tom, Thnong, and Tram villages) and other 2 villages of Srorngae commune (Prey Run and Prey Cheuteal villages). The canal in the system was rehabilitated by the CPP District Working Group.

Benefits: The rehabilitation of the reservoir provides benefits to farmers in 5 villages of Sangkat Rokar Krav[33] and 2 villages of Srongae commune[34]. The benefits from the scheme improvement include the following:

- Supplementary irrigation water
- Drought intervention
- Production of extra crop (early wet season)
- Improved paddy yield
- Access to roads and towpaths

In Rokar Krav, 375 hectares of dry season paddy benefits from the improvement of the reservoir. Before the improvement, farmers also cultivated paddy on the same lands but they usually encountered an undersupply of irrigation water from the reservoir and thus the farm yielded less. Following the improvement, all 375 hectares of dry season paddy fields receive adequate water. As a consequence, farmers feel more able to predict their farm production and outputs. The yield was reported to have increased from 2.8 t/ha to about 3.8 t/ha on average, indicating a 28% increase. About 20% of these paddy lands receive the water through pumps while the rest enjoy the gravity flow right into the fields.

Farmers in Prey Run and Prey Cheuteal villages of Srorgnae commune benefit as the following from the scheme improvement. The reservoir provides irrigation water to about 100 hectares as supplement to rainfalls and drought intervention in the wet season, compared to about 60 hectares before the rehabilitation. The irrigation water also allows the cultivation of an extra crop during early wet season on 70 hectares between April and July. With regard to yield people do not see much different as the rehabilitation did not bring much different in terms of access to water, it was just more convenient to harvest the water from the reservoir. The yield of wet season paddy and early wet season paddy were reported to be similar which is about 3.5 t/ha on average.

The water management committee said that the cultivated area for early wet season paddy has actually reduced from about 130 hectares before the scheme improvement to about 70 hectares only, which declined about 45%. However, it was explained that the decrease is not owing to the improvement of the scheme itself, but the fee charge for water use and affect of pests. Before, the irrigation water was pumped with financial support from the CPP District Working Group and no fees were charged from farmers. As such, a lot of farmers grow early wet season paddy and competed with one another for water. Now, when the water fee is imposed, some farmers quit the production. Other farmers quit because their farms were very affected by pests, rats in particular. For instance, Mrs. Kong Phon, a farmer in Prey Cheuteal, harvested only 200 kg this year compared to 1,100 kg last year on her 0.35 hectare farm.

Maintenance: Following the rehabilitation in 2009, a management committee, which is not really a FWUC, was established on the part of Srorgnae commune to supervise the operation

[33] A Sangkat of Krong Doun Kaev, Takeo province
[34] A commune of Traing district, Takeo province

and management of water distribution among farmers in the system. The committee comprises 3 members. The water fee is charged at KHR 300,000 (USD 75) per hectare for the cultivation of paddy in early wet season while drought intervention for the production of wet season paddy, if any, is assisted by the CPP District Working Group. The collected revenue is mainly used to pay salary for the management committee members, fuel, maintenance of the pumps, and some dikes and pipes in the downstream of the system.

On the part of Sangkat Rokar Krav, a group of seven people was also formed to be a committee to operate the supply of the water from the reservoir to the paddy field while beneficiary farmers pay them in paddy rice, which is about 40-50 kg per hectare. This fee is meant to pay for their labour to supervise the irrigation water, not for the maintenance of the reservoir.

All these suggest that there are no mechanisms at the local level to take the responsibility of the scheme maintenance. Though some forms of management committees were established they are not meant to take care of the upstream of the scheme such as the main canal, the dam of the reservoir, and the water gate.

Successes and shortfalls: As viewed by the local people and authorities, the success of the scheme improvement is counted on the part that 1) it stores more water to ensure sufficient supply for paddy fields that used to often face the water shortage, 2) it is more convenient to harvest the irrigation water through pumps, and 3) it provides road access to farmers to travel on the dram of the reservoir and the towpath of the main canal. What is viewed as a shortfall is that the rehabilitation effort did not form farmers into an FWUC.

Conclusion: The scheme improvement does not result in the expansion of the irrigated coverage, but has helped to address the water shortage in the system and contributed to some yield improvement.

Scheme 12: Banteay Thleay Irrigation Scheme [Takeo]

Overview: The construction of the irrigation scheme started in 1996. It was then a newly constructed scheme with assistance from EU through PRASAC project. The scheme consists of about 56 km main canal system[35] covering 4 communes of Koh Andaeth district. These communes include Kropum Chhouk, Prey Khlar, Rominh, and Prey Yuth Phkar. The site visit found that the water is available in all canals of the system in the dry season and no water gates or diversion structures are constructed to control the water because the canals are deep enough to allow natural water flow from Bassac River.

