



**Improvement of Irrigation Efficiency
on Paddy Fields
in the Lower Mekong Basin project**

**Overall Progress Report
for the 2005 to 07 Funding**

July 2005 to May 2008

**under the framework of
“Programme to Analyze and Evaluate
Water and Ecosystem in Asian Paddy Fields”**

**funded by the Ministry of Agriculture, Forestry and
Fisheries, Japan**

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5. Report on the RAP training workshop and Initial assessment
6. Field work country reports

LIST of ABBREVIATIONS and ACRONYMS

ADB	Asian Development Bank
AEWEPF	Programme to analyze and evaluate water and ecosystem in Asian paddy fields
AIFP	Agriculture, Irrigation and Forestry Programme, MRCS
CD	Compact Disc
CEO	Chief Executive Officer, MRC
CNMC	Cambodia National Mekong Committee
CPWF	Challenge Programme on Water and Food
DMPF	Project to Demonstrate the Multi-Functionality of the Paddy Fields over the Mekong River Basin
ESPIM	Evaluation Study of Paddy Irrigation under Monsoon Regime
FAO	Food and Agriculture Organization of the United Nations
FAO-RAP	FAO Regional Office for Asia and the Pacific
GMS	Greater Mekong Sub-region
ICCS	International Cooperation and Communication Section, MRCS
ICID	International Commission on Irrigation and Drainage
IIEPF	Improvement of Irrigation Efficiency on Paddy Fields in the Lower Mekong Basin project
INWEPF	International Network for Water and Ecosystem in Paddy Fields
JC	Joint Committee, MRC
JPY	Japanese Yen (currency)
LA(s)	Line Agency(ies)
Lao PDR	Lao People's Democratic Republic
LMB	Lower Mekong Basin
LNMC	Lao National Mekong Committee
MAF	Ministry of Agriculture and Forestry, Laos
MAFF	Ministry of Agriculture, Forestry and Fisheries, Japan
MOWRAM	Ministry of Water Resources and Meteorology, Cambodia
MRC	Mekong River Commission
MRCS	Mekong River Commission Secretariat
NIRE	National Institute for Rural Engineering, Japan
NMC(s)	National Mekong Committee(s)
OPD	Operations Division, MRCS
PAWEES	International Society of Paddy and Water Environment Engineering
PO	Programme Officer
RAP	Rapid Appraisal Process
RID	Royal Irrigation Department, Thailand
SIWRR	Southern Institute of Water Resources Research, Vietnam
TNMC	Thai National Mekong Committee
TSD	Technical Support Division, MRCS
TOR	Terms of Reference
USD	US dollar
VNMC	Vietnam National Mekong Committee
WSMP	Watershed Management Project
WWF4	4 th World Water Forum

1 Introduction

Improvement of Irrigation Efficiency on Paddy Fields in the Lower Mekong Basin project (IIEPF) aims to improve irrigation efficiency through the introduction of the guidelines, which cover technical, institutional and managerial aspects of irrigation scheme and facilities operation.

In this context, IIEPF sets overall and immediate objectives as below:

Overall objective:

To improve irrigation efficiency on paddy fields in the Lower Mekong Basin

Immediate objectives:

1. to appraise irrigation efficiencies and the irrigation system based on the modern concepts in the selected irrigation schemes;
2. to enhance capacity of all the stakeholders in using up-to-date concepts of irrigation efficiencies and water balance and modern tools and procedures for their assessment; and
3. to produce guidelines for improving irrigation efficiency on paddy field based on actual water use conditions in the member countries

This project is funded by the Ministry of Agriculture, Forestry and Fisheries, Japan under the framework of “Programme to analyze and evaluate water and ecosystem in Asian paddy fields (AEWEPF.)”

IIEPF is implemented under the framework of the MRC. IIEPF works closely with the “Project to Demonstrate Multi-functionality of Paddy Fields” (DMPF.) Both projects, IIEPF and DMPF, manage a part of “Component 2: Irrigation and Agriculture” of the Agriculture, Irrigation and Forestry Programme (AIFP) of the MRC.

This progress report aims to cover all the project related activities during three years’ (mid-2005 to mid-2008) project lifetime.

[First year (July 2005 to July 2006)]

Activities under the first year (July 2005 to July 2006) can be summarized as formulation of the detail action plan of project implementation, revision of the project document and commencement of the field observation at four selected pilot sites.

Detail of the first year activities was reported as “Progress Report for the Funding 2005 MK G/R-06026” in November 2006, which include following items:

- Preliminary consultation with Member Countries,
- Internal discussion and drafting project design,
- Consultation with FAO,
- Recruitment of the Programme officer,
- National consultation meetings,
- Consultation meeting with FAO-RAP,
- Improvement of the Project concept,

- Collaboration with FAO,
- First regional workshop,
- Submission of the revised project document,
- Procurement of equipment,
- Pilot site selection, and
- Sub-contract for Fieldwork.

[Second year (July 2006 to July 2007)]

Since the revised project document was agreed in principle by Member Countries at the first regional workshop, the project commenced substantial activities with line agencies mainly at the field level.

Major activities under the second year funding are summarized as follows:

- Rapid Appraisal Process (RAP) training workshop,
- Initial scheme assessment by RAP,
- Brief training on electro-magnetic current meter,
- Initial discussion for field observation, and
- Field observation and backstopping.

Detail of the second year activities was also reported as “Progress Report for the Funding 2006 MK G/R-07031” in October 2007.

[Third year (July 2007 to May 2008)]

Activities under the third year were continuation of field observation/analysis and its field/office work for drafting the guidelines in principle, which are summarized as follows:

- Field observation and backstopping, (continuing from 2nd year)
- Data analysis, (continuing from 2nd year)
- Drafting guidelines, and
- Second regional workshop.

[Other project activities]

In addition this report also covers other project activities as below, which do not fall into a specific year.

- Annual consultation meeting with the development partner,
- Related publicity, and
- Other external events.

2 Activities

2.1 Preliminary consultation with the Member Countries

Another Japan funding AIFP project namely “Project to Demonstrate Multi-functionality of Paddy Fields (DMPF)” organized its third regional workshop on 27 and 28 July 2005 in Haiphong, Vietnam. The workshop aimed to summarize the activities under the DMPF and provided an opportunity for preliminary consultations on IIEPF with Member Countries. The basic concept of the project was presented in order to collect comments from the Member Countries.

The member countries participants provided comments actively. Most of the comments were useful to reflect into revision of project design. The basic concept to focus on irrigation efficiency and its improvement was supported by the participants, however, participants were reluctant to integrate policy related issues and recommended to concentrate activities on technical issues only.

2.2 Internal discussion and drafting project design

Following the comments made at the third regional workshop of DMPF and respecting to the donor’s intention, a concept note was prepared for internal discussion. A series of discussions with AIFP colleagues, OPD director and CEO was held to develop project concept and to make its consensus. Based on discussions, the concept note was finalized and ready to consult with the FAO for collaboration. These activities were conducted from August to early September 2005.

Drafting the revised project document was conducted in September 2005 in parallel with the consultation with the FAO. Drafting the Terms of Reference for field activities and its technical backstopping note was conducted in November 2005.

2.3 Consultation with FAO

The FAO headquarters (H.Q.) was the consultation counterpart at the initial stage, because FAO H.Q. is in charge of another Japan funding project under the framework of AEWEPP. A series of e-mail communication reached the basic understanding for the FAO to provide conceptual assistance to the project implementation. These communications also provided the points needed to clarify in the project document.

Another series of consultations via e-mail communication was conducted based on the draft project document by the middle of October 2005. The FAO agreed in principle to provide assistance to the project by data provision and others, which were described in the project document.

Further direct discussions were held in Ho Chi Minh City in late October 2005. These discussions were realized at the occasion of the workshop organized by the FAO namely “Regional Workshop on the Future of Large Rice Based Irrigation System.” These discussions concluded that:

- The FAO basically agreed to support the MRC’s project by providing data, know-how etc. as described in “4. Implementation arrangement” of the draft project document.
- As the FAO and the MRC reached basic understanding on collaboration, FAO Regional office for Asia and the Pacific (FAO-RAP) will be involved in forthcoming activities for both sides’ convenience.
- The FAO will basically follow their original 5 years project design. Requirement by the donor for collaboration will be mainly realized by supporting the MRC’s project. But the FAO’s project will consider paying more attention to the Mekong River Basin.

As the FAO H.Q. side agreed the MRC to contact the FAO-RAP, two brief consultations were conducted with FAO-RAP staff at the above regional workshop and at MRC “International Forum on Integrated Water Resources Management of the Mekong River Basin” at Chiang Rai, Thailand in the late of November 2005.

2.4 Recruitment of the Programme officer

Since nature of the project showed necessity of a supporting staff mainly in charge of fieldwork and its technical backstopping, one Programme Officer was recruited by the project.

2.5 National consultation meetings

A series of national consultation meetings with four Member Countries to discuss detail of the project document and other related issues were proposed by the MRC’s official letter dated 20 October 2005. Meetings were held from December 2005 to January 2006, after “the International Forum on Integrated Water Resources Management of the Mekong River Basin” and MRC Council and Donor Consultative Group Meetings, which was held in early December 2005.

The four countries agreed to focus the project concept on irrigation efficiency and its improvement. Major comments were as follows:

[Final product]

- Examine the structure of the guideline proposed as the final output of the project;
- Suggest to conduct trial application of the drafted guideline within the project lifetime;
- Consider either guideline or manual as the appropriate final product;

[Site selection]

- Advise that site selection would be important for producing guideline applicable to the whole basin;
- Suggest to discuss site selection at the regional workshop;
- Request site visit as a part of workshop activities;

[Others]

- Add water productivity analysis (crop production per water supply) as a part of project activities
- Consider to add crop water requirement analysis as a part of project activities; and
- Inquire focus is efficiency on either canal system or field application.

2.6 Consultation meeting with FAO-RAP

At the 20 January 2006 consultation meetings, the FAO Regional Office for Asia and the Pacific (FAO-RAP) provided comments on the project concept and suggested to recruit a consultant to improve the quality of this concept. Specific comments for improvement were as follows:

- Definition of irrigation efficiency focusing only on flow rates in various points is old-fashioned and causes the problem;
- Modern definition of efficiency is based on an irrigation system level water balance analysis; and
- Water balance should take re-circulation of drainage and re-use of seepage into account.

More general collaboration with the FAO was also discussed. The FAO-RAP suggested to conduct “Rapid Appraisal Process (RAP)” in order to assess irrigation scheme performance and promised assistance to conduct training workshop on RAP and conducting RAP itself. It was suggested that an agreement should be concluded between the two organisations specifying the cost-sharing principle.

2.7 Improvement of the Project concept

One international consultant was identified by the FAO H.Q. to improve the project concept. This assistance was arranged as part of FAO-MRC collaboration under the framework of AEWEPF. The cost of this consultancy service was covered by the Japan funding FAO project namely “Evaluation Study of Paddy Irrigation under Monsoon Regime (ESPIM).” IIEPF covered only travel cost, i.e. airfare and DSA, for this consultant.

From 20 February to 14 March 2006 with 20 working days, the consultant engaged in improvement of 1) project document, 2) its annexes, 3) terms of reference for fieldwork and 4) its technical backstopping note incorporating modern concept of water balance and irrigation efficiency analysis. Final products with slight amendment were distributed to Member Countries prior to the first regional workshop.

2.8 Collaboration with FAO

An agreement between FAO-RAP and MRC was concluded in March 2006, specific inputs were stipulated as:

- Dispatch one resource person to the inception workshop in order to provide comments and other related information to reinforce project concept;
- Dispatch two resource persons as lecturers to the workshop on Rapid Appraisal Process (RAP);

- Dispatch one resource person for each of the four RAPs in the MRC member countries in order to help assessing the irrigation scheme performance;
- Identify appropriate consultant to draft guidelines to improve irrigation efficiency; and
- Dispatch one resource person to the closing regional workshop and to each of the four closing national workshops in order to support the conclusion of the project including comments on draft guidelines.

Under this collaboration framework, the MRC agreed to provide to the FAO-RAP result of RAPs and other assessed data under IIEPF. Agreed cost-share for this arrangement is that the MRC covers travel cost of FAO-RAP staff and the FAO-RAP covers staff contribution time.

2.9 First regional workshop

The first regional workshop was held in Vientiane, Lao PDR on 3 and 4 May 2006. The workshop aimed to

- Finalize the project document, and
- Discuss the outline of forthcoming activities under the project.

During one and half day workshop, items below were presented and discussed.

- Project concept and draft revised project document
- Rapid Appraisal Process (RAP) and FAO's collaboration
- Field observation and Data analysis work and its Terms of Reference
- Candidate pilot project sites
- RAP training workshop

Brief conclusion of the workshop was:

- The project document would be submitted to the donor for its approval after agreed amendment was made;
- Terms of reference was confirmed by NMCs/LAs and MRCS, It would be sent to NMCs soon attached with invitation letter calling for contract procedure; and
- RAP workshop would be conducted 18 to 21 July 2006 as agreed.

The proceedings of this workshop is included in the attached CD.

2.10 Submission of the revised project document

Revision of the project document was initiated just after the first regional workshop. All the comments including the revision of the budget plan were taken into account. The revised version was sent to the donor through the Embassy of Japan in Lao PDR on 14 June 2006. Project document is made available in the Annex-1.

2.11 Procurement of equipment

Procurement process was delayed from the original schedule but a total of four sets of electro-magnetic current meter were procured. The process included a-month-long

model selection, another one-month-long communication with supplier for confirming specification and selecting options and around two months of delivery time.

2.12 Pilot site selection

During the first regional workshop, some countries proposed to conduct joint field visit with the MRCS and NMC/LAs in order to decide pilot project sites.

The Nam Houm project proposed as a pilot project by Lao PDR was carefully reviewed through the preparation process of the workshop and presented at the workshop as a typical irrigation system of the country.

Figure 1 Location Map

In Viet Nam, because of complexity of Mekong delta irrigation practice, careful discussion and field observation were conducted to identify appropriate pilot site. After a briefing of Mekong delta irrigation systems, the MRCS, the VNMC and the SIWRR recognized that selecting some small plot area with closed boundary within an irrigation scheme was a realistic option to conduct field observation effectively and smoothly. Further explanations from the project office (called “irrigation works company”) and field visits identified the Long Hai irrigation system of the Go Cong irrigation project as an appropriate pilot site. Other two plots (one in the Go Cong project and the other in other project) were also observed but recognized their difficulties with plenty of open outlet connected to outside of the boundary.



In Cambodia, the field visit revealed that Komping Pouy project in Battambang province, the first priority candidate, was suitable pilot site with both physical conditions (the only completed irrigation system in Cambodia as cited as MOWRAM staff and its closed boundary) and availability of relevant data. Two other projects in Pursat province were also visited but they were confirmed not to be appropriate for the project purpose because of their insufficient physical conditions and data availability.

In Thailand, the Huay Luang project proposed by the TNMC and the RID was even recognized as an appropriate pilot site, a field visit was conducted mainly to confirm flow measurement points and other detail of the fieldwork. Following the field visit, discussion with RID Headquarter staff was also held to negotiate their first submission of a proposal for sub-contract. The discussion also covered preparation of RAP workshop.

2.13 Sub-contract for Fieldwork

Negotiation processes to conclude sub-contracts with NMCs were delayed in comparison to the original schedule. It started just after the RAP training workshop in the middle of July 2006, although careful preparation was made by the MRCS.

Contract value and date with each country is as follows.

Thailand	17 November 2006	42,965 USD	Contract No,	717/2006
Viet Nam	27 October 2006	49,968 USD		721/2006
Laos	26 October 2006	42,855 USD		722/2006
Cambodia	29 November 2006	43,391.5 USD		723/2006

TOR of the fieldwork for each country is common in general except implementing agency and duty station.

2.14 Rapid Appraisal Process (RAP) training workshop

The RAP training workshop was conducted as a part of capacity building activities, which the project document describes as below.

Outputs and activities

To meet the objective 2: to enhance capacity of all the stakeholders in using up-to-date concepts of irrigation efficiencies and water balance and modern tools and procedures for their assessment, the following outputs are planned;

Output 2.2: Training workshop on RAP

Activity 2.2.1: Organizing and conducting RAP workshop

This training workshop was organized in cooperation with the FAO Regional Office for Asia and the Pacific (FAO-RAP) as a part of FAO-MRC collaboration under the project.

The training workshop was conducted on 18 to 21 July 2006 at the MRC conference room, Vientiane, Lao PDR with participation of 22 attendances in total. These included four (4) participants each from member countries, two (2) resource persons from the FAO-RAP, one (1) from the FAO Lao PDR office and two (2) professional staff and one (1) support staff from the MRC Secretariat.

This four-days workshop basically included four sessions a day, two in the morning and two in the afternoon. First two days were mainly spent for general information of

- What is the irrigation system modernization and why it is important,
- Water control methods in order to realize irrigation modernization, and

- Modern concept of water balance, irrigation efficiency and productivity including multiple use of irrigation water.

Last two days were mainly spent for RAP itself, which included:

- Outline of RAP,
- How to interpret indicators from RAP,
- How to set up modernization plan from the RAP result, and
- Review of filled RAP worksheets prepared by the participants.

Detail of the workshop has been separately reported by the workshop proceedings with the result of initial scheme assessment. This report was delivered to the donor, NMCs and line agencies in September 2007 and is also posted on the MRC web site, (<http://www.mrcmekong.org/programmes/AIFP/publications.htm>), however it is also stored in the attached CD.

2.15 Initial scheme assessment by RAP

Following the above RAP training workshop, performance assessment of the selected pilot sites was conducted with the application of RAP. This assessment was carried out by the line agencies with technical support by two resource persons from FAO-RAP and with facilitation by the MRCS from July to August 2006.

This activity had two major purposes, which were:

- On the job training to follow up the RAP training workshop and
- Initial assessment of performance of the schemes by currently available data.

The second purpose was to meet the project's immediate objective #1 as described in the project document as follows, and was followed by additional two sub-purposes, which were:

- To identify options for scheme improvement, and
- To identify missing data to complete RAP at the final stage of field observation.

Outputs and activities

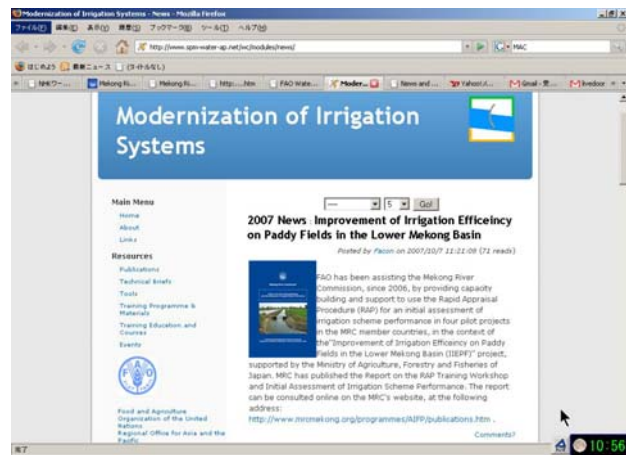
To meet the objective 1: to appraise irrigation efficiencies and the irrigation system based on the modern concepts in the selected irrigation schemes, the following outputs are planned;

Output 1.4: Rapid Appraisal Process

Activity 1.4.1: Organizing data required to conduct RAP

Activity 1.4.2: Conducting RAPs in the selected irrigation schemes

These first results allowed consolidating necessary and valuable information for the formulation of some proposals to improve performance of the schemes but the missing data did not make it possible to reach a final conclusion. Detail of this activity was reported by the separate publication “Report on the RAP Training Workshop and Initial Assessment of Irrigation Scheme Performance,” published as mentioned in 2.14 above and also introduced by the FAO in its web site as on the right.