Benefits: The rehabilitation has brought about the following benefits:

- Supplementary irrigation water

[35] This does not include the tertiary canals that further extend the irrigation water to the fields through pumps.

- Change of seasonal crop
- Production of extra crop in early wet season
- Improved paddy yield
- Access to waterways and towpaths
- Improved fish population

About 56 km of the canal system was built by the PRASAC project. The current paddy lands were all covered by floods from Bassac River in the wet season. Before the construction of the system, farmers farmed floating rice on about 4,000 hectares with an average of about 2.5 t/ha. Since 1997, the canal system has brought a lot of changes in paddy production in all four communes. Farmers no longer cultivated the floating rice. They shifted to grow dry season paddy when the flood started to recede in November. The paddy production covered about 9,500 hectares with an average yield of around 4 t/ha, suggesting an expansion of 4,500 hectare new lands and 60% yield increase (or 1.5 t/ha) on former floating rice land. The FWUC further elaborated when growing floating rice, farmers were even vulnerable to floods – in some years the paddy were ruined by big floods and thus harvested less outputs. Besides all these benefits, it was estimated that about 4,700 hectares, which is about 50% of the paddy land in the system, are favorable for the production of a second crop and thus farmers cultivate the extra crop right after the harvest of the first crop. The second crop yields a little less which averages about 3.5 t/ha.

Building on these achievements, an AusAid's project, CAVAC, aims to construct new canals of 26 km to improve and expand irrigation coverage on the estimated command area of 7,000 hectares, as reported by PDWRAM. By the time of this survey, more than 10 km were also rehabilitated and constructed, but only part of the command area has benefited from irrigation water in the last season while the rest stand to benefit during the coming crop season. Unlike the PRASAC, the efforts made by CAVAC don't just provide irrigation water to dry season paddy fields but extend it to the wet season paddy fields. Interviews with local authorities indicates that CAVAC's canals will not just supply enough water for its command area that used to be fully dependent on rains but will allow farmers in the system to grow two crops per year on the wet season paddy land. "The water is plenty," the commune authority confirmed, "and no water gates or diversion structures are needed along the canals as water level from the river is high enough to flow into the system." Such endowment of topography imposes much less cost to the irrigation project while the project itself generates great impacts to farmers.

Maintenance: The Banteay Thleay Irrigation Scheme has been run by a FWUC of 5 members[36] with other 5 representatives to assist the coordination at the commune level. FWUC is taking the responsibility over all the 57 km main canals while the provision of irrigation water to the paddy field is sub-contracted. Each sub-contractor is running a pump to extend the water from the main canal into the paddy fields, build and maintain the tertiary canals in their division, collect water fee from the farmers, and pay the fee to the FWUC. The

[36]Including 1 chief, 2 vice chiefs, 1 accountant, and 1 cashier.

sub-contractors pay the fee to FWUC at 140 kg of paddy rice per hectare, while the farmers are charged 75 liters of fuels and 405 kg of paddy rice per hectare..In cash terms, the farmers pay about KHR 639,000 (or USD 156) per hectare[37] for the water fee.

According to the FWUC the sub-contractors pay fees on about 900 hectares for 2010. This means FWUC only collected fees from just about 10% of the cultivation area. And if full payment were made on all these 900 hectares, the total revenue should roughly be KHR 94 million[38]. However, FWUC committee reported that the actual revenue from fee collection for 2010 was only KHR 49 million, which about 50% of the amount it should be. This suggests that there is a lot of irregularity and weak enforcement in the fee collection.

Conclusion: The scheme provides enormous benefits to farmers. Availability of irrigation water encouraged farmers to shift the production of floating rice on about 4,000 hectares to dry season paddy with 60% better yield. Furthermore, farmers were able to expand their paddy production on 5,500 hectares more and cultivate the second crop on about 50% (4,700 ha) of first crop area. Given the endowment of the topography and water availability from Bassac River, the expansion of the canal system by CAVAC project will further extend the irrigation water to benefit the wet season paddy.

[37] The calculation assumes the fuel price at KHR 4,300 per litre and paddy price at KHR 800 per kg.
[38]FWUC charged fees at 140 kg of paddy rice per hectare and the price of paddy rice is assumed at KHR 750 per kg.

The NGO Forum on Cambodia

Address: #9-11, Street 476, Sangkat Toul Tom Pong I,
Khan Chamkar Morn, Phnom Penh, Cambodia.
P.O. Box: 2295 Phnom Penh-3
Tel: (855-23) 214 429
Fax: (855-23) 994 063
E-mail: ngoforum@ngoforum.org.kh
Website: www.ngoforum.org.kh