2.16 Brief training on electro-magnetic current meter

This training was conducted by a dispatched engineer, Mr. Jacky Cheong, on 26 Sept 2006 at the Tha Ngon project, suburban of Vientiane, Lao PDR. The training was composed of a three-hours lecture for the basic function and operation of the current meter followed by a practice on the field. Three members of the field observation team from Lao line agencies were provided training. Essence of the training was compiled as a brief note and disseminated to other three countries’ team members by AIFP Programme Officer at the initial discussion mentioned in 2.17 below.



2.17 Initial discussion for field observation

Sub-contracts for field observation were concluded with four NMCs from October to November 2006. Once the contract was concluded initial discussion with line agencies was held to confirm detail of field activities.

Items listed below were the purposes of this discussion.

- Comprehensive discussion for overall activities of the whole work
- Detail discussion for short term activities to launch field observation
- Facilitation of discussion among the team members (between NMC and Line Agencies), if required
- Hand over a set of current meter

- Brief training how to use current meter

Discussions deepened understanding of field activities by the team, clarified the detail work plan for the beginning stage of field observation and contributed to smooth implementation of the fieldwork.

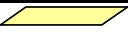

2.18 Field observation and backstopping

At four selected pilot sites field observation was conducted by Member Country teams to cover one year including 2006/07 dry season and 2007 wet season crops (in Viet Nam three crop seasons) based on agreed TOR and the detail work plan proposed by the line agencies. A common TOR was attached as Annex-11 of the previous (2005) progress report. Work plans were also attached as Annex-3 of the previous (2006) progress report.

Based on the work plan, crop calendar and irrigation practice, monitoring and technical backstopping was conducted as shown in Table 1. Some of the monitoring/backstopping were conducted together with field reconnaissance for the guidelines described 2.20 below.

Table 1 Monitoring Plan

	2006		Year 2007												2008		
	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	
Crop calendar and irrigation schedule																	
Komping Pouy (Cambodia)																	
Nam Houm (Laos)																	
Huay Luang (Thailand)																	
Go Cong (Vietnam)																	
Monitoring plan																	
Komping Pouy (Cambodia)			*		*			*			*		*				
Nam Houm (Laos)	*	*	*		*						*		*		*		
Huay Luang (Thailand)			*		*					*		*		*			
Go Cong (Vietnam)				*	*				*		*		*				

Legend:  Cropping Pattern
 Irrigation Period

Through each field visit the MRCS provided recommendations and advices to the field teams, which are summarized as backstopping record and attached in Annex-2. This process contributed to support field observation and also permitted strengthening of field team capacities.

2.19 Data analysis

Collected data from the above activity (2.18) was primarily analysed by Member Country teams with intensive technical backstopping by the MRCS. This activity mainly aims to appraise performance of irrigation system as mentioned as the objective 1 but also is expected to contribute capacity enhancement of involve irrigation engineers through practical field and office works as objective 2 of the project as following.

Outputs and activities

To meet the objective 1: to appraise irrigation efficiencies and the irrigation system based on the modern concepts in the selected irrigation schemes, the following outputs are planned;

Output 1.1: Establishment of minimum set of data to evaluate irrigation efficiencies and irrigation system

Output 1.2: Assessment of water balance, irrigation efficiencies and water productivity

Output 1.3: Appraisal of scheme management

To meet the objective 2: to enhance capacity of all the stakeholders in using up-to-date concepts of irrigation efficiencies and water balance and modern tools and procedures for their assessment, the following outputs are planned;

Output 2.1: Backstopping note for the implementing agencies

Activity 2.1.2: Backstopping the implementing agencies during the entire project implementation period, particularly during the data collection and analysis phase.

Analysis was conducted by two stages. The first analysis covering only 2006/07 dry season completed from March to May 2007 (depending on the crop calendar of each pilot site) and compiled into the draft interim reports by NMCs/LAs, which were submitted to MRCS from July to September 2007. For the quality control of the reports, the MRCS had provided the outline of the interim report as guidance for the line agencies in advance. The MRCS also provided written comments for quality improvement respectively.

The second analysis was conducted at or after completion of all the field observation, which covers both dry and wet crop seasons (or three crop seasons in Viet Nam.) This analysis includes the previous analysis prepared for the interim report and reflections of the above comments and discussion.

Another round of discussions with the written comments was again held with selected countries as following schedule;

Cambodia	2 May 2008	with Dr. Tara
Viet Nam	23 May 2008	with Mr. Toan

Thailand agreed and understood MRCS's comments fully and was confident to reflect them into their final submission. Therefore supporting discussion was not held for them.

With regard to the progress of Lao team, a number of frequent meetings were held from April to May 2008.

The four teams are working on the final version of the report which will be available soon.

(1) Further analysis by MRCS

The MRCS plans to conduct in depth analysis based on collected data and primarily analysis by member countries, however till now only one analysis was completed and compiled as a technical paper, which is a comparison analysis of irrigation efficiency and water productivity at three pilot schemes with gravity irrigation in 2006/07 dry season crop. This paper was presented at the 3rd Southeast Asia Water Forum in October 2007 and is available on the MRC web site

(http://www.mrcmekong.org/download/Papers/Irrigation_efficiency_paper.pdf) and attached as Annex-4.

This paper is being improved and will be submitted to international journal such as “Paddy and Water Environment” or other appropriate occasions like “PAWEES international conference 2008.”

Further analysis and publication covering entire observation period and tidal irrigation in the Mekong delta will be available by the end of this year.

2.20 Drafting guidelines

As the project final product, the guidelines contributing to improve irrigation scheme water management are planned as mentioned as objective 3 of the project.

Outputs and activities

To meet the objective 3: to produce guidelines for improving irrigation efficiency based on actual water use conditions in the member countries;

Output 3.1: Guidelines to improve irrigation efficiency

Activity 3.1.1: Reviewing the analysis data and relevant documents

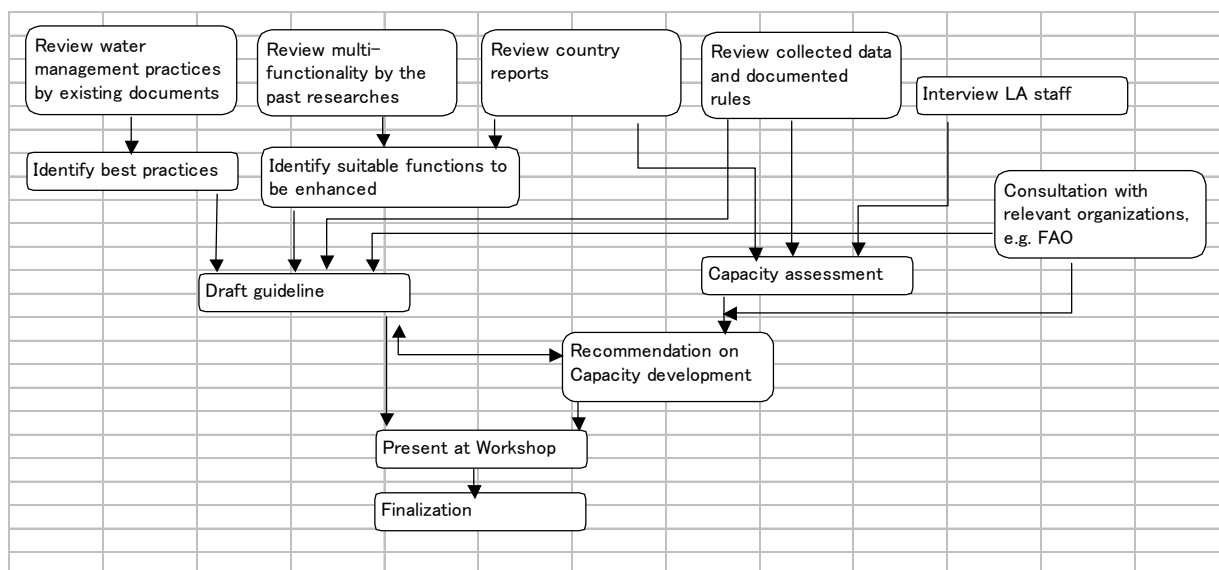
Activity 3.1.2: Consulting with the relevant national and international organizations

Activity 3.1.3: Drafting the guidelines

Activity 3.1.4: Regional workshop to discuss and introduce the guidelines

To carry out this task, the project set workflow as shown in Figure 2, and to support this task, the project appointed National Institute for Rural Engineering (NIRE), a Japanese research institute specialized in irrigation and agricultural engineering, in August 2007.

Figure 2 *Workflow for the guidelines*



Based on this work plan, the MRCS with assistance by NIRE consultant, conducted a series of field reconnaissance including field observation and intensive interview with water managers, farmers and other relevant persons. Through this field reconnaissance a series of detailed discussions were also held between the MRCS and the consultant. Table 2 shows the summary of this exercise.

Table 2 *Field reconnaissance for the guidelines*

Duration	Outline
10 to 24 Sept. 07	<ul style="list-style-type: none"> • Initial discussion to confirm basic strategy and work plan, to clarify detail of the technical proposal • Visit four pilot sites to identify the feature of the sites • Confirmation of the office work to prepare the second field visit
01 to 14 Nov. 07	<ul style="list-style-type: none"> • Discussion the basic concept of the guidelines • Visit four sites for collecting detailed information of water management mainly through the interviews
18 to 20 Feb. 08	<ul style="list-style-type: none"> • Preparatory discussion for the workshop • Outline of the working draft of the guideline and presentation at the workshop • Supplementary field visit to the Nam Houm project for dry season practices

With the aim to ensure the relevance and the quality of these guidelines, the project decided to involve the Line Agencies and NMCs in this process. Some delays have been observed. The working draft will be submitted to Member Countries by September for comments and acceptance.

2.21 Second regional workshop

The second regional workshop was held in Vientiane, Lao PDR on 25 March 2008. The workshop aimed to

- Share all the activities and their outputs/findings under the project with Member Countries including field activities, various publications produced by the MRCS and the guidelines being drafted by the NIRE consultant; and
- Discuss the draft guidelines and asked opinions and comments of Member Countries for further improvement.

During one-day workshop, items below were presented and discussed.

- Overview of the IIEPF implementation and progress;
- Field observation and analysis by Member Countries;
- Summary of technical backstopping to 06/07 dry season observation by the MRCS;
- Key concept of the guidelines; and
- Application of the guidelines to the pilot sites.

Concept and application of the guidelines were presented during the workshop. Participants provided useful recommendations on the guidelines and supportive comments to the project and its products in general.

As a result the conclusion of the workshop can be summarized as:

- The Member Countries satisfied with the progress and achievement of the project although only the concept of the guidelines could be presented;
- The Member Countries supported the next steps toward completion of the project;
- Most of the countries suggested continuation of this or similar kind of trial to identify irrigation efficiency or scheme performance both expansion of targets and deepening analysis by any financial resources; and
- A country acknowledged the IIEPF a successful MRC project and appreciated it.

Workshop proceeding is now under printing process. Once printed it will be delivered to the donor, NMCs/LAs and relevant organisations accordingly and will be posted on the MRC web site, however is included in the attached CD.

2.22 Annual consultation meeting with the development partner

The donor – the Ministry of Agriculture, Forestry and Fisheries, Japan – dispatched their officials every year at the end of their fiscal year and held an annual consultation meeting with the MRCS. The purpose of this meeting was to review and evaluate the project progress and to clarify coming year activities. The mission also pledged the coming year funding and confirmed its detailed formality. The major issues discussed/agreed at each meeting are summarized below.

[First year]

Intensive discussion to solve significant delay of the DMPF implementation was the main issue of this year. Although the IIEPF had concentrated to re-formulate the

project design, it was as planned no big argument was raised. Many options for the DMPF were discussed, but as a result more effort to accelerate DMPF activities was encouraged and steady progress of IIEPF was also suggested.

[Second year]

The progress of the IIEPF together with the DMPF and their perspectives of the forthcoming implementation were discussed and confirmed. The mission appreciated MRC's effort for the implementation of both DMPF and IIEPF. The mission also spent time to share ideas for the future cooperation with the MRC after completion of this current three years project.

[Third year]

The third year consultation meeting spent time for pledging another three-year project focusing on irrigation water management similarly to the IIEPF and recruitment of a new project manager from the MAFF Japan and their detailed procedure.

2.23 Related publicity

Responding to the progress of the project various works to publicise the project has been conducted since 2006. Below are brief descriptions of those works.

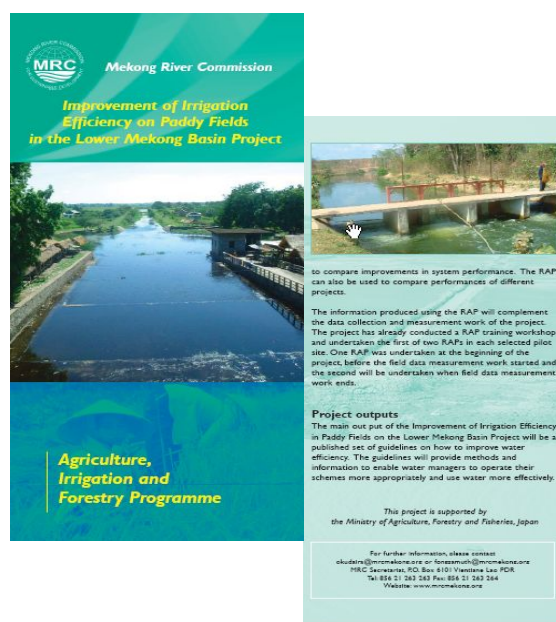
(1) Revision of web site information

The AIFP web site information was revised reflecting finalization of the project design and other structural changes of the AIFP, i.e. the commencement of WSMP phase 2, transfer of CPWF from TSD. This work has been conducted in cooperation with the Communications Unit/ICCS of the MRCS and other AIFP projects. Revised website (<http://www.mrcmekong.org/programmes/agriculture.htm>) includes concise but comprehensive information of each project under the AIFP and some visual outputs of the projects especially from the DMPF.

(2) Brochure

A triple-fold leaflet briefly describing the background, objectives, activities, methodology and expected output of the project was produced in cooperation with the Communications Unit/ICCS of the MRCS. This brochure was delivered to Member Countries (NMCs) and to the donor in October 2006 and is used to brief the outline of the project at various occasions, such as Informal Donor Meeting, CPWF International Forum on Water and Food, etc. and to the visitors to MRCS. Image of the brochure is shown on the right and full document is available from the MRC web site.

[http://www.mrcmekong.org/download/programmes/AIFP/agriculture Irrigation le](http://www.mrcmekong.org/download/programmes/AIFP/agriculture_Irrigation_le)



[aflet.pdf](#))

(3) Poster

The project has produced a series of posters to highlight the progress semi-annually. This work was originally initiated for MRC Governance meetings, i.e. Joint Committee and Council meetings, to show the project activities in visualized format. The first poster was prepared for the Thirteenth meeting of the Council in December 2006. Second, third and fourth posters were also prepared for JC meeting in May, August 2007 and April 2008 respectively. All those are available on the MRC web site (<http://www.mrcmekong.org/download/programmes/AIFP/Improvement-poster1.pdf>, poster2.pdf, poster3.pdf, AIFP-IIEPF-Poster4.pdf), and A4 size posters are attached in Annex-3.

(4) International Conference in Chiang Rai

The MRC co-organized an international conference on “Mekong Research for the People of the Mekong” from 18 to 21 October 2006 in Chiang Rai, Thailand. On this occasion, AIFP Programme Officer made a presentation to introduce the project outline. Full text delivered at the conference is available on the MRC web site (http://www.mrcmekong.org/download/Papers/fullpaper_impr_of_irrigation.pdf) and attached as Annex-4.

(5) CPWF international forum

The MRC hosted an international event namely “CPWF International Forum on Water and Food” in cooperation with the Challenge Program on Water and Food (CPWF) from 12 to 17 November 2006 with a few hundreds of participants over the world. Five presentations were delivered the first day, which included 1) Crop-water productivity improvement, 2) Water and People in Catchments, 3) Aquatic ecosystems and fisheries, 4) Integrated basin water management systems and 5) Global and national water and food systems. These presentations were aiming to show in what ways the MRC addresses issues of relevance to the CPWF. At this opportunity, Senior Advisor represented the AIFP and delivered a short oral presentation for the first theme including region’s features in agriculture and irrigation, justification of further water resources development in the region, review of the past MRC works and introduction of a new challenge of the MRC-AIFP. Presentation handout is attached as Annex-4.

(6) Third Southeast Asia Water forum & PAWEE conference

At the third South East Asia Water Forum (22 to 26 Oct. 2007 at Kuala Lumpur, Malaysia) and at 2007 PAWEE Sixth International Conference (18 to 20 Oct. at Seoul, Korea) Programme Officer presented a brief analysis of irrigation performance based on comparison of three gravity schemes in 2006/07 dry season. At SE Water Forum the presentation composed a part of MRC co-hosting session contributing to the forum and was placed in the session 3D: Climate, Drought and Water Management. For PAWEE conference Programme Officer was invited as both MRC participant and Lao delegate. Context of the presentations were basically same at those two occasions. Full text and presentation slides are available on the MRC web site

http://www.mrcmekong.org/download/Papers/Irrigation_efficiency_paper.pdf,
http://www.mrcmekong.org/download/Papers/Irrigation_efficiency_ppt.pdf) and
attached as Annex-4 (full text only).

(7) GMS Agricultural Conference

Programme Officer made another presentation on other topic, which was the first analysis of tidal irrigation practices in the Mekong delta. This presentation was made at GMS Agricultural Conference on 9 February 2008 at Nakhornphanom, Thailand. Although this analysis was premature and still needed further improvement, the presentation intended to share unique characteristic of tidal irrigation identified through the fieldwork under the IIEPF and to encourage further development of the analysis. In this line AIFP team is working hard to compile a technical paper featuring tidal irrigation. Abstract and handout of this presentation are attached as Annex-4.

2.24 Other external events

In addition to the above activities directly related to the project, Senior Advisor and Programme Officer attended several external events. Participation in those events has allowed a capacity building of the staff and to share and disseminate knowledge. Brief information of those events is summarized in the following table.

Table 3 *Summary of other external events*

Event	Date	Venue	Attendance	Summary
International Network for Water and Ecosystem in Paddy Fields (INWEPF) steering meeting	2 to 4 Nov 05	Seoul, Korea	O	Senior Advisor together with Dr. Tu, OPD director and Mr. Minh AIFP-PO attended 2 nd steering meeting and following symposium. The steering meeting mainly discussed the message from INWEPF to the WWF4 in Mexico and agreed on it.
	5 to 7 Jul 07	Bangkok Thailand	O, F	Mr. Hung, OPD director represented the MRC and made a presentation on brief outcome of DMPF work to visualise various paddy field functions with quantitative evaluation at sub working group meeting. Steering meeting also discussed the message to 1 st Asia-Pacific Water Summit in Beppu, Japan.
4th World Water Forum	16 to 22 Mar 06	Mexico city Mexico	O	A representative delegation was sent from the MRC including the Secretariat, NMCs and line agencies. AIFP sponsored participants to join ICID-INWEPF joint session and other relevant sessions were provided an opportunity to learn the most update discussion on water and development issues at global scale. Note that the cost for AIFP related participants was fully covered by the DMPF and not charged to the IIEPF as agreed by the donor.
International Commission on Irrigation and Drainage (ICID) conference	9 to 15 Sep 06	Kuala Lumpur Malaysia	F	The conference provided various important technical information on irrigation practices presented by professors from universities around the world and senior engineers from different organizations such as ADB, FAO, World Bank, etc. This information contributed to providing wider and clearer vision on irrigation activities and water management throughout the world to the Programme officer. The conference also provided opportunity to build up wider network with other irrigation specialists around the world to sharing information and learning together.

Event	Date	Venue	Attendance	Summary
E training	Sep 06	N.A.	F	The Programme Officer participated in the Online Training Course on “Service Oriented Management of Irrigation System (SOMIS)” which was hosted by UNESCO-IHE, Netherlands in September 2006 with 140 hours actual learning time. The course was very useful, especially for building up his capacity and for IIEPF implementation because the course provided knowledge and skill of field practice with up-to-date concept of service oriented management of irrigation systems including physical, economic and institutional aspects of services. The course has also opened chance for participants to discuss and share experience each other and with professors as well. The lesson and the provided documents are used as references to help project formulation and implementation.
Asian Development Bank (ADB) Greater Mekong Sub-region (GMS) meeting	5 to 8 Dec 06	Siem Reap Cambodia	O	At this meeting namely 4th meeting of the working group on agriculture, various initiatives to contribute regional scale (beyond the countries’ boarder) agricultural development were reported and discussed. The meeting provided comprehensive information of GMS activities on agriculture in the region.
International seminar on river and development	25 to 28 Apr 07	Bali Indonesia	F	This event was organized by Indonesian Association of Hydraulic Engineers and Water Resources, Ministry of Public Works of Indonesia. This event provided various insights. Especially a half-day field visit to traditional irrigation system in Bali provided a good example of paddy field multi-functionality, i.e. formulation of beautiful scenery, irrigation water for domestic use, watershed protection by paddy fields, agriculture and irrigation linking to religion and so on.

Note: O(kudaira Hiroshi), F(ongsamuth Phengphaengsy)

3 Plan and Progress

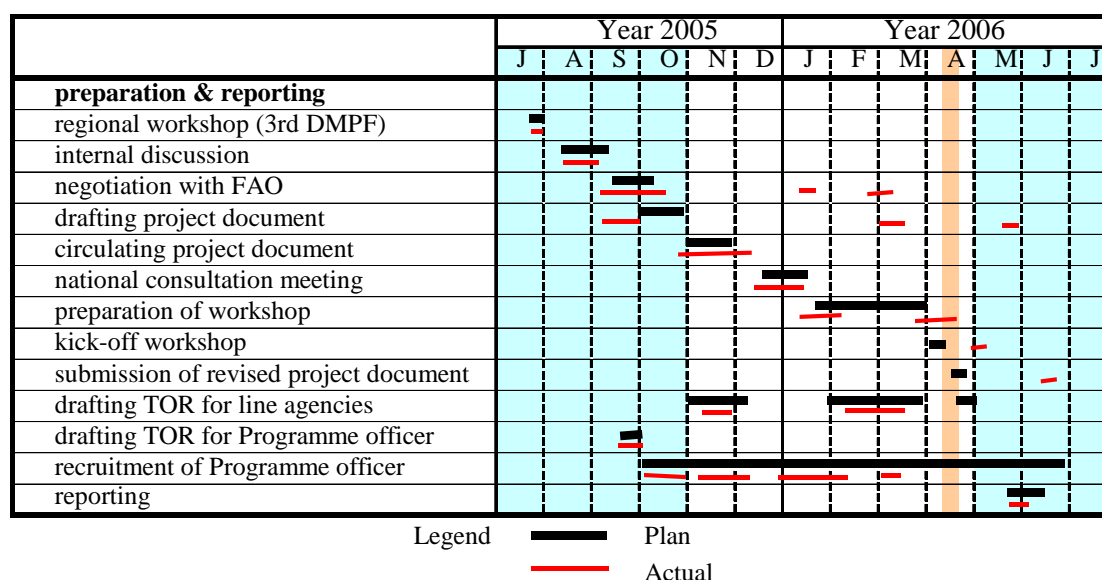
The lifetime of this project is divided in two stages: project design and planning stage and implementation stage. Therefore this chapter also divides into two major parts accordingly and describes the project progress in comparison with the original plan. Furthermore tasks for drafting guidelines are also provided by one independent section, because detail of these tasks was identified and planned through the project implementation but had not been fixed in detail in the project design.

(1) Project design and planning

Table 4 shows planned activities, its schedule as of the beginning of the project preparation (i.e. July 2005) and actual progress up to the submission of the revised project document (June 2006.) Thick line shows the planned schedule and thin line shows the actual progress.

Actual progress was ahead of the original schedule up to the national consultation meetings (i.e. by January 2006.) Since the consultation with the FAO-RAP revealed necessity to improve the project concept, the project document and other relevant documents, one month from the middle of February 2006 was spent for this work. (See 2.7). Participation to the 4th World Water Forum in March, JC Meeting and Lao New Year holidays (they are also holidays in Cambodia and Thailand) in April forced to postpone the first regional workshop to May 2006. By the submission of the revised project document, overall schedule was approximately one and half-month behind with the original schedule.

Table 4 *Progress of project design and planning*

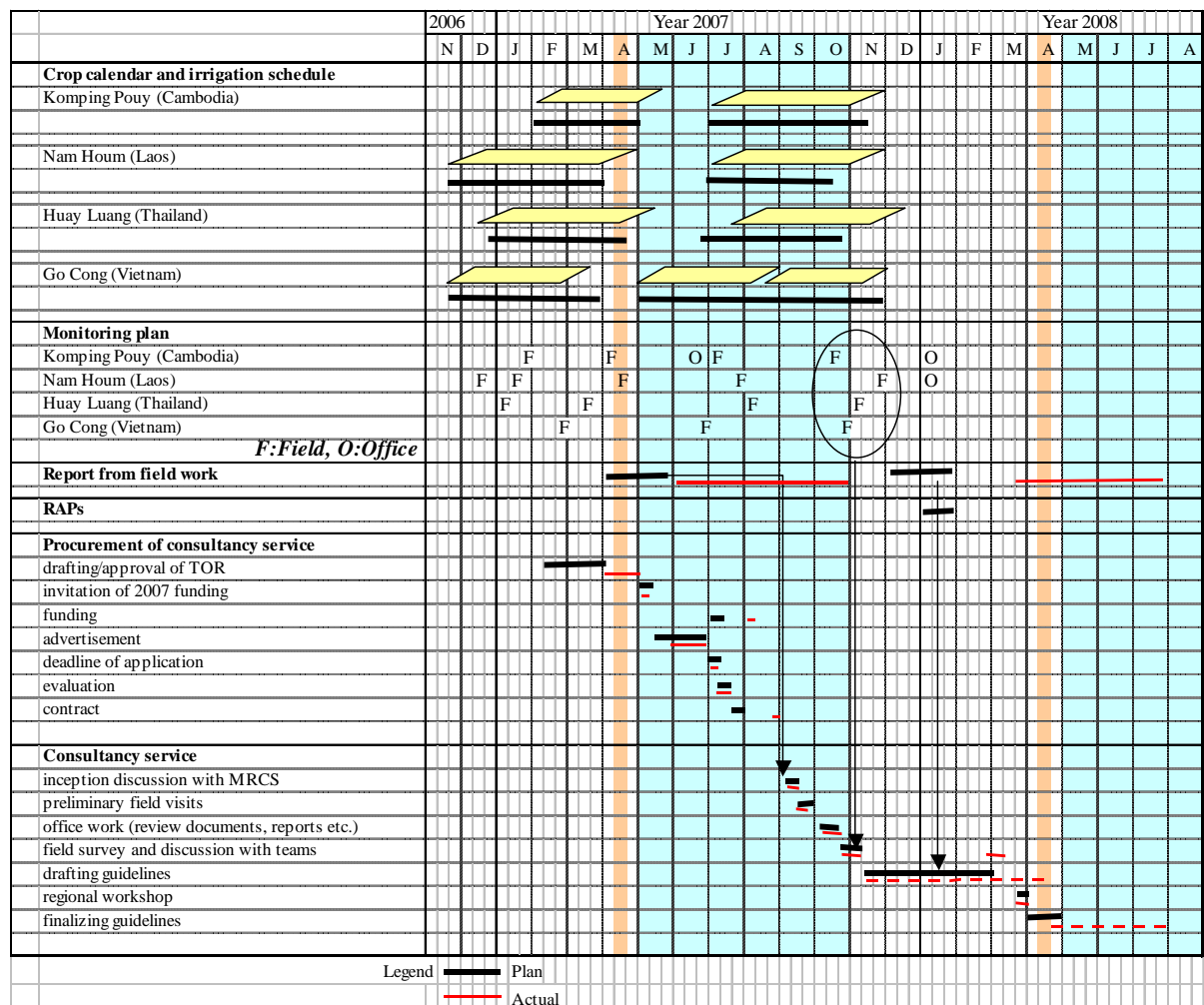


(2) Implementation

Table 5 shows the plan and the actual progress of activities since the first regional workshop. This table basically follows the detailed work plan attached to the project document but focuses only on activities after the first regional workshop.

reaches to the acceptable level for consultation with Member Countries, although the countries agreed the MRCS could decide procedure for consultation and finalisation at the second regional workshop (see 2.21.)

Table 6 Progress of drafting guidelines



4 Achievements and Outputs

4.1 Collaboration with FAO

Collaboration with FAO covered two aspects of the project implementation, which were assistance to the project formulation by the FAO consultant (See 2.7) and assistance to the RAP training workshop followed by the scheme performance appraisal (See 2.14 and 2.15.) The later was conducted based on the agreement between the two organizations (See 2.8.)

The assistance by the FAO consultant helped to formulate the project design in improving the logical framework, making water balance concept fit into the project design and developing detailed backstopping note for the fieldwork.

FAO's contribution to the training workshop and its follow-up activity provided capacity building opportunity for riparian irrigation engineers as described in 4.2 below.

4.2 Improved knowledge on irrigation modernization

With the four-day RAP training workshop, 16 engineers from Member Countries have gained and improved basic knowledge of irrigation modernization in terms of

- What is the irrigation system modernization and why it is important,
- Water control methods in order to realize irrigation modernization,
- Modern concept of water balance, irrigation efficiency and productivity including multiple use of irrigation water.

Those 16 engineers assisted by other 12 engineers conducted RAP at the selected pilot sites. This exercise and the training workshop provided a basic idea of RAP, a diagnosis tool for irrigation scheme performance, with views of

- Outline of RAP,
- How to interpret indicators from RAP,
- How to set up modernization plan from RAP result.

4.3 Initial assessments

The performance of four pilot irrigation schemes were assessed, analyzed and compared by common diagnostic tool, RAP. This performance assessment became good reference and benchmark of the field observation and analysis. Detail of this work (objectives, procedure etc.) is recorded in 2.14 and 2.15.

The achievements are summarised as follow.

- A primary data set of four pilot sites concerning water use and scheme management has been established in a uniform format. This data set can be used as reference for the relevant work in the future.
- The team members have gained deeper understanding of the situation of their own irrigation schemes.

- Involved team members have developed their capacities in terms of up-to-date concepts of irrigation efficiencies and water balance through the training workshop and field level on-the-job training.
- Team members have also developed their capacities to use modern tools and procedures to evaluate the system performances by systematic diagnostic procedure that includes both visits to the office to interview the project staff and field evaluation on control structures, operational strategies, communications and water delivery service.

Detail of the findings and other observation are available in chapter 5 of the attached CD.

4.4 *Scheme performance analysis*

As described in 2.19 (1) and 2.23, the MRCS analysed a part of collected information from the pilot sites and presented results at international events. Summary of the analysis is as follows:

- The results showed that all three gravity irrigation schemes demonstrated a high degree of efficiency even though some schemes have earth type canals in poor condition. The main reason for this is because using the water balance approach which definitely shows the lower volumes of available water delivered to the fields rather than the classical concept. A higher efficiency was observed in schemes with active and strict water management with a high degree of monitoring and evaluation of water allocation. Sites with low efficiency had poorly designed hydraulic structures allowing excessive water into command areas and then drain out without being used.
- Water productivity captures the performance of water use by providing total output values per unit of available irrigation water. High water productivity is found in schemes practicing multiple agriculture activities, while the low water productivity is observed at schemes practicing single crop.
- Based on the primary results obtained from the efficiency and water productivity assessment, strict and active water management is required to reach the maximum amount of cultivated area without water shortages affecting production. For schemes with too large capacity canals, enlarging cultivated areas where possible needs to be considered; otherwise irrigation water in the canal is drained out of command areas without being used. Combining cultivated area with multiple agriculture activities is also essential for increased water productivity.

Since the analysis is still primary level and has not covered all the data collected, the MRCS continues further effort to provide in-depth analysis of irrigation practices at four pilot sites, which will be composed of 1) comparison of scheme performance at three gravity schemes in both dry and wet seasons and 2) water balance and performance analysis of a tidal irrigation in Viet Nam delta. These will be delivered through the year 2008.

4.5 Guidelines for efficient water management

The MRCS envisages completing and delivering the guidelines as the project's final output by September 2008.

5 Financial report

5.1 Budget and expenditure

The project was almost fully funded as proposed by the revised project document except a slight gap in the third year. Because of this funding gap and for adjustment up to the second year, the third year planned budget was revised from the originally proposed one. Table 7 shows the comparison between proposed and allocated budget and actual expenditure.

Table 7 Comparison of budget and expenditure

BL	Item	1st Year (2005-6)			2nd Year (2006-7)			3rd Year (2007-8)			Total	
		Proposed	Received & allocated	Actual Expenditure	Proposed	Received & allocated	Actual Expenditure	Proposed	Received & allocated	Actual Expenditure	Received & allocated	Actual Expenditure
11	Consultant	6,000	6,000	4,496.46				82,000	60,000	59,176.00	66,000	63,672
12	International staff	135,000	135,000	140,425.63	120,000	120,000	132,723.62	125,000	136,500	111,311.81	391,500	384,461
13	Supprot staff		500	8,000.00		500	3,000.00		6,000	3,092.98	7,000	14,093
15	Official travels	14,350	14,350	14,050.66	16,600	16,600	19,297.11	26,200	16,000	11,377.84	46,950	44,726
18	Riparian Professional staff	17,200	17,200	9,593.22	35,000	35,000	37,999.12	40,000	43,600	20,370.80	95,800	67,963
21	Sub-contract	75,000	75,000	71,683.60	105,000	105,000	107,495.24				180,000	179,179
30	Workshop	23,800	23,800	29,145.31	22,900	22,900	7,272.32	21,800	22,600	6,830.00	69,300	43,248
42	Equipment	28,500	28,500	25,513.00	500	500	98.00	500	1,000	1,004.00	30,000	26,615
52	Reporting cost	1,000	1,000	775.88	1,000	1,000	2,341.08	2,000	2,000	0.00	4,000	3,117
53	Miscellaneous	1,453	953	1,805.38	1,303	803	2,681.48	4,803	1,574	2,249.15	3,330	6,736
70	Secretariat support cost	39,299	39,299	36,112.86	39,299	39,299	28,782.69	39,299	37,605	22,954.44	116,203	87,850
	Total	341,602	341,602	341,602.00	341,602	341,602	341,690.66	341,602	326,879	238,367.02	1,010,083	921,660

5.2 Fund status

Balance as of the end of May 2008 is

Zero (0) USD for 2005 funding (1.1\24\05\JPN\A)

Minus (-) 88.66 USD for 2006 funding (1.1\53\06\JPN\A) and

88,511.98 USD for 2007 funding (1.1\81\07\JPN\A).

Evidence of expenditure of each funding is attached as Table 8.

The 2006 funding includes unliquidated obligations for the final payment for the sub-contract with NMCs/LAs (see 2.19) with approximately 51,000 USD. Once these obligations are cleared, negative balance will be settled by relocating some expenditure to the 2007 funding.

Remaining fund is to be used for the activities by July 2008 including remuneration for the staff and will be spent out at the end of July 2008. Once all the fund is spent out and the project accounts are closed, final status will be reported to the donor.

5.3 Summary of expenditure

(1) BL11 - International consultant

This budget line covers two different aspects of expenditure.

For the first year, travel cost for FAO consultant only was charged to this budget line. This consultant was engaged in improvement of project concept, the project document and related documents. Remuneration of this consultant was covered by the Japan funding FAO project as a part of FAO-MRC collaboration.

For the third year, subcontract with National Institute for Rural Engineering Japan was also charged to this budget line.

(2) BL12 - International experts

This budget line covers three years remuneration of Senior Advisor of AIFP (from July 2005 to July 2008), yearly reserve for repatriation grant and other related expenditure. The cost for his home leaves was also charged.

(3) BL13 - Support staff

This budget was originally secured for hiring riparian support staff temporally to reduce workload of regular staff. Since the project requires assistance for editing the published documents, such as the workshop proceedings, the project brochure, the posters, web site information and so on, the project requested Communications unit/ICCS of the MRCS to provide their assistance and the cost was charged to this budget line.

(4) BL15 - Official travels

All the travel cost for AIFP regular staff was covered. This is mainly composed of the meetings with line agencies and participation of other external meetings, forums and conferences.

(5) BL18 - Riparian Professional staff

This budget line covers remuneration of Programme Officer of AIFP since his enrolment (from March 2006 to July 2008.) Remuneration of AIFP Programme coordinator for three months (August to October 2006) was also charged to this budget line. This arrangement was explained to the donor before taking action and also at annual consultation meeting and acknowledged by the donor.

(6) BL21 - Sub-contract

The field observation and analysis work entrusted to four National Mekong Committees were charged to this budget line.

(7) BL 30 - Training (Workshop)

This budget line covers the expenditure for 1) first regional workshop in 2006, 2) second regional workshop in 2008 and 3) RAP training workshop and initial scheme assessment for Member Countries participants.

(8) BL41/42 – Equipment

Two sets of laptop computer for the MRC office use and four sets of electromagnetic current meter were procured.

Procurement of small office equipment was also charged to this budget line.

(9) BL52 - Reporting costs

Printing three kind of the workshop proceedings, the project brochure, the yearly progress reports and the final report is (to be) charged to this budget line.

Table 8 (1) Fund report (2005)

Date: Wednesday, 17 January, 2007
 Time: 09:11AM
 User: LATDARA

Mekong River Commission
 Yearly Fund Status Report - Detail

Page: 1 of 1
 Report: PA02Y.rpt
 Company: MRCS

Budget Line	Description	Approved Budget (1)	Year-To-Date Actual (2)	Proj-To-Date Actual (3)	Unliquidated Obligations (4)	Total Expenditure (5) = (3) + (4)	Budget Balance (6) = (1) - (5)	Expenditure / Budget (7) = (5) / (1)
11-00-00	International consultants	6,000.00	4,496.46	4,496.46	0.00	4,496.46	1,503.54	74.94 %
12-00-00	International experts	135,000.00	71,436.03	140,425.63	0.00	140,425.63	-5,425.63	104.02 %
13-00-00	Support staff	500.00	8,000.00	8,000.00	0.00	8,000.00	-7,500.00	,600.00 %
15-00-00	Official Travels	14,350.00	5,640.94	14,050.66	0.00	14,050.66	299.34	97.91 %
17-00-00	Riparian experts	0.00	0.00	0.00	0.00	0.00	0.00	0.00 %
18-00-00	Riparian professional staff	17,200.00	8,449.70	9,593.22	0.00	9,593.22	7,606.78	55.77 %
21-00-00	Sub-contracts (line agencies)	75,000.00	71,683.60	71,683.60	0.00	71,683.60	3,316.40	95.58 %
30-00-00	Workshop	23,800.00	28,762.31	29,145.31	0.00	29,145.31	-5,345.31	122.46 %
42-00-00	Non-Expendable Equipment	28,500.00	21,862.00	25,513.00	0.00	25,513.00	2,987.00	89.52 %
51-00-00	Operation and Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	0.00 %
52-00-00	Reporting costs	1,000.00	775.88	775.88	0.00	775.88	224.12	77.59 %
53-00-00	Miscellaneous	953.00	1,324.23	1,805.38	0.00	1,805.38	-852.38	189.44 %
	Subtotal:	302,303.00	222,431.15	305,489.14	0.00	305,489.14	-3,186.14	101.05 %
70-00-00	Secretariat Support Cost (11%)	39,299.00	26,976.47	36,112.86	0.00	36,112.86	3,186.14	91.89 %
	Total:	341,602.00	249,407.62	341,602.00	0.00	341,602.00	0.00	100.00 %
	Total Fund Received:			341,602.00				
	Outstanding Advance:			0.00				
	Total Cash available:			0.00				

Table 9 (2) Fund report (2006)

Budget Line	Description	Approved Budget (1)	Mth-To-Date Actual (2)	Proj-To-Date Actual (3)	Unliquidated Obligations (4)	Total Expenditure (5) = (3) + (4)	Budget Balance (6) = (1) - (5)	Expenditure / Budget (7) = (5) / (1)
12-00-00	International Staff (MRCs)	120,000.00	0.00	132,723.62	0.00	132,723.62	-12,723.62	110.60 %
13-00-00	Support Staff	500.00	0.00	3,000.00	0.00	3,000.00	-2,500.00	600.00 %
15-00-00	Official Travel	16,600.00	0.00	19,297.11	0.00	19,297.11	-2,697.11	116.25 %
18-00-00	Riparian Professional Staff	35,000.00	0.00	37,999.12	0.00	37,999.12	-2,999.12	108.57 %
21-00-00	Sub-contract	105,000.00	0.00	56,247.00	51,248.24	107,495.24	-2,495.24	102.38 %
30-00-00	Training	22,900.00	0.00	7,272.32	0.00	7,272.32	15,627.68	31.76 %
42-00-00	Non-expendable Equipment	500.00	0.00	98.00	0.00	98.00	402.00	19.60 %
52-00-00	Reporting Cost	1,000.00	0.00	2,341.08	0.00	2,341.08	-1,341.08	234.11 %
53-00-00	Miscellaneous	803.00	-20.07	2,681.48	0.00	2,681.48	-1,878.48	333.93 %
	Subtotal :	302,303.00	-20.07	261,659.73	51,248.24	312,907.97	-10,604.97	103.51 %
70-00-00	Management & Admin. Fee (11%)	39,399.00	-2.21	28,782.69	0.00	28,782.69	10,516.31	73.24 %
	Total :	341,602.00	-22.28	290,442.42	51,248.24	341,690.66	-88.66	100.03 %
	Total Fund Received :	341,602.00						
	Outstanding Advance:	0.00						
	Total Cash available :	51,159.58						

Mekong River Commission
Fund Stat Rpt - Detail/Control

Date: Monday, June 02, 2008
Time: 09:24AM
User: PHANIPHONG

Period Ending : 05-2008
Funding Source : Japan

Project : 1.11531061UPNIA
Improvement of Irrigation Efficiency on Paddy Fields in the LMB, MRC009.12

Pages: 1 of 1
Report: PA202.rpt
Company: MRCs

Table 9 (3) Fund report (2007)

Budget Line	Description	Approved Budget (1)	Mth-To-Date Actual (2)	Proj-To-Date Actual (3)	Unliquidated Obligations (4)	Total Expenditure (5) = (3) + (4)	Budget Balance (6) = (1) - (5)	Expenditure / Budget (7) = (5) / (1)
11-00-00	Int'l Experts/Consultants	60,000.00	0.00	20,336.00	38,840.00	59,176.00	824.00	98.63 %
12-00-00	International Staff (MRCS)	136,500.00	10,875.65	111,311.81	0.00	111,311.81	25,188.19	81.55 %
13-00-00	Support Staff	6,000.00	546.49	3,092.98	0.00	3,092.98	2,907.02	51.55 %
15-00-00	Official Travel	16,000.00	1,354.09	11,377.84	0.00	11,377.84	4,622.16	71.11 %
18-00-00	Riparian Professional Staff	43,600.00	2,497.05	20,370.80	0.00	20,370.80	23,229.20	46.72 %
30-00-00	Training	22,600.00	6,830.00	6,830.00	0.00	6,830.00	15,770.00	30.22 %
41-00-00	Expendable Equipments	1,000.00	90.00	1,004.00	0.00	1,004.00	-4.00	100.40 %
52-00-00	Reporting Costs	2,000.00	0.00	0.00	0.00	0.00	2,000.00	0.00 %
53-00-00	Miscellaneous	1,574.00	363.35	2,249.15	0.00	2,249.15	-675.15	142.89 %
	Subtotal:	289,274.00	22,556.63	176,572.58	38,840.00	215,412.58	73,861.42	74.47 %
70-00-00	Management & Admin Fee 13%	37,605.00	2,932.36	22,854.44	0.00	22,854.44	14,650.56	61.04 %
	Total:	326,879.00	25,488.99	199,527.02	38,840.00	238,367.02	88,511.98	72.92 %
	Total Fund Received:	326,879.00						
	Outstanding Advance:	0.00						
	Total Cash available:	127,351.98						

Page: 1 of 1
Report: PA202.rpt
Company: MRCS

Mekong River Commission
Fund Stat Rpt - Detail/Control
Period Ending: 05-2008
Funding Source: Japan

Date: Monday, June 02, 2008
Time: 09:22AM
User: PHANIPHONG
Project: 1.1181107.JPNVA
Improvement of Irrigation Efficiency on Paddy Fields in the Lower Mekong Basin 2007: MK2007/04

ANNEXES

Annex 1

Project Document



Mekong River Commission

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Improvement of Irrigation Efficiency on Paddy Fields in the Lower Mekong Basin project (IIEPF-AEWEPF)

Project document

This project is funded by the Ministry of Agriculture, Forestry and Fisheries of Japan under the framework of “Programme to analyze and evaluate water and ecosystem in Asian paddy fields (AEWEPF).” AEWEPF has two components; 1) “Improvement of Irrigation Efficiency on Paddy Fields in the Lower Mekong Basin project (IIEPF-AEWEPF or simply IIEPF)” which is carried out by the MRC and 2) “Evaluation Study of Paddy Irrigation under Monsoon regime (ESPIM)” that is carried out by FAO.

1. Background and Justification

The Mekong River is the biggest international river in Southeast Asia. The Mekong River Basin has high development potential because of its ecological diversity such as climate, land, flora and fauna, soil and water resources. Water resources are widely used for agriculture, hydropower generation, navigation, fisheries, industries, tourism, domestic use, etc. and contribute to economic development and well-being of the population in the region.

Agriculture is the predominant economic sector of the Lower Mekong Basin (LMB), which employs 85% of the population of about 60 million. Further agricultural development is required to feed rapidly growing population of the region. Therefore agriculture sector is high on the agenda of each riparian country’s development strategy.

With the growing population and industry in the region, the competition for water between different sectors (domestic, industrial, agriculture) and even among different crops (rice versus industrial crops) is also growing and the situation calls for Integrated Water Resources Management (IWRM) at the irrigation system, national and basin levels.

Rice is dominant crop of the Lower Mekong Basin. As it allows short-term inundation caused by intensive rainfall, it suits the climate of the region. Inundation on paddy fields prevents soil erosion and replants failure, and contributes to removing salinity. In addition it also plays an important role in the maintenance of rural traditions and communities. There is a growing realization of the multi-functionality of the paddy rice systems.

On the other hand, rice is the single biggest user of fresh water in the region, although lack of rainfall in the dry season and dry spells in the rainy season are among

the major constraints to rice production, particularly in rainfed areas, and water productivity in paddy fields remains low in both rainfed and irrigated rice. For further development of water resources in the region and investments in irrigation, it is important to increase efficient use of water in paddy fields.

MRC strategic plan 2006-2010 also puts emphasis on “improving efficiency of water use” as one of the development needs of the basin. BDP (Basin Development Plan) phase I endorses these needs with several priority projects focusing on water use efficiency improvement. Another evidence can be observed on the needs of drought management. Mekong river basin has frequently suffered from drought. Drought in 2004 affected vast area of the Mekong delta and North-east Thailand raised this issue as another core issue of the region and MRC has started to formulate drought management programme. This fact also calls for efficient water use in the basin.

Not many irrigation schemes in the LMB countries shows high performance in terms of efficient water use. Irrigation efficiency, which is an indicator of effective water resources management, of these schemes varies between countries but is low in general. These low efficiencies lead to water shortages within the command area of irrigation schemes particularly in the dry season or dry spells during the rainy season.

Improvements in irrigation efficiency will lead to improved equity in water distribution and minimize the gap between potential crop water requirement and actual water use. One effective approach to achieve these improvements is a good guidance for irrigation facilities operation in institutional, managerial and technical aspects. This guidance will benefit farmers and other water users and persons/organizations in charge of water management (i.e. water users groups, water management authorities, etc.) directly. If efficient and equitable water use is realized, this makes positive impact on water resources management at from sub-basin, national to basinwide level.

There is not enough information available in the region on reliable estimates of irrigation efficiencies and actual water use. Previous studies that provide some kind of estimates mainly analyze field level efficiencies and lack the use of modern and up-to-date concepts of irrigation efficiencies and water balance.

Assessment of irrigation efficiencies alone does not provide insights into how these could be improved. An appraisal of selected paddy field irrigation scheme as a whole and at different levels: main system level, distributional level, tertiary level, and field level; and assessment of different components of irrigation system management will provide insights into the constraints causing the low efficiency levels. These components include: water delivery at different levels, water requirement, allocation and distribution practices, operation of the scheme, physical infrastructure (this includes efficiencies) and stakeholders’ participation into the decision making. Furthermore irrigation schemes, that are predominantly designed and constructed for rice paddy irrigation, provide water also for other uses, such as fish farming, domestic water supply, etc. Hence, while considering water requirements for multiple uses of the scheme, their requirements should also be considered. Once the constraints and the bottlenecks are known only then the improvements for increasing water use efficiency could be identified.

Rigorous analysis of water use situation in an irrigation system using up-to-date concepts and tools will allow the managers and decision makers to plan targeted improvements in order to improve irrigation efficiencies, which is the main goal of this project. Modern methodologies to appraise irrigation projects provide insights in the bottlenecks and help to identify potentials for improvements and must be used in order to successfully embark upon the improvements. One such methodology is Rapid Appraisal Process (RAP), which has been widely used by Food and Agriculture Organization of the United Nations (FAO) and the World Bank for evaluating irrigation system performance and prioritizing improvements for modern management of the systems.

The use of modern concepts in assessing the current situation and introduction of improved and modern techniques to manage water resources efficiently are vital for improving irrigation efficiencies, sustainability and productivity of irrigated agriculture in the LMB countries.

2. Objectives

As described in the background, improvement in irrigation efficiency is one of the key factors in optimizing water use at the basin level and to utilize limited water resources effectively. In this context, IIEPF sets overall objectives as below:

Overall objective:

To improve irrigation efficiency on paddy fields in the Lower Mekong Basin

Immediate objectives:

1. to appraise irrigation efficiencies and the irrigation system based on the modern concepts in the selected irrigation schemes;
2. to enhance capacity of all the stakeholders in using up-to-date concepts of irrigation efficiencies and water balance and modern tools and procedures for their assessment; and
3. to produce guidelines for improving irrigation efficiency on paddy field based on actual water use conditions in the member countries:

3. Outputs and activities

3.1 To meet the objective 1: to appraise irrigation efficiencies and the irrigation system based on the modern concepts in the selected irrigation schemes, the following outputs are planned;

Output 1.1: Establishment of minimum set of data to evaluate irrigation efficiencies and irrigation system

Activity 1.1.1: Identifying and selecting the main diversion structures and canal sections for flow measurement, calibration, and monitoring

Activity 1.1.2: Measuring and monitoring flows at the selected points

Output 1.2: Assessment of water balance, irrigation efficiencies and water productivity

- Activity 1.2.1: Measuring conveyance efficiencies
- Activity 1.2.2: Gathering information and conducting measurements on parameters required to assess water balance and crop water requirement – ETo, Rainfall, Deep percolation of rice;
- Activity 1.2.3: Calculating crop water requirement
- Activity 1.2.4: Conducting water balance analysis based on the modern concepts
- Activity 1.2.5: Assessing irrigation efficiencies on the modern concepts
- Activity 1.2.6: Assessing crop water productivity (yield per unit of water consumed, and yield per unit of water diverted)

Output 1.3: Appraisal of scheme management

- Activity 1.3.1: Reviewing official and actual rules, principles and practices of water allocation, distribution and operation
- Activity 1.3.2: Reviewing stakeholders’ participation in decision-making regarding the water allocation and distribution

Output 1.4: Rapid Appraisal Process

- Activity 1.4.1: Organizing data required to conduct RAP
- Activity 1.4.2: Conducting RAPs in the selected irrigation schemes

- 3.2 To meet the objective 2:** to enhance capacity of all the stakeholders in using up-to-date concepts of irrigation efficiencies and water balance and modern tools and procedures for their assessment, the following outputs are planned;

Output 2.1: Backstopping note for the implementing agencies

- Activity 2.1.1: Drafting the backstopping note including an overview of the modern concepts, and notes on field and secondary data collection and analysis
- Activity 2.1.2: Backstopping the implementing agencies during the entire project implementation period, particularly during the data collection and analysis phase.

Output 2.2: Training workshop on RAP

- Activity 2.2.1: Organizing and conducting RAP workshop

Output 2.3: National workshops in the project countries

- Activity 2.3.1: Organizing national workshops in the member countries to discuss the outcomes of the data analysis

Output 2.4: Report on assessment of existing capacity and recommendations for capacity development training of the line agency staff

- Activity 2.4.1: Reviewing the guidelines, backstopping and other relevant reports
- Activity 2.4.2: Interviewing the line agency personnel
- Activity 2.4.3: Consulting with the relevant national and international organizations

3.3 To meet the objective 3: to produce guidelines for improving irrigation efficiency based on actual water use conditions in the member countries

Output 3.1: Guidelines to improve irrigation efficiency

Activity 3.1.1: Reviewing the analysis data and relevant documents

Activity 3.1.2: Consulting with the relevant national and international organizations

Activity 3.1.3: Drafting the guidelines

Activity 3.1.4: Regional workshop to discuss and introduce the guidelines

4. Implementation arrangement

4.1 Under the framework of the MRC

The project and MRC's vision

IIEPF is implemented under the framework of the MRC, more specifically IIEPF manages a part of Sub-component #1 "Water Use Efficiency in Paddy Irrigation System" of the Agriculture, Irrigation and Forestry Programme (AIFP) (2001-2005) of the MRC. IIEPF will contribute the Mission of the MRC, that is "To promote and coordinate sustainable management and development of water and related resources," through achieving immediate and overall objectives.

MRC Secretariat

Senior advisor on Irrigation/AIFP is responsible for day-to-day management of project implementation under the supervision on the AIFP Programme Coordinator and the OPD Director. Programme officer is recruited to support Senior advisor mainly on field observation and related activities.

National Mekong Committees & Line agencies

Involvement of NMCs as representatives of its member countries is the essential approach of the MRC activity. Through utilization of knowledge and experience of member countries, this approach is advantageous in some aspects such as 1) smooth coordination of the project implementation, 2) prioritization of specific subjects to be analyzed through the project and 3) implementation of practical activities.

Moreover, involvement of relevant line agencies responsible for water issues, such as irrigation planning and/or water resources management is crucial to conduct field observation and to finalize guidelines on effective water use appropriately, reflecting real needs of each country.

This project also provides some opportunities for capacity building of the relevant officers in the related fields. In other word, roles and responsibilities of relevant line agencies should be carefully determined in accordance with their existing capabilities and target level of capacity building.

4.2 Collaboration with the Food and Agricultural Organization of the United Nations

Collaboration with international organizations specialized in agriculture and irrigation will contribute to reinforce outputs of this project. Among UN agencies,

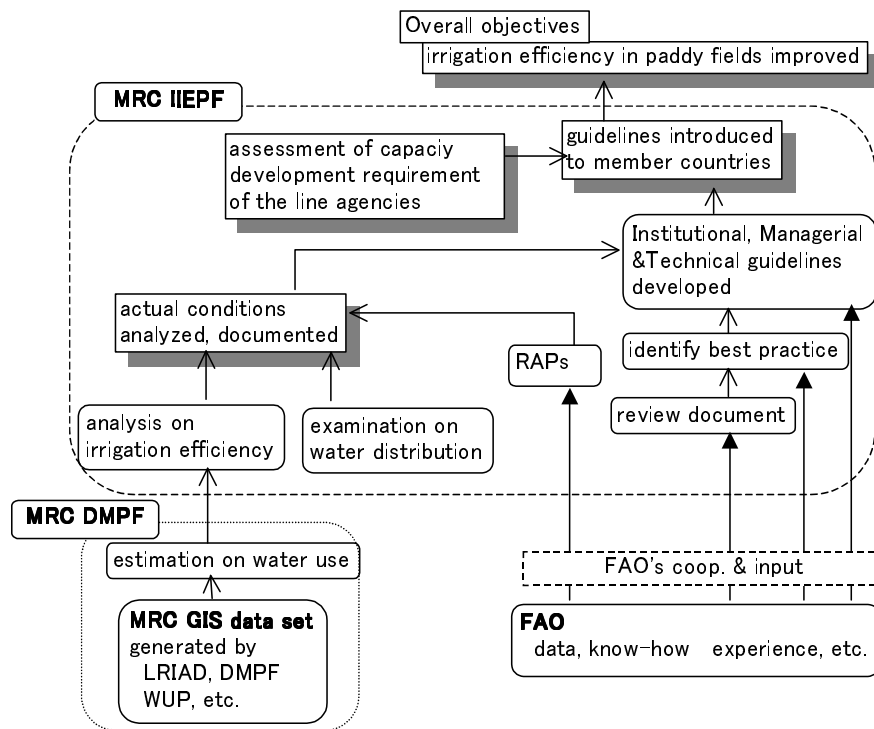
with the reasons below, FAO is one of the most significant organizations to collaborate for implementation of this project.

- FAO is the only UN technical organization specialized in agriculture development including irrigation
- FAO has broad knowledge, experience, know-how and remarkable history on agricultural and irrigation development all over the world
- FAO is implementing the project “the Evaluation Study for Paddy Irrigation in Monsoon areas (ESPIM)” which is funded by the Government of Japan

Thus IIEPF will be implemented by the MRC in close collaboration with FAO. ESPIM/FAO provides technical advice on drafting and finalizing the project document to improve its quality. Furthermore Outputs 1.4, 2.1, 2.2, 3.1, and 4.1 of the project, in particular, will benefit from collaboration and input from FAO.

FAO will make available to MRC relevant data and documents to identify best practices for improving water management. FAO will also help the project to conduct RAPs. In addition FAO will provide feedback on the draft of the guidelines.

Schematic diagram of implementation arrangement is shown below:



Rapid Appraisal Process

The Rapid Appraisal Process (RAP) was jointly developed by the Irrigation Training and Research Centre (ITRC) of California Polytechnic University and FAO in late 90's and since then has been successfully used by FAO and the World Bank in various Asian countries to appraise several irrigation projects.

The methodology uses modern concepts of canal operation and water use efficiencies and is based on the understanding that the irrigation systems operate under a set of physical and institutional constraints and with a certain resource base. The systems are analyzed as a series of management levels, each level providing

water delivery service through the system's internal management and control processes to the next lower level, from the bulk water supply to the main canals down to the individual farm or field.

With the service quality delivered to the farm and under economic, agronomic constraints, system and farmers' management produces results (crops yields, irrigation intensity, water use efficiency etc.), while symptoms of poor system performance and institutional constraints are manifested as social chaos (water thefts, vandalism), poor condition of infrastructure, poor cost recovery and weak water users associations.

The RAP allows qualified personnel to systematically and quickly determine key indicators of irrigation projects. The RAP can generally be completed with two weeks or less of field and office work provided that some readily available data on the project have been organized by the project authorities in advance.

Key performance indicators from RAP help to organize perceptions and facts, hence facilitate informed decision regarding

- The potential for water conservation within a project
- Specific weakness in project operation, management, resources, and hardware
- Specific modernization actions that can be taken to improve project performance

Furthermore, it also provides initial indicators that could be used as benchmarks in order to compare the improvements in the performance of the system once the modernization plans are implemented. A good assessment of the current situation gives a clear idea on where situation must be improved and helps in prioritizing the areas for improvements. The RAP could also be used to compare the performance of the different projects.

The RAP is considered useful for IIEPF as it provides good indication, in relatively short time, of the constraints and bottlenecks in the system and thus helps in identifying options for improvements at different levels of the irrigation system. Among other things, it gives information on the following:

- water allocation and distribution practices;
- operation rules and procedures;
- irrigation efficiencies (conveyance, field, overall project efficiencies);
- physical infrastructure (hardware) of the system;
- involvement of water users in the decision making process (stakeholders involvement);

All the above mentioned information is part of the detailed data collection work of IIEPF, thus the information from RAP will compliment the data collection and measurement work of IIEPF. RAPs will be conducted in each selected irrigation scheme twice during the project's life.

- once at the beginning of the project, before the field data measurement work starts; and

- second time when field data measurement work ends.

5. Work plan

Project period is three (3) years, commencing in June 2005 and to be completed in June 2008.

Work plan will be revised yearly responding to the progress of the project. This work plan shows outline of year-by-year schedule for project implementation at the beginning stage. Detail time frame for each activity is shown as Annex-1.

5.1 Activities planned in the 1st year (June 2005 to June 2006)

Most of the time of the year 1 is spent in preparation. There is a gap between the funding and implementation of the project. The project started in the June 2005, when budget was transferred from the donor to the MRC bank account, and officer in charge of the project implementation assigned to the MRCS in the middle of July 2005. Then the project document was revised. This revised project document will now be shared by the four member countries and will be submitted to the donor for approval.

Planned major activities in this period are as below:

1. Discussion with the FAO for collaboration
2. Series of discussions and national consultation meetings with four National Mekong Committees and other relevant line agencies to reach consensus on content of the project
3. Revision of the project document
4. Drafting backstopping note for field observation and analysis work of the project
5. Regional workshop to officially inaugurate the project
6. Preparation of sub-contract with line agencies

5.2 Activities planned in the 2nd year (June 2006 to June 2007)

Field observation will start in the year 2 of the project implementation and will continue to the third year. Work for drafting guidelines to improve irrigation efficiency will be sub-contracted in the second half of the year 2.

Planned major activities in this period are as below:

1. Preparation of detail work plan for field observation
2. RAP training workshop
3. RAPs in the member countries
4. Measurements, data collection and analysis

5.3 Activities planned in the 3rd year (June 2007 to June 2008)

Field observation will continue in the first half of year 3. An international consultant will be hired to review existing documents, identify best practices for improved water management, and draft institutional, managerial and technical guidelines for efficient water use. A regional workshop will be organized to propose draft guidelines. Final report will be produced based on the result of all the activities. Major activities planned for the last year of the project are:

1. RAPs by the implementing agencies
2. Drafting the guidelines

3. Assessment of the capacity building requirement of the relevant line agencies
4. National workshops to discuss results of the analysis
5. Regional workshop to introduce the draft guidelines
6. Final report of the project

6. Cost breakdown

Total budget is approximately one (1) million USD. Details with breakdown are described below.

BL	Item	1st Year	2nd Year	3rd Year	Total
12	International staff	135,000	120,000	125,000	380,000
15	Official travels	14,350	16,600	26,200	57,150
11	Consultant	6,000		82,000	88,000
18	Riparian Professional staff	17,200	35,000	40,000	92,200
21	Sub-contract with line agencies	75,000	105,000		180,000
30	Workshop	23,800	22,900	21,800	68,500
42	Equipment	28,500	500	500	29,500
52	Reporting cost	1,000	1,000	2,000	4,000
53	Miscellaneous	1,453	1,303	4,803	7,559
70	Secretariat support cost	39,299	39,299	39,299	117,897
	Total	341,602	341,602	341,602	1,024,806

7. Roles and responsibilities

The project implementation is managed by MRC (i.e. by MRCS in close cooperation with NMCs/relevant Line agencies.) In addition involvement of FAO as a collaboration partner is expected. Roles and responsibilities of related persons are as follows.

7.1 Senior advisor

Senior advisor has overall responsibility for project implementation in cooperation with Programme officer, Consultant and NMCs/relevant Line agencies. Roles are shown below.

- Overall management of the project
- Coordination with NMCs/relevant Line agencies
- Organizing collaboration with the FAO
- Organizing national and regional workshops
- Making sub-contract with NMCs/relevant Line agencies and Consultant
- Managing consultancy services
- Conducting supplement backstopping to NMCs/relevant Line agencies
- Reporting to AIFP coordinator/OPD director and the donor

7.2 Programme officer

Programme officer is mainly responsible for monitoring and technical backstopping of field observation and related activities conducted by NMCs/relevant Line agencies.

Specific items for technical backstopping are as below.

- Introduction of modern and up-to-date concepts of irrigation efficiencies and water balance to relevant line agency staff

- Establishment of detailed work plan for field observation including preparation of quotation
- Selection of measurement points within the irrigation scheme
- Field observation on flow measurement, identification of actual irrigated area, water requirement measurement and other relevant data collection water allocation and distribution practices
- Assessment of water balance, irrigation efficiencies and water productivity
- RAPs conducted at the end of the data collection period
- Finalization of country reports

Other roles of Programme officer are to assist Senior advisor's task in particular items listed below.

- Organizing national and regional workshops
- Managing consultancy services
- Reporting to the MRCS and the donor

In addition the Programme Officer will participate in the following:

- Training workshop on RAP, and
- RAPs conducted by FAO in the member countries

7.3 Consultant

Consultant will mainly be responsible to draft institutional, managerial and technical guidelines for efficient water use and to assess capacity development requirement of the stakeholders in order to effectively utilize these guidelines. These activities are undertaken in close collaboration with and input from FAO. In order to achieve this purpose, the consultant will be expected to undertake activities mentioned below.

- Review of existing documents
- Identify best practices
- Drafting institutional, managerial and technical guidelines
- Capacity development requirement assessment of the managers in order to be able to use the guidelines
- Presentation of draft guidelines at regional workshop
- Finalization of guidelines
- Reporting to AIFP

7.4 NMCs & relevant Line agencies

NMCs/relevant Line agencies are responsible for data collection in the fields and other related activities with technical backstopping by Programme officer on their demand. Items responsible for are below.

- Selection of the pilot project site
- Measurement and calculation of in flow and out flow of the selected site over time
- Assessment of water balance
- Identification of actual irrigated area over time
- Assessment of water requirement including the measurement and/or collection of necessary data and parameters

- Calculation and analysis of irrigation efficiency
- Assessment of water productivity
- Analysis and documentation of water allocation and distribution practices
- Participation of selected members in the training workshop on RAP
- Conducting RAP at the end of the data collection period
- Taking part in national and regional workshops organized by MRC
- Reporting to AIFP

7.5 FAO

In addition to the said framework of MRC, FAO is expected to be involved in project implementation as a collaboration partner. Expected collaboration partners are the Land and Water Management Division of the FAO headquarters and the FAO Regional Office for Asia and the Pacific (FAO-RAP). Expected contributions made by the FAO are as below.

- Providing existing information, knowledge, know-how and other resources including human resources related to water management and its best practices in order to improve project document and to enhance project outputs
- Participating in the inception workshop to provide comment to update project concept including the introduction of FAO's input to IIEPF
- Conducting training workshop on RAP in order to contribute to capacity building of relevant line agencies
- Conducting RAPs in the project countries in order to contribute to assess irrigation system performance
- Participating in the national and regional workshops organized by MRC to 1) discuss results from the field data analysis and 2) introducing the guidelines to the project countries in order to review and provide feedback on draft guidelines

8. Other relevant information

8.1 Achievements under AIFP and others

Through past activities including LRIAD¹, the MRC has generated and stores various GIS data sets. Data sets relevant to water use are as follows:

- Topography
- District boundary
- Catchment boundary
- River Network
- Soil (by LRIAD)
- Population density
- Irrigation Scheme (by LRIAD)
- Isohyets
- Maximum flood extend (by LRIAD)
- Forest cover

¹ LRIAD is "Land Resources Inventory for Agricultural Development project" conducted from 1998 to 2001 as one of AIFP projects.

Through implementation of DMPF², the MRC has also produced supplementary GIS data sets related to paddy rice farming and rainfall. Details are as follows:

- Rice farming statistics at district, which are composed of
1) planted area, 2) harvested area, 3) production and 4) yield of rainy and dry seasons respectively,
6) planted area, 7) production, 8) yield of whole year, and
9) population, 10) per capita production.
- Rice cropping area in each month
- Fertilizer use
- Rainfall in time series, which are composed of
1) monthly, 2) rainy and dry season, 3) annual of average of 1985 to 2000.
- Land use map, which reclassifies agricultural land and focuses on paddy field.

DMPF also estimated actual condition of water use. The output is estimation of irrigation water use, which is mapped in GIS data sets and is composed of

- Rainfed and irrigated paddy rice areas
- Monthly water requirement and estimated water use

Since this work was conducted based on existing data, result is based on a lot of approximations and assumptions.

8.2 Linkage with DMPF

IIEPF and DMPF cover some part of sub-component #1 and #4 of AIFP (2001-2005) respectively. In this sense, IIEPF is positioned parallel with DMPF under AIFP framework.

DMPF is conducting estimation of irrigation water use based on dataset presently available at the MRC. In this process, DMPF pointed out that the reliability of some data needed to be improved for more accurate estimation. Irrigation efficiency is one of those data. Unlike other data needed reliability improvement, irrigation efficiency is a factor, which is affected by aspects on structure and management. This means improvement of irrigation efficiency can be expected by counter-measures on structure or management and leads to effective water use. In this context, awareness of the issues for IIEPF comes up from DMPF.

Furthermore DMPF produced vast data of both basinwide and one plot of paddy field level. IIEPF reviews those and identifies effective or useful data for IIEPF implementation, if any, and utilizes or incorporates those as reference

8.3 Multi-functionality

Multi functional roles are secondary functions, which are generated naturally and additionally in process of water use for agricultural production. In this sense, aiming to generate multi functional roles cannot be principle objective of water use. Thus, proposed guidelines consider improvement of irrigation efficiency as priority objective and also pay maximum attention to maintain multi functional roles, especially multiple use of irrigation water such as for fish farming, domestic water supply etc.

² DMPF is another AIFP project, namely "Project to Demonstrate the Multi-functionality of the Paddy Fields over the Mekong River Basin."

ANNEX-1 (2)

Breakdown of activities

This section provides a brief explanation of the activities and events that are presented in the detailed work plan in Page 1 of Annex 1. The number in the brackets corresponds to the number given to the activity in the work plan.

Regional workshop [1]

Senior advisor introduces tentative concept and time frame of IIEPF to member countries on the occasion of the 3rd DMPF regional workshop. Purpose of this activity is to share basic concept of the project with member countries, to retrieve ideas, demands, comments and expectations etc. on the project in order to reflect those into draft project document.

Internal discussion [2]

Senior advisor prepares a concept note of the project and organizes a series of discussions among AIFP team, with OPD director and with CEO to share common understanding and to establish basic concept of the project.

Discussions with FAO [3]

Based on drafted concept note, Senior advisor discusses with FAO potential collaboration between IIEPF and FAO. A letter of agreement will later be signed between FAO and MRC for this collaboration.

Drafting project document [4]

Senior advisor drafts project document. Project document includes basic concept, detail work plan, implementation arrangement, budget allocation and agreed collaboration with the FAO.

The Project document is improved to incorporate comments from the national consultation meetings [6] and FAO [3]. This work is undertaken with the input from FAO.

Circulating project document [5]

MRCS distributes draft project document to relevant authorities of member countries prior to the national consultation meetings.

National consultation meeting [6]

Senior advisor holds national consultation meeting in each member country respectively. Purpose of the meeting is to get feedback on the project concept. Comments are used to improve project document.

Preparation for the workshop and Inception workshop [7& 8]

The AIFP organizes inception workshop to officially commence the project. Member countries participate in the workshop. FAO is also invited to participate.

At workshop, Senior advisor reviews draft project document, addresses member countries' comments made through national consultation meetings and their reflections and/or reactions into project document and its implementation. Agenda of the workshop includes field trip followed by the discussion on site selection.

Forthcoming activities and their necessary arrangement are to be discussed at this workshop in detail. Roles and responsibilities with time frame of NMCs/Line agencies are one of the most important issues to be clarified at the workshop.

Submission of revised project document [9]

The MRCS submits revised project document to the donor for the approval.

Drafting TOR for NMCs/Line agencies and Sub-contract procedure with NMCs/Line agencies [10 &11]

Senior advisor prepares TOR for subcontract with NMCs/Line agencies. TOR is finalized reflecting on outputs of the workshop [8]. Contracts need to be made at the end of 1st year of the project (by June 2006) or the early beginning stage of the 2nd year.

Drafting TOR for Programme officer and Recruitment of Programme officer [12 & 13]

Programme officer, who is mainly responsible for technical backstopping to NMCs/Line agencies, is recruited.

Equipment procurement [14]

Based on comments from national consultation meetings, Senior advisor procure the necessary equipment following the regulation of MRC. Four sets of electromagnetic current meter are on the short list.

Drafting TOR for sub-contract and Selection of International consultant [15 & 16]

Senior advisor prepares TOR of international consultant, and recruits him/her in cooperation with FAO. Contract needs to be made before the end of the 2nd year of the project (April 2007).

Reporting [17]

Senior advisor prepares project's yearly progress and final reports. The final report covers field observation activities, analysis of observations and proposed guideline for efficient water use. The deadlines for the yearly progress reports are June 2006 and June 2007 and the one for the final report is June 2008.

Pilot project site selection [18]

NMC/Line agencies of each country determine one (1) appropriate pilot project site (irrigation scheme) to conduct field observation respectively with close consultation with the MRCS. Senior advisor and Programme officer are to be involved in this activity.

Tentative criteria of selection are 1) representativity of agro-ecosystem and irrigation typology of the basin, 2) accessibility, 3) appropriate size, 4) availability of relevant information. Expected representativity for each site of the country is as follows.

Lao	paddy field in hilly area, pump irrigation
Thailand	gravity irrigation, with PIM approach
Cambodia	wet low land around the Great Lake or other sub-basin
Vietnam	irrigation in low land delta, tidal irrigation

Another set of criteria for the representativity that could be used for selecting project sites is to select only gravity irrigation systems (with or without reservoir) with different management strategies, e.g. Public managed, Jointly managed, etc.

Intensive discussions for detail work plan [19]

A series of discussion sessions is to be held to support NMCs/Line agencies in establishing their detailed work plan including quotation. Senior advisor and Programme officer provide necessary backstopping for this activity, if required.

Preparation of maps [20]

NMC/Line agencies of each country prepare schematic plan of irrigation system and appropriate scaled command area map of the selected pilot project.

Examining irrigation system [21]

NMC/Line agencies of each country examines irrigation system of the pilot project site and draw schematic plan of irrigation system, which includes command area and planed water quantity of each secondary canal. This activity is conducted with backstopping by Programme officer on their demand.

Selection of measurement points [22]

NMC/Line agencies of each country determine measurement points for both current speed and water requirement with close consultation with Senior advisor and Programme officer.

Number of measurement points for current speed is determined according to the size of the pilot project site, but measurement points should basically cover from intake to paddy fields.

Measurement points for water requirement are determined by representing water use of the pilot project site and to try to cover all the classification of soil in the pilot project site. Outputs of [20] and [21] are referred for this activity.

Water quantity measurement [23]

NMC/Line agencies of each country measure water flow at selected points. The detailed information on how to conduct these measurements is explained in the backstopping note. Programme officer provides technical backstopping for discharge measurement on their demand.

Identification of irrigated area [24]

NMC/Line agencies of each country identify actually irrigated area. A combination of interviews with water users and members of water users association and observation will be used to collect this information. Programme officer provides technical backstopping for this activity on their demand.

Water use monitoring [25]

NMC/Line agencies of each country monitor water use in paddy fields at the selected points of the pilot project site. Programme officer provides technical backstopping for this activity on their demand.

Interim and final analysis [26]

NMC/Line agencies of each country conduct analysis and draft an interim report. The deadline for the report is May 2007.

At the end of field observation (planned for January 2008), NMC/Line agencies of each country perform final analysis of irrigation efficiencies and submit

the draft report to the MRCS. Programme officer provides technical backstopping on their demand.

Examining water management practices [27]

NMC/Line agencies of each country examine actual water management procedure at the pilot project site from head works, main to tertiary canals up to paddy fields. Field observations and interviews with farmers are used to collect the information. Programme officer provides technical backstopping for this activity on their demand.

Documentation of collected information [28]

NMC/Line agencies of each country document information regarding water management practices at the pilot project site. Programme officer provides technical backstopping for this activity on their demand.

RAPs [29 & 30]

The information from RAP will compliment the data collection and measurement work of IIEPF. RAPs will be conducted in each selected irrigation scheme twice during the project's life.

- once at the beginning of the project, before the field data measurement work starts; and
- second time when field data measurement work ends.

The first set of RAPs will be conducted by FAO Office for Asia and the Pacific (FAO-RAP), Bangkok and the second by the NMCs/Line agencies. A 4-5 days training workshop will be organized in collaboration with FAO-RAP to train the line agencies in conducting RAPs and to introduce to them the concepts on which RAP is based on.

The Programme officer of the project, who is responsible for backstopping the NMCs/Line agencies in data collection, will also join the training and the RAP exercises. The Programme officer together with the NMCs/Line agencies will be responsible for organizing the required data before the exercise will begin. FAO-RAP will provide a list of the data requirement well in advance to allow the Programme officer and NMCs/Line agencies to gather the relevant documents and data.

National Workshops [31]

To discuss the results of data collection, analysis and RAPs and to introduce the new concepts for assessing irrigation efficiencies, 1-2 days workshops will be organized in each member country after the analysis is completed. Managers from different irrigation schemes will participate in the workshop. The methodology used for the data collection and analysis and the results of the analysis will be presented and discussed during the workshop.

Reviewing project reports, other documents and identifying best practices [32 & 33]

International consultant reviews project reports (including project data analysis, and RAP), other existing documents and relevant information and identifies best practices related to efficient water use and irrigation management. Inputs from FAO headquarters and FAO-RAP are taken into account.

Drafting guidelines [34]

International consultant drafts institutional, managerial and technical guidelines, which aims at improving irrigation efficiency and to enhance multi-function of rice cultivation and paddy field irrigation.

On the occasion of drafting, consultant examines observed and analyzed irrigation efficiency of the pilot project sites obtained through [23] to [26], analyzes relationship between irrigation efficiency and water distribution practices obtained through [26] to [28] and takes that information into account. This activity is also reinforced by inputs from the FAO.

Capacity Requirement Assessment of the line agencies [35]

Capacity building and training requirement of the line agencies are assessed to investigate their ability to effectively use the proposed guidelines. The international consultant will be responsible for this activity.

Regional workshop [36]

The MRCS organizes regional workshop to discuss institutional, managerial and technical guidelines for efficient water use and management. Relevant staff of MRC, NMCs/Line agencies from its member countries and relevant international organization will participate in the workshop.

Consultant presents draft guidelines with their process of drafting and expected benefits.

The MRC invites official(s) from Headquarters and/or FAO-RAP as resource person(s). The FAO official(s) is (are) expected to provide recommendations based on their output of Japanese funded project (ESPIM) and other existing knowledge and experience, etc.

Finalizing guidelines [37]

International consultant finalizes the guidelines, in close cooperation MRCS, taking into account recommendations made at the regional workshop [36].

Annex 2

Backstopping Record

Summary of BTO reports

Note: "by" means O(kudaira Hiroshi), F(ongsamuth Phengphaengsy)

Date	Country				Summary of findings and Outline of backstopping	by
	C	L	T	V		
15 Nov 06		*			<ul style="list-style-type: none"> • Detail irrigation practice confirmed • Bridge construction for flow measurement almost completed • Percolation measurement points fixed • Know-how for measurement and flow rate calculation provided 	O, F
17 Dec 06		*			<ul style="list-style-type: none"> • Marking on the bridge for measurement suggested to be improved • Sharing know-how for observation among the team requested • Date recording sheet suggested to be produced confirmed • Three percolation measurement tanks ready but not installed, quick installation promised • Two staff gauges for percolation in fishpond installed • Evaporation pan and rain gauge installed • Date sheet to record irrigated area distributed to farmers • Observation/Interview to supplement data collection suggested • Document of irrigation practices being collected 	F
8-9 Jan 07			*		<ul style="list-style-type: none"> • Schematic and command area map not completed • Improvement/modification of existing schematic map suggested • Calculation of crop water requirement well prepared • Crop calendar information not collected and requested to start • Irrigated area identification on-going • Lotus farming and fishpond identified/confirmed as multiple use • Conveyance test planned Jan to Feb 2007 • No progress on management practices made and promised to start 	F
16, 19 Jan 07		*			<ul style="list-style-type: none"> • Flow measurement regularly conducted twice a month • Suggestions to improve accuracy provided • Four bridges suggested to raise up elevation avoiding turbulence • All three percolation measurement tanks installed • Measurement being conducted twice a day • Evaporation being recorded • Assign one staff exclusively for accurate reading suggested • Identification of irrigated area waiting for transplanting completed • For vegetable and fishpond, data collection on-going • Method to estimate fishpond water use provided • Assistance to conduct conveyance test promised • Gate calibration at three points agreed to be conducted • Producing maps delayed and emphasized to complete soon • Management practice information being collected, but documentation not started yet 	F
26-29 Jan 07		*			<ul style="list-style-type: none"> • Maps prepared, but requested further improvement • Bridge completed except points without flow in dry season • Measurement points changed/added/deleted based on detail survey • Cross section survey completed • Form for flow rate recording and percolation completed • Canal clearance initiated and being continued • Five percolation tanks ready, installation points fixed and agreed by farmers, installation waiting for broadcasting • Recorder of percolation assigned • Evaporation pans made available and to be installed • Arrangement for rainfall data acquisition made • No action for management practice information made • Further explanation for this work required 	F

Date	Country				Summary of findings and Outline of backstopping	by
	C	L	T	V		
26-28 Feb 07				*	<ul style="list-style-type: none"> Topographic survey postponed until harvesting Maps not produced and to be initiated after topo-survey Two data loggers for water level observation installed Flow measurement for H-Q curve to be conducted in flood season Five sets of 5 staff gauges for percolation installed and farmers assigned to gauge reading Scales suggested to be replaced, because hard to read Percolation measurement not initiated Evaporation rainfall and cropping pattern recording commenced Some Vietnamese information for management practice identified 	O, F
21 Mar 07		*			<ul style="list-style-type: none"> Detail of conveyance test decided Flow measurement being conducted appropriately Percolation measurement also being conducted well even one point stopped because of readiness of harvesting Evaporation/rainfall measurement being continued but suggested slight improvement on gauge reading Planted area information collected, collection of spatial information under way Fishpond water use recording on-going Gate calibration partially conducted 	F
3, 4 Apr 07	*				<ul style="list-style-type: none"> Improvement of two kinds of maps suggested and agreed Enough experience of the observation team for flow measurement confirmed Flow measurement done properly with well-organized data sheet For accurate flow measurement, cleaning up canals, 3 times measurement for one point suggested Percolation, evaporation & rainfall measurement instrument well installed & observers trained Method to identify actual irrigated area discussed and agreed Conveyance loss test not conducted, detail procedure with measurement points discussed and agreed H-Q curve measurement point confirmed, and other points added Data analysis not yet started but promised to do soon Information of management procedures collected but not compiled 	F
10,11 Apr 07			*		<ul style="list-style-type: none"> Maps produced but further improvement requested which includes to translate from Thai to English, to add canal name roads and other information Flow measurement, conveyance loss test, and collection of percolation, rainfall and other meteo-info. properly conducted Information of management procedures not collected yet and this task requested to start soon Outline of interim report presented by MRCS and agreed 	F
22-24 Jun 07	*				<ul style="list-style-type: none"> Outline of interim report supplementary discussed Analysis work delayed and further needs of backstopping for analysis identified Measurement instruments still in good conditions Production data collection demonstrated and agreed 	F
20-22 Jul 07				*	<ul style="list-style-type: none"> Detail discussion on submitted draft interim report conducted based on written comments by MRCS Effort for more accurate data confirmed by field visit, which includes percolation and flow rate 	F

Annex 3
Poster

Improvement of Irrigation Efficiency on Paddy Fields in the Lower Mekong (IIEPF) Project

In 2006 AIFP commenced the IIEPF project which focuses on irrigation efficiency. The project held a two-day inception workshop in May, followed by another four-day workshop providing training on a method to evaluate irrigation scheme performance called the "Rapid Appraisal Procedure (RAP)" in July.

From July to August, AIFP staff working with teams from the member countries conducted initial scheme assessments of four selected schemes by applying RAP. The training workshop and these assessments were supported by two technical staff from the FAO Regional Office for Asia and the Pacific (FAO-RAP) under a collaboration agreement between MRC and FAO-RAP.

Selected pilots projects for IIEPF are Nam Houm in Lao PDR, Huay Luang in Thailand, Komping Pouy in Cambodia and Go Cong in

Viet Nam. The report of the training workshop and initial assessments will be made available this year.

The IIEPF project has now proceeded to its next activity: intensive observation of irrigation water use at four pilot projects, identifying irrigation efficiency and water productivity and aiming to develop specific guidelines for efficient water use. Field observation started (or will start) from the middle of November to January (depending on actual cropping and irrigation practices of the countries) and continue until the end of 2007.

Further information, such as the project outline and the proceedings from the inception workshop, is now available on the MRC website. (<http://www.mrcmekong.org/programmes/AIFP/publications.htm>)



Improvement of Irrigation Efficiency on Paddy Fields in the Lower Mekong (IIEPF) Project

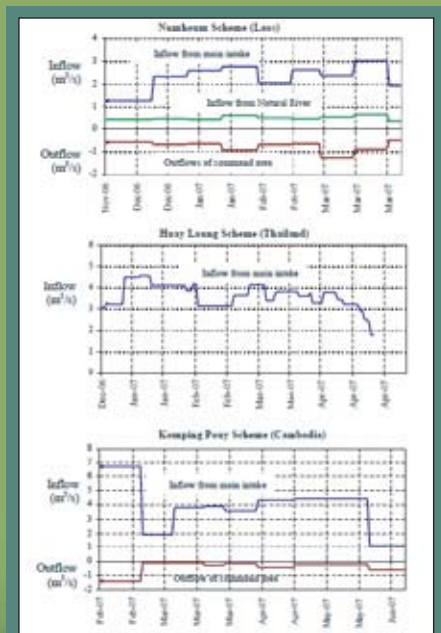
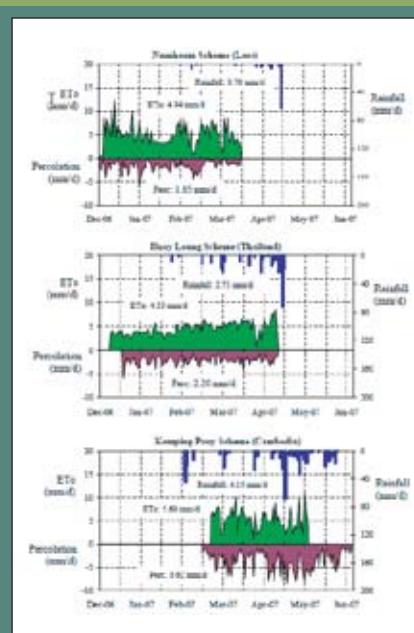
Fig 1. Location Map



The IIEPF project aims to contribute to efficient irrigation water use through providing good institutional, managerial and technical guidance for irrigation facilities operation. In order to achieve this project objective, the IIEPF project is now conducting intensive field observation at four selected pilot irrigation schemes. (Fig 1.)

As shown in Fig 2, the IIEPF project has completed 2006/07 dry season observation and MRCS, in cooperation with line agencies, is now conducting in-depth analysis of water balance, irrigation efficiency and water productivity at command area level. The project plans to publish technical reports in various publications and forums such as the 3rd Southeast Asia Water Forum, and the Paddy and Water Environment Journal among others. These reports will be compiled as a part of the project's outputs.

The figures below show some examples of interesting results achieved so far. Further analysis is now continuing. In parallel, field observation to cover the 2007 rainy season irrigation practices is also under way at the four pilot sites. The final result of two crop seasons' observation will be made available in early 2008.



Flow measurements



Evaporation/Percolation measurement



Evaporation/Percolation measurement



Evaporation/Percolation measurement

The figures above show daily rainfall, evaporation and percolation rate at three pilot sites. Observation reveals that rainfall this dry season has been generally low and only 0.7 mm/day was recorded at Nam Houm in Lao PDR. This information is to be used for field level water balance analysis.

These three figures above show the rate of water flow into and out from the command area of the schemes. This information is to be used to understand scheme-level water management practices and will be key information when proposing ideas to improve water use efficiency.

Fig 2. Detailed work plan



Evaporation/percolation measurement



Rain gauge

	2006		Year 2007													
	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	
Crop calendar and irrigation schedule																
Komping Pouy (Cambodia)																
Nam Houm (Laos)																
Huay Luang (Thailand)																
Go Cong (Vietnam)																

Improvement of Irrigation Efficiency in Paddy Fields of the Lower Mekong (IIEPF) Project

Fig 1 Location



Fig 3 Schematic plan



The IIEPF project contributes to efficient use of irrigation water by providing institutional, managerial and technical guidance. The project conducted intensive field observation at four selected pilot irrigation schemes (Fig 1) and has identified unique water management practices under tidal irrigation in Viet Nam's Mekong Delta.

The Go Cong irrigation project is located about 100 km south west of Ho Chi Minh city along a branch of the Mekong River. Within this 54,000 ha irrigation project, Long Hai area was selected as a pilot site (Fig 2). Long Hai is bordered by a riverbank and ring dyke and connected with the main canal and the river by two sluice gates. Fig 3 shows a schematic plan of this scheme together with elements of water balance analysis.

Fig 2 Aerial photo of Long Hai pilot site



Fig 4 Water balance analysis

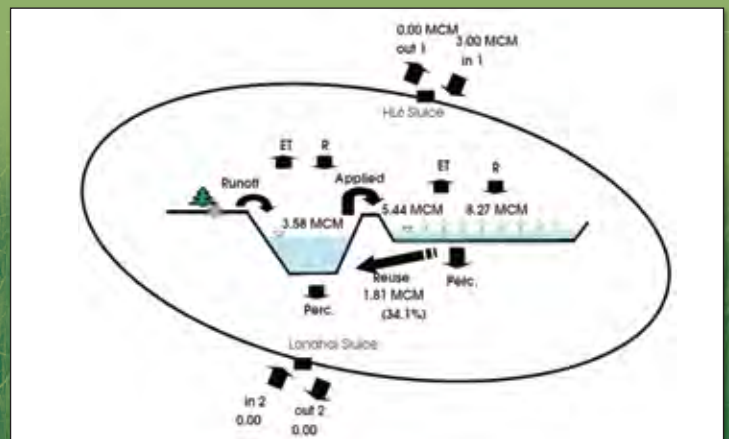


Fig 4 and Table 1 show a brief summary of water balance analysis. Water diverted from the main canal into this closed command area is stored in the inside canals and applied to paddy fields. Part of the applied water returns to the canals and is reused; recycled water accounted for 34% of the water fed to the winter-spring crop in 2006-2007. This practice saves on the amount of water diverted from the main canal. Compared with water diverted to the command area, irrigation efficiency here is estimated at 105%.

Table 1

Water Balance Component	MCM
Crop Water Requirement (CWR)	3.47
Effective Rainfall (ER)	0.29
Irrigation Water Requirement (IWR)	8.27
Actual Water Applied (AWA)	5.44
Available Water in Canal (AWC)	3.58
Reuse Water (return to canal)	1.81

Gate



Individual pump



Canal



Flow measurement



Annex4

External Presentation

IMPROVEMENT OF IRRIGATION EFFICIENCY IN PADDY FIELDS IN THE LOWER MEKONG BASIN PROJECT (IIEPF)

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Abstract

Improving performance of irrigation schemes in the Lower Mekong Basin countries is an obvious issue for agricultural development for the region. Irrigation efficiency, which is an indicator of effective water resources management, of these schemes varies greatly between countries. The project of *Improvement of Irrigation Efficiency in Paddy Fields (IIEPF)* in the Lower Mekong Basin (LMB) considers the current situation and introduces up-to-date concepts in assessing irrigation efficiencies in order to produce guidelines to manage water resources more efficiently, sustainably and productively. The study not only focuses on efficiency, but covers all aspects of scheme improvement with three major objectives: (1) to appraise irrigation efficiencies (2) to enhance the capacity of stakeholders and (3) to produce guidelines for improving irrigation efficiency on paddy fields based on actual water use conditions in the LMB member countries. The project document has been finalized, and field observation and data collection will start from October 2006. Conveyance and overall system irrigation efficiencies will be analyzed, water productivity will be computed, and then recommendations will be made to improve the efficiency of water use. The FAO's Rapid Appraisal Process (RAP) will be applied as a tool to evaluate scheme performance as a part of the project's analysis. A set of guidelines will be produced as a main result of the project and it is expected to provide the managers of the irrigation schemes in the LMB with a framework to improve irrigation efficiencies and water productivity through improved irrigation management.

Keywords: irrigation efficiency, water balance, water distribution, paddy field, water productivity

INTRODUCTION

The Mekong River is one of the biggest international rivers in the Southeast Asia and exhibits high development potential. Water resources are widely used for various sectors including agriculture, which employs 85% of the total population in the Lower Mekong Basin countries, MRC-BDP [1]. Hence, further agricultural development is still required to feed the rapidly growing population of the region. Rice is the dominant crop here and represents the single biggest consumptive user of fresh water in the region. For the further development of water resources and efficient investments in irrigation, it is important to increase the effective use of water in paddy fields.

Lack of rainfall in the dry season and dry spells in the rainy season are, however, among the major constraints to regional rice production, and water productivity in paddy fields remains low. Improving the performance of irrigation schemes in the Lower Mekong Basin (LMB) countries is an obvious issue for agricultural development. Irrigation efficiency, which is an indicator of effective water resources management, of these schemes varies greatly between countries. A particularly concern is water shortage within irrigation scheme command areas, particularly in the dry season or in dry spells during the rainy season.

Improvement of efficiency can improved equity in water distribution and can minimize the gap between potential crop water requirements and actual water use. In consequence, it will lead to the determination of the effectiveness of water use and lead to the improvement the livelihood of people. Farmers can use lesser water or lower input in investment while obtaining higher production and remaining more water in the sources which can maintain the ecological cycle and environment of river basin.

However there are not enough reliable estimates of irrigation efficiencies and actual water use within the region to develop a reliable understanding of efficiency trends. Previous studies that have attempted such estimates have mainly analyzed field level efficiencies and lacked the use of modern and up- to-date concepts of irrigation efficiencies and water balance, FAO [2].

The project of Improvement of Irrigation Efficiency in Paddy Fields in the Lower Mekong Basin (IIEPF) considers the current scheme situation and introduces up-to-date concepts in assessing irrigation efficiencies in order to produce

guidelines to manage water resources efficiently, sustainably and productively. The assessment of irrigation efficiencies alone may not provide insights into how these can be improved. To cover all aspects of scheme improvement, objectives are set as follows:

- 1) to appraise irrigation efficiencies and irrigation systems in the selected pilot sites based on the up-to-date concepts,
- 2) to enhance the capacity of stakeholders in using up-to-date concepts of irrigation efficiency and water balance tools and procedures for their assessment, and
- 3) to produce guidelines for improving irrigation efficiency on paddy fields based on actual water use practices in the LMB member countries.

The main activities to be undertaken are data collection, analysis, consultation with riparian countries, and the establishment of guidelines. The project document has been finalized, and field observation and data collection will start from October 2006.

STUDY AREAS

Four irrigation schemes in LMB countries: Cambodia, Lao PDR, Thailand, and Vietnam were selected as pilot sites. The Huay Luang irrigation project was selected as pilot site in Udon Thani, Thailand, Num Houm irrigation project in Laos, Komping Pouy irrigation project in Cambodia, and Go Cong irrigation project in the Mekong Delta, Vietnam. Most schemes are gravity irrigation system except Go Cong irrigation project in the Mekong delta which is operated and taking water by gates. These schemes were selected as the representation of typical irrigation gravity type, appropriate size of command areas, accessibility, and availability of relevant information.

METHODOLOGY

1. Data Collection

Existing data will be collected including schematic and scale command area maps, information related to water distribution practice, and organizational structures. Inflows and outflows of command areas will be recorded and measured to conduct water balance. Water discharge in the main, secondary, and tertiary canals will be measured to identify flow inside command areas. Other measurements, such as percolation, seepage and water levels in paddy fields and fish ponds will be conducted over the course of a year. Actual irrigated areas and cropping patterns will be recorded every month by water user groups and farmers. Paddy production will be determined by unit harvested and interviews with farmers. Finally, conveyance and irrigation efficiencies will be analyzed, water productivity will be computed, and then recommendations will be made to improve the efficiency of water use.

Field observation and data collection are planned to be conducted one year including dry and wet season in each selected irrigation scheme. The data collection will start from the dry season in the middle of October 2006. The main activities of field observation and data collection include:

- (1) Produce schematic plans of irrigation system and scaled command area map of the irrigation scheme to identify point of flow measurement and indicating capacity and water discharge for all off takes of each canal;
- (2) Identify the actual irrigated area in order to identify gaps between designed and actual areas for computing crop water requirement;
- (3) Record multiple uses of irrigation water such as fishponds and domestic use for considering water use within command areas and will be used to compute total scheme water requirement;
- (4) Record cropping patterns under different crops and crop calendars;
- (5) Record water level changes in paddy field by installing wooden staff gauge in command areas for monitoring percolation in paddy fields;
- (6) Obtain rainfall and evapotranspiration data in the project site or from the nearest meteorological station;
- (7) Collect paddy production (yield) by gathering from Water User Groups and interviewing farmers and also cross check the data with unit harvest method in order to examine water productivity; and
- (8) Record the data of stakeholders for decision making on distribution of irrigation water within schemes and produce organizational charts of stakeholders (irrigation managers, water users, others) involved in the decision making process.

The FAO's Rapid Appraisal Process (RAP) will be applied as a tool to evaluate scheme performance and it is planned to be conducted two times before project starting and after data collection period. Its results will be a part of project's results.

2. Conducting Water Balance

In order to improve irrigation efficiencies it is very important for managers of irrigation schemes to keep track of where the water is going within the gross command area or boundaries of the scheme. Water balance or water accounting could help the managers understand where the water within the command area of the scheme is actually going, which helps in correcting the management strategies. According to IWMI [3], water balance provides information about all inflows and outflows within a defined boundary and also provides different water efficiencies such as conveyance efficiency, delivery efficiency, and application efficiency, while taking into account the multiple uses of water within the scheme.

Figure 1 gives an example of different flows within a defined boundary and potential water use within the boundary which has been developed by IWMI. The inflows are divided into many uses within the command areas before drain out of the system.

Figure 2 shows the component of flows of water balance which was developed by Facon et al. [4]. The boundary is set in 3 dimensions and the component of flows includes:

- Surface inflow and lateral inflow into the system and diversions within the system
- Groundwater use within the scheme
- Recirculation and reuse of the drainage water
- Crop water requirement within the scheme
- Water requirement by the other uses of water
- Rainfall within the command area of the scheme and potential evapotranspiration (ET_o)

Since the lateral ground water inflow and outflow are difficult to monitor in practical, a simple water balance concept shown in Figure 3 was developed and applied for the IIEPF project in consultation with FAO. Inflow into command areas and outflow of command areas will be measured. The inflow includes water diverted to command areas, precipitation, natural flow entering into command areas, ground water circulated within and delivered from outside of command areas. Outflow of command areas like evapotranspiration, committed water and drain out water will be also measured and recorded.

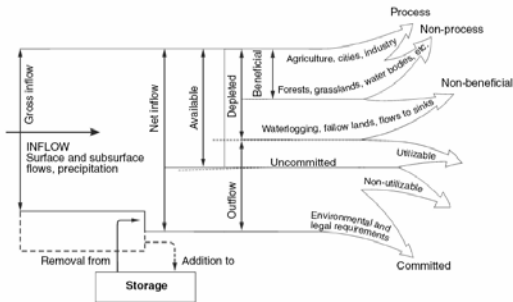


Figure 1: Water balance concept by IWMI

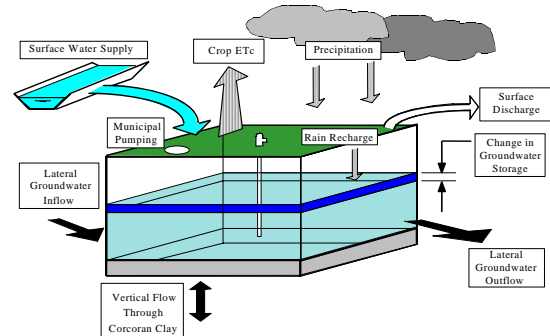


Figure 2: Water balance concept by FAO

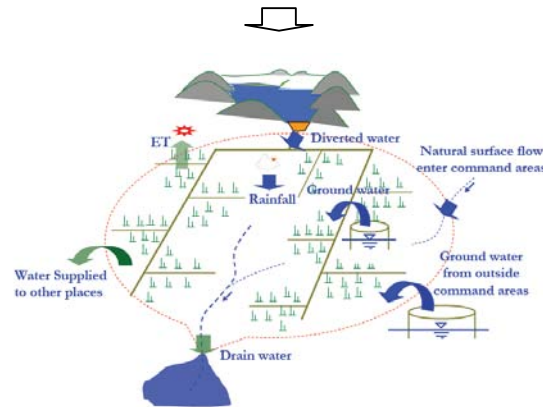


Figure 3: Water balance concept applied for IIEPF project

This approach to assess efficiencies is different from the classical approach in the sense that this considers water as “loss” only when it is not used for beneficial evapotranspiration or it flows to the sink and could not be of any use even to the sink.

According to Figure 3, water balance for IIEPF project is defined as follows

$$AWS = (P+DIV+CS)-(ET+N+C)$$

Where

- AWS = Available water supply within command areas
- P = Total precipitation
- DIV = Diversions or surface inflows from irrigation canal and natural flows into the command areas
- CS = Changes in storage or recharge of water within and outside command areas
- ET = Evapotranspiration
- N = Non- utilizable water supply (drain water or flood water to sinks)
- C = Committed flows to the other areas, for example legally or conventionally committed outflows from command areas to outside command areas

3. Total Scheme Water Requirement

Total scheme water requirement considers multiple uses of water within command areas such as water use for paddy, non-paddy crops and water use for fish pond. The total scheme water requirement will be calculated based on consultation with the FAO as follows.

$$\text{Total scheme water requirement} = \text{Paddy crop water requirement} + \text{non-paddy crop water requirement} + \text{fish pond water requirement}$$

Note that for practical reasons, water requirements for paddy and fishponds both consider percolation. For non-paddy crops, percolation will be assumed to be minor and will be neglected.

4. Conveyance Efficiency

An estimate of the amount of water that is “lost” or mismanaged in the conveyance system is required for effective management decisions and equitable water distribution. Thus it is important to know where the water is going within the conveyance system. Conveyance loss tests will be conducted using long reaches at three levels of canals: main, second and tertiary canals and can be computed from Wahaj [5].

$$\text{Conveyance Loss} = Q_{in} - Q_{out} \quad \text{and} \quad Q_{out} = \sum_1^n q_n + Q_{outflow}$$

$$\text{Conveyance Efficiency} = \frac{\sum_1^n q_n + Q_{outflow}}{Q_{in}}$$

Where

- Q_{in} = Diverted water into canal where conducting conveyance test
- $Q_{outflow}$ = Water flowing out of the canal section on which conveyance losses tests are conducted
- q_n = Water diversions out from offtake along canals

5. Overall Project Command Area Efficiency

With the concept of water balance, inflow and outflow are computed and once conveyance efficiency is calculated, overall project command areas efficiency will be computed as follows.

$$\text{Overall Project Command Area Efficiency} = \frac{\text{Total scheme water requirement} - \text{Effective rainfall}}{\text{Total water delivered to users}} \times 100$$

$$\text{Total water delivery to users} = (\text{Total inflow}) * (\text{Conveyance efficiency}) - (\text{Committed flows downstream}) - (\text{Flows to sink or Drain out})$$

Committed flows are considered if the conveyance network of the selected irrigation scheme is transporting water to downstream of the irrigation scheme command area.

6. Water Productivity

According to Burt and Styles [6], water productivity can be assessed as yield per unit of water diverted and yield per water consumption. Paddy yield will be collected from each Water User Group (WUG), interviewing farmers and cross check with unit harvested method. Water diverted and water consumption values are obtained by conducting water balance.

$$\text{Water Productivity for system} = \frac{\text{Paddy Yield}}{\text{Water Diverted}}$$

$$\text{Water Productivity for command areas} = \frac{\text{Paddy Yield}}{\text{Water Consumption}}$$

7. Scheme Management Appraisal

The assessment of irrigation efficiencies alone may not provide insights into how the performance of irrigation schemes can be improved. To cover all aspects of scheme improvement, it is intended to identify management aspect by the following steps.

- Identify stakeholders for decision making on distribution of irrigation water within the scheme in order to understand different processes of scheme management and later for implementation of improvement plans
- Examine the organizational structures of stakeholders (irrigation managers, water users, others) involved in the decision making of the scheme management including structure of identified stakeholders' formal or informal organizations, for example Project authority, Water Users Association, etc. which will help to identify the right level for intervention in terms of capacity development and implementation of improvement plans.
- Examine procedure of water allocation such as water ordering by farmers and water supplying by the project level, and also identifying the rules or regulations regarding water allocation for different users within the irrigation scheme. These rules, formal or informal, will provide the basis for water distribution practices, and thus to a certain extent, influences irrigation efficiencies. The official rules and actual procedures followed by the project authorities to allocate water will be documented as part of the data collection work. The main questions that need to be identified for these issues are:
 - What are the official water distribution rules used in the project?
 - What are the actual water distribution practices in the project?
 - What are the official rules and procedures to operate irrigation facilities?
 - What are the actual operation and procedures to operate irrigation facilities?
 - What criteria are used by the project authorities to allocate water to different uses/ users? (for example to paddy fields versus other crops, versus fishpond)
 - Do project authorities allocate water differently to different parts of the command area (for example along the head reaches and the tail reaches)?
 - Is the criteria used by the project authorities in practice different from the official criteria (or official rules)? If yes then what are the difference between the criteria practically used and officially adopted for water allocation?
 - Is water allocated differently over time (for example in dry and wet seasons or within the wet season when there is not enough water available)?

8. Rapid Appraisal Process (RAP)

The Rapid Appraisal Process (RAP) was jointly developed by the Irrigation Training and Research Centre (ITRC) of California Polytechnic University and Food and Agriculture Organization (FAO) in the late 90's and since then has been successfully used by FAO and the World Bank in various Asian countries to appraise several irrigation projects. The methodology uses modern concepts of canal operation and water use efficiencies and is based on the understanding that the irrigation systems are operated under a set of physical and institutional constraints and with a certain resource base. Key performance indicators from RAP help to organize perceptions and facts, hence they facilitate informed decisions regarding the potential for water conservation within a project, specific weakness in project operation, management, resources, and hardware, and specific modernization actions that can be taken to improve project performance. The RAP also provides initial indicators that could be used as benchmarks to compare the improvements in the performance of the system once the modernization plans are implemented. A good assessment of the current

situation gives a clear idea on where situation must be improved and helps in prioritizing the areas for improvements. The RAP could also be used to compare the performance of the different projects.

RAP is applied as an assessment tool for IIEPF projects to evaluate system performance. It is conducted in each selected irrigation scheme twice during the project's life: once at the beginning of the project, before the field data measurement starts, and second time when field data measurement ends. The monitoring data for one year round will be used to fill the missing values when RAP is conducted for the first time. Training is provided to the team of each member country regarding techniques for conducting RAP with instructions and consultations of senior water management officers from FAO under cooperation between MRC and FAO. The results of internal and external indicators of RAP will provide useful information for IIEPF including

- Water allocation and distribution practices,
- Operation rules and procedures,
- Irrigation efficiencies (conveyance, field, overall project efficiencies),
- Water productivities,
- Project cost recovery,
- Physical infrastructure (hardware) of the system, and
- Involvement of water users in the decision making process (stakeholders involvement).

9. Establishment of Guidelines

A set of proposed guidelines will be established in close collaboration with and input from FAO and it expected to include three main parts: introduction, assessment, and improvement. It will be produced based on the main analysis result obtained and consultation with riparian countries regarding the actual situation and constraint. The establishment of guideline is expected to follow the following procedures:

- Review of existing document
- Identifying best practice
- Capacity development requirement assessment of the managers in order to be able to use the guidelines
- Draft institutional, managerial and technical guidelines
- Discussion of draft guidelines at regional workshop
- Finalization of guidelines

EXPECTED MAJOR OUTPUT

The guidelines will be produced as a main output of the project. A set of guidelines is expected to provide the managers of the irrigation schemes in the Lower Mekong Basin countries with a framework to improve irrigation efficiencies and water productivity through improved irrigation management. The guidelines will be a reference for the scheme manager to operate their scheme more appropriately and use water more effectively. The recommendations will be proposed to improve system management based on analysis data and information obtained.


ACKNOWLEDGEMENTS

The IIEPF project has been supported by Ministry of Agriculture, Forestry and Fishery, Japan and implemented by the Agriculture, Irrigation and Forestry Program (AIFP), Operations Division (OPD), MRC.

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MRC's activities on irrigation water use

Okudaira Hiroshi
AIFP, MRCS

1

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Agriculture in the region


	Cambodia	Laos	Thailand	Vietnam
GDP Share	37%	47%	18%	23%
Export Share	5%	6%	22%	24%

- Agriculture, now Dominant sector in the region

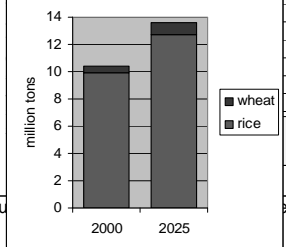
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Increasing demand in LMB

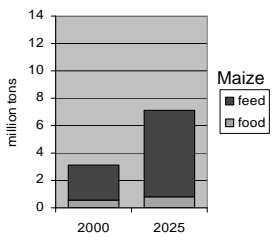


Population (millions)



2000 2025

million tons



2000 2025


Source: FAO AQUASTAT & IWMI WATER-SIM simulation

- Agriculture, in the future, still needs to meet growing demand


3

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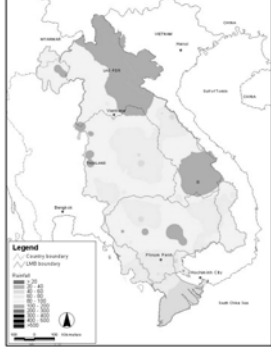
Rice planted area & Rainfall



Rice Planted Areas in April




Rainfall in April



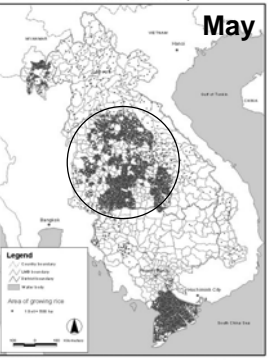
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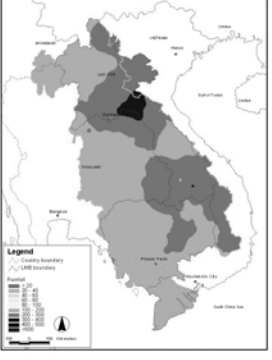
Rice planted area & Rainfall



Rice Planted Areas in May




Rainfall in May



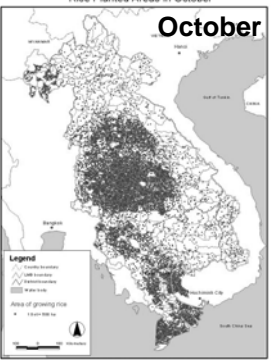
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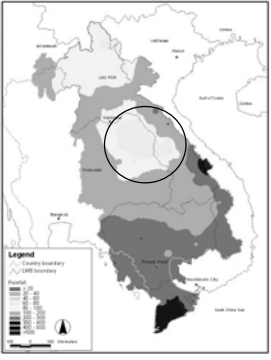
Rice planted area & Rainfall



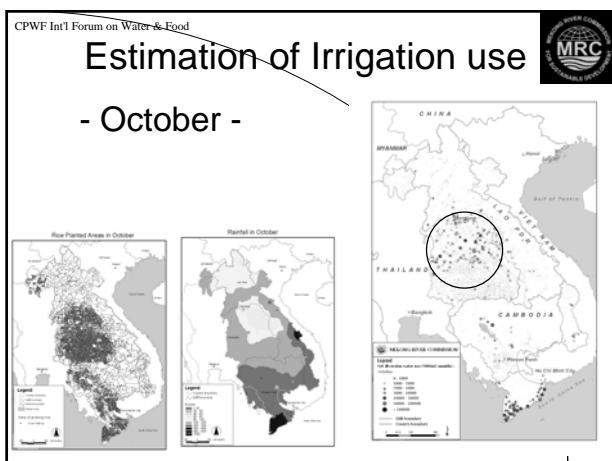
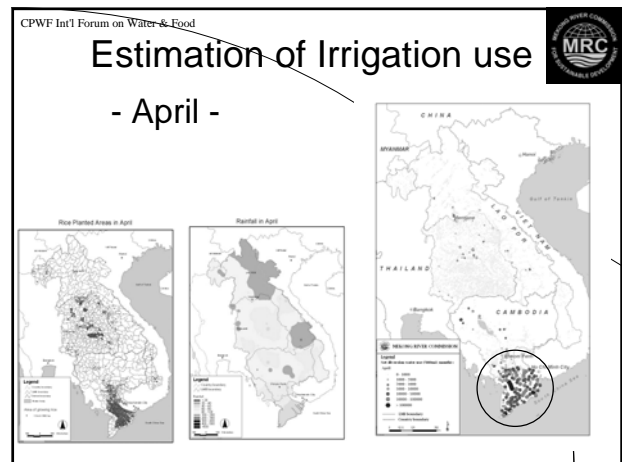
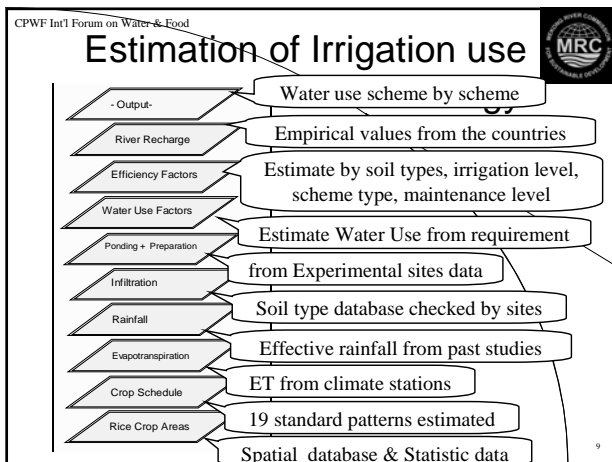
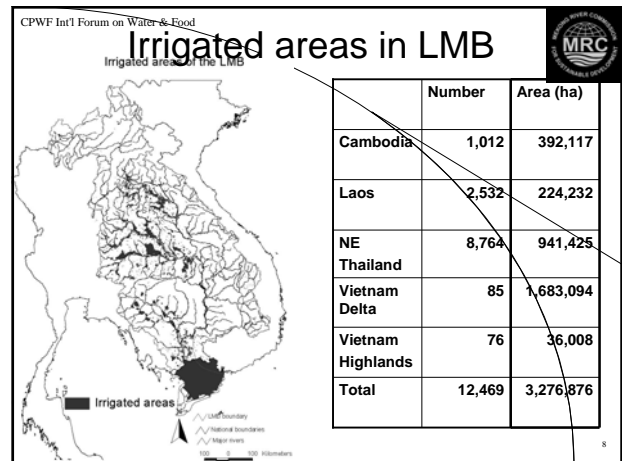
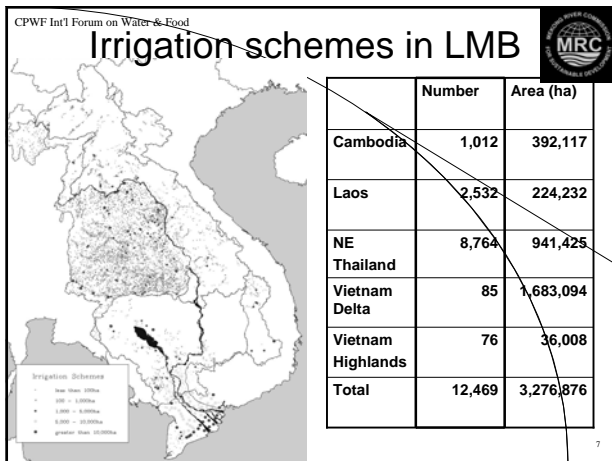
Rice Planted Areas in October



Rainfall in October



6



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Estimation of Irrigation use

Annual water use (billion m ³)	
Cambodia	2.7
Laos	3.0
NE Thailand	9.4
Vietnam Delta	26.3
Vietnam Highlands	0.5
LMB total	41.8

● 8.8% of annual discharge (475 bill. m³)

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Estimation of Irrigation use

- Constraint & Recommendations -

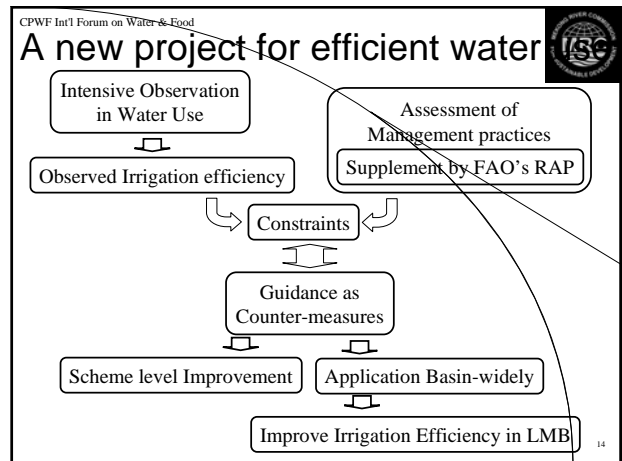
Based on assumptions & estimations

- Accuracy is not so high
- Data quality improvement recommended

Specifically

- Detail monitoring as samples
- Soil, Infiltration, fish pond data improvement
- Water use analysis at selected schemes
- Upgrading scheme database

13



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Pilot sites

15

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Time Frame

	2005		2006		2007				2008	
	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Preparation stage	█		█							
Regional Workshop	█		█						█	
Scheme Appraisal			█						█	
Site selection			█							
Field observation					█					
Data analysis					█		█		█	
Review documents					█		█		█	
Drafting guidelines									█	
Finalizing									█	

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for more Info.

Project brochure available at MRC booth & MRC Web site

<http://www.mrcmekong.org/programmes/AIFP/publications.htm>

17

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Thank you very much for your attention

18

Irrigation Efficiencies and Water Productivity in Paddy Fields in the Lower Mekong River Basin: Application of a Water Balance Approach at Irrigation Scheme Level

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Abstract

Improving irrigation performance is a crucial issue for agriculture and irrigation development in the Lower Mekong River Basin to secure food production for people's livelihoods. Irrigation efficiency is the most important indicator to determine an irrigation scheme's performance. This study looks at water management practices and irrigation efficiency in three pilot sites in the Lower Mekong River Basin: the Numhoum scheme in Laos, the Huay Luang scheme in Thailand, and the Komping Pouy scheme in Cambodia. Irrigation efficiency and water productivity were analyzed using a water balance approach at the irrigation scheme level and results in the pilot areas show efficiencies that are definitely higher using this approach than by using the classical concept. Lower water productivity was observed at pilot schemes in areas of single cropping and higher productivity in areas where multiple agriculture activities were practiced. Strict and active water management is required to control and save water to meet agricultural demand and have sufficient water to expand cultivation areas while avoiding shortages. Promoting multiple uses of water for various agriculture activities in command area will increase water productivity.

Keywords: *irrigation efficiency, water balance, water distribution, paddy field, water productivity.*

1. Introduction

Within the Lower Mekong River Basin (LMB), agriculture is one of the largest users of water resources. The agriculture sector employs more than 80% of the population in the LMB countries (MRC, 2003) and further agricultural development is required to feed a rapidly growing population. Rice production is the single largest consumptive use of fresh water in the region.

Lack of rainfall in the dry season and low water productivity in the region are major constraints to increased rice production. Improving the performance of irrigation schemes would help farmers increase production. There is potential to expand irrigation in the LMB, but investment to upgrade existing irrigation systems, improve irrigation efficiency and water productivity is also needed.

Irrigation efficiency is an indicator of effective water resource management and this varies greatly in the LMB. It is generally low. Improving water distribution will help farmers use less water to obtain increased yields while leaving more water in the ecology and environment of the river basin, resulting in improved livelihoods in the region.

There are few reliable calculations of regional irrigation efficiencies so it is difficult to appraise efficiency trends. Previous studies conducted in the region assessed irrigation efficiency using the classical approach (Anougounamphai *et al.*, 1981; Bos and Nugteren, 1990; Thong-aram, 1995; Thanasak, 1997; Vudhivanich *et al.*, 2002; Higuchi *et al.*, 2004; Yoshida *et al.*, 2004). These studies, in the main, analyzed field level efficiencies but did not apply the water balance concept.

To help further the understanding of irrigation in the LMB, this study used the water balance approach to assess irrigation efficiency and water productivity in paddy fields, vegetable cultivation, and fish farming. A water balance analysis identifies inflows and outflows to determine the available water supply and delivered to the fields within a command area. Overall water productivity includes the total economic value per unit of irrigation water consumed.

2. Study areas

Gravity irrigation is commonly practiced in the LMB and three gravity irrigation schemes with reservoirs were selected for this study: the Numhoum scheme (Laos), Huay Luang scheme¹ (Thailand), and Komping Pouy scheme (Cambodia). Figure 1 shows their locations.

¹ The Huay Luang site is comprised of two sections of main canal and this study collected data at the left main canal only.

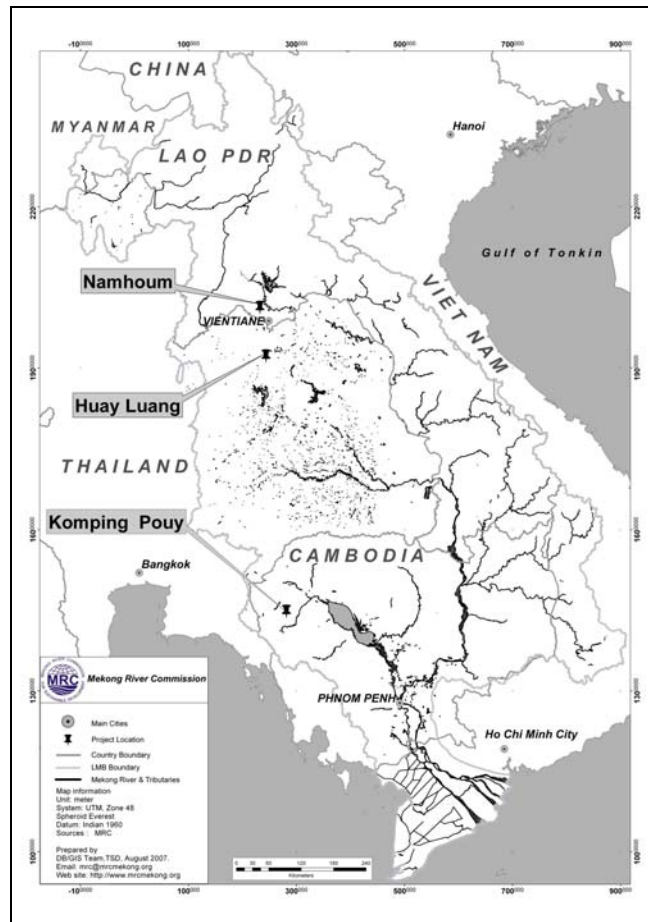


Figure 1: Location of pilot schemes

3. Methodology

3.1 Data collection

Data collection took place during one seasonal crop in the dry season period from October 2006 to the beginning of March 2007. Crop schedules varied in each scheme as shown in Figure 2. Existing information on water distribution practices in the project sites was reviewed. The ETo, ETc, rainfall, and percolation were measured on site on a daily basis by Lysimeter and simple rain gauge. The measurement of the irrigation water flow in the canal system and natural streams entering in and draining of the command areas were conducted twice a week. Cropping pattern and planted area was recorded every week and cross checked with data recorded by GPS to identify the boundary of the command area. Crop yield and prices were collected for all agriculture activities; mainly paddy, vegetables, and aquaculture which are practiced within the command area.

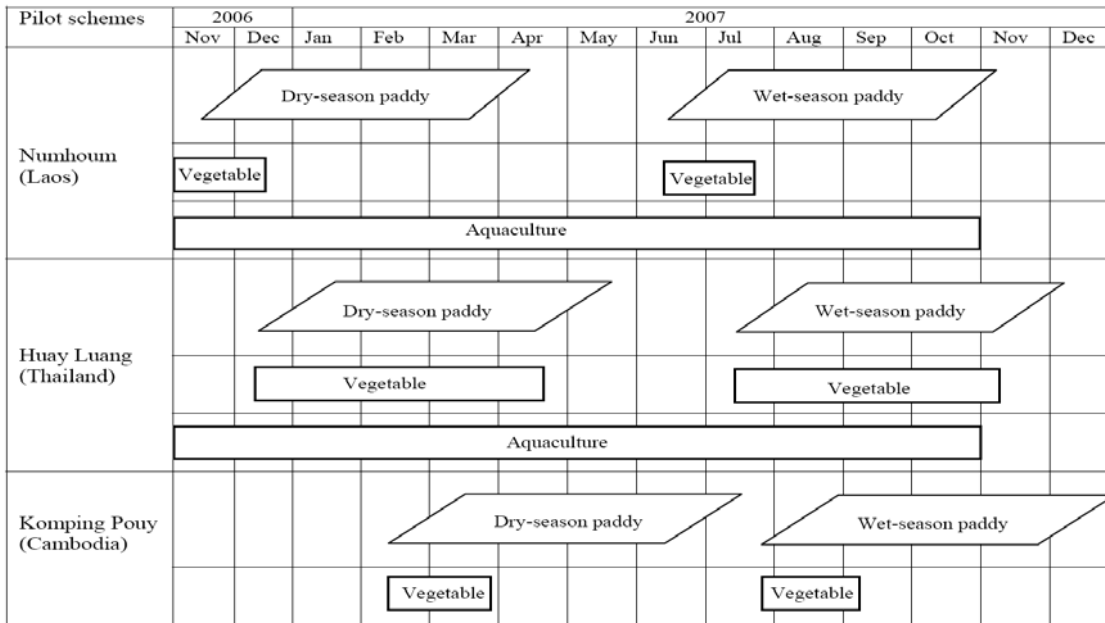


Figure 2: Crop schedule in pilot schemes

3.2 Water requirement

Because various agriculture activities are practiced in the pilot sites, the water requirement (WR in mm/d) for each agricultural practice is defined as follows (Smith, 1992; Allen, 1998).

Water requirement for paddy crops,

$$WR_p = ET_0 \times k_c + P + LP \quad (1)$$

Water requirement for non-paddy crops,

$$WR_n = ET_0 \times k_c \quad (2)$$

Water requirement for fishponds and lotus farming,

$$WR_f = ET_0 \times k_c + P \quad (3)$$

Where

ET_0 : Potential or reference evapo-transpiration in mm/d

K_c : Crop coefficient (dimensionless)

LP : Land preparation in mm/d

P : Percolation in mm/d

The water requirements for paddy, lotus, and fishponds consider percolation. For non-paddy crops, percolation is assumed to be minor and neglectable. The ET_c ($ET_0 \times K_c$) of paddy was obtained by direct measurement in the paddy field, while K_c of non-paddy crops came from FAO publications (Allen *et al.*, 1998). The standard values of 1 for fishponds and 1.2 for lotus farms are used for the water requirement calculation. For land preparation, the stand value of 3.89 mm/d for 28 days was applied in the Numhoun scheme and 6.67 mm/d for 30 days in the Huay Luang scheme (Thong-aram, 1995). In the Komping Pouy scheme, the value of 5.60 mm/d for 30 days was applied (Hara, 2001).

The total water requirement (SWR in m³) is calculated based on the requirements for multiple uses of all agricultural activities within command area including paddy and non-paddy crops, lotus farming, and fishponds as follows.

$$SWR = \sum_{i=1}^n \int_{j=1}^m WR_{ji} \times A_{ji} \quad (4)$$

Where

- i : Type of agricultural activity (e.g. paddy, non-paddy, fish farming)
- j : Day
- m : Number of days
- n : Number of agricultural activities practiced within command area
- WR_{ji} : Water requirement (mm/day x 10⁻³) of crop type (i) at the day (j)
- A_{ji} : Actual cultivated area (m²) of crop type (i) at the day (j)

3.3 Water balance at irrigation scheme level

To ensure effective water management, it is necessary to establish where the water is going within the scheme boundary. The water balance concept provides information on all inflows and outflows in a command area and also determines the water delivery destinations, while taking into account the multiple uses of water within the command area. There were studies supporting a water balance and water accounting concept in assessing irrigation efficiency and water productivity (Molden, 1997; DNRM, 2001; Seckler *et al.*, 2003). Figure 3 shows the water balance components in an irrigation scheme.

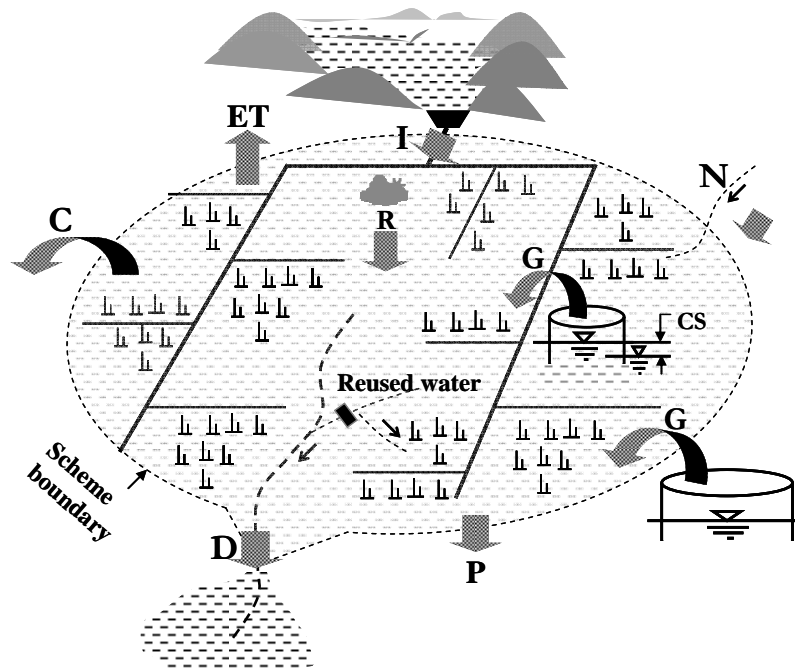


Figure 3: Water balance component

From Figure 3, water balance is defined as follows.

$$AWS = (R + I + N + G - CS) - (ET + P + D + C) \quad (5)$$

Where

- AWS : Available water supply within command area (m³)
- R : Rainfall (m³)

- I : Intake from main canal (m³)
- N : Natural flow entering command area (m³)
- G : Deep ground water from inside and outside command into the command area (m³)
- CS : Changes in storage or recharge of percolation and ground water use (m³)
- ET : Evapo-transpiration (m³)
- P : Percolation (m³)
- D : Drain water to sinks outside and without reuse or non-utilizable water supplies (m³)
- C : Committed flows to the other areas, for example legally or conventionally committed outflows from command areas to outside (m³)

The changes of storage (CS) and ground water inflows (G) are not considered in the analysis because no significant ground water is used in the pilot schemes.

3.4 Overall command area efficiency

With the concept of water balance, inflow and outflow are computed and once conveyance efficiency is calculated, overall project command area efficiency is then computed as follows.

$$E_{overall} = \frac{SWR - ER}{WDF} \times 100 \quad (6)$$

Where

- SWR : Total scheme water requirement (m³)
- ER : Effective rainfall (m³) which is calculated using FAO formulas (Thong-aram, 1995) as follows.

$$ER = \sum_{i=1}^n [10 \times A_i \times (1 - 0.006 R_i) R_i] \quad (7)$$

Where

- i : Day
- n : Number of days
- A_i : Actual cultivated area (ha) on data collection day (i)
- R_i : Rainfall (mm) data collection day (i)

WDF : Total water delivered to the fields (m³) which is defined as followed

$$WDF = (I \times E_c + N) - (D + C) \quad (8)$$

Where

- I : Total diversions or surface inflows from irrigation canal into the command area (m³)
- E_c : Conveyance efficiency (%) in equation (9)
- N : Total natural flows entering command area (m³)
- D : Drain water to sinks outside and without reuse or non-utilizable water supplies (m³)
- C : Committed flows to other areas (e.g. legally or conventionally committed outflows from command areas to outside (m³))

Committed flows are considered in cases where an irrigation network transports water downstream through a command area. There are no committed flows in the pilot sites.

3.5 Conveyance efficiency

Calculating the volume of lost or mismanaged water is necessary for improved water management and for securing proper water delivery to the users.

The conveyance efficiency (E_c in %) is an indicator of this effectiveness and is determined as follows.

$$E_c = \frac{\sum_{i=1}^n Q_{out}}{\sum_{i=1}^n Q_{in}} \times 100 \quad (9)$$

Where

- i : Inlet and outlet of the canals
- n : Number of inlets and outlets of the canal when conducting conveyance loss test
- Q_{out} : Water flowing out of the canal section (m^3/s)
- Q_{in} : Diverted water into canal (m^3/s)

The conveyance test was conducted using long distances at three canal levels (main, second and tertiary) by measuring all inflows and outflows at each canal level from the beginning to the end of the irrigation period. Two or three second-level canals, tertiary canals, and farm ditches were selected as representative for the schemes.

3.6 Water productivity

Greater production with the same volume of water is the primary objective² of irrigation water management. Water productivity is one of the significant values to determine that water is used efficiency. There are several definitions to calculate water productivity, but in this study, water productivity (WP) is defined (in USD/ m^3) as the economic value of all agriculture activities per one unit of available water supply within a command area (Burt, 2002) and calculated as follows.

$$WP = \frac{\text{Value of total output (USD)}}{AWS(m^3)} \quad (10)$$

Where

- Value of total output : The total production value in the command areas calculated as USD
- AWS : Available water supply (m^3) in equation (5)

4. Results and Discussions

4.1 Observed data

Figure 4 (a) shows the results of observed field data during one dry season crop in the Numhoum, Huay Luang, and Komping Pouy schemes. The data observed include daily rainfall, evapo-transpiration, and percolation rate in mm per day.

Rainfall: Rainfall during the dry season is generally low at the pilot schemes with averages of only 0.7 mm/d in the Numhoum scheme, 2.73 mm/d in Huay Luang, and 4.15 mm/d in Komping Pouy. Higher rainfall was observed in the scheme located at the lower area of the basin (Komping Pouy) and the lowest rainfall was recorded in the Numhoum scheme located at the most upstream of the pilot areas. The peak rainfall period during dry season occurs between April and May.

ETc: Evapo-transpiration (ETc) was observed during different periods in the pilot schemes depending on their cropping patterns. The daily average ETc observed in the Numhoum scheme was 3.22 mm/d which is relatively low compared to the standard value (6.97 mm/d) used by many irrigation water management schemes in the Vientiane Plain. This value (6.97 mm/d) is used in Nongkai province of Thailand and there is no specific experiment determining the ETc for Laos. The highest value of ETc recorded was 4.7 mm/d in the middle of February to early March. This value is significantly lower compared to Thailand and Cambodia. In the Huay Luang scheme, the ETc was 5.03 mm/d which is highest among the three pilot sites. The variation of ETc through the crop season is rather clear between the initial and development periods. The recorded ETc is under 5 mm/d mainly from January to February and above 5 mm/d February to March. The average value

² The phrase – More Crop per Drop – is often used to describe this objective.

of 5.03 mm/d seems reliable compared with the values being used in Northeast Thailand with 5 to 9 mm/d in dry season and 4 to 7 mm/d in wet season (Thong-aram, 1995). The highest percolation value was observed in Cambodia. The high ET_c (higher than 5 mm/d) occurs mainly in March and April when the hottest period in the dry season. The daily average of ET_c is recorded as 4.76 mm/d which is similar to the value (5mm/d) being used by project site.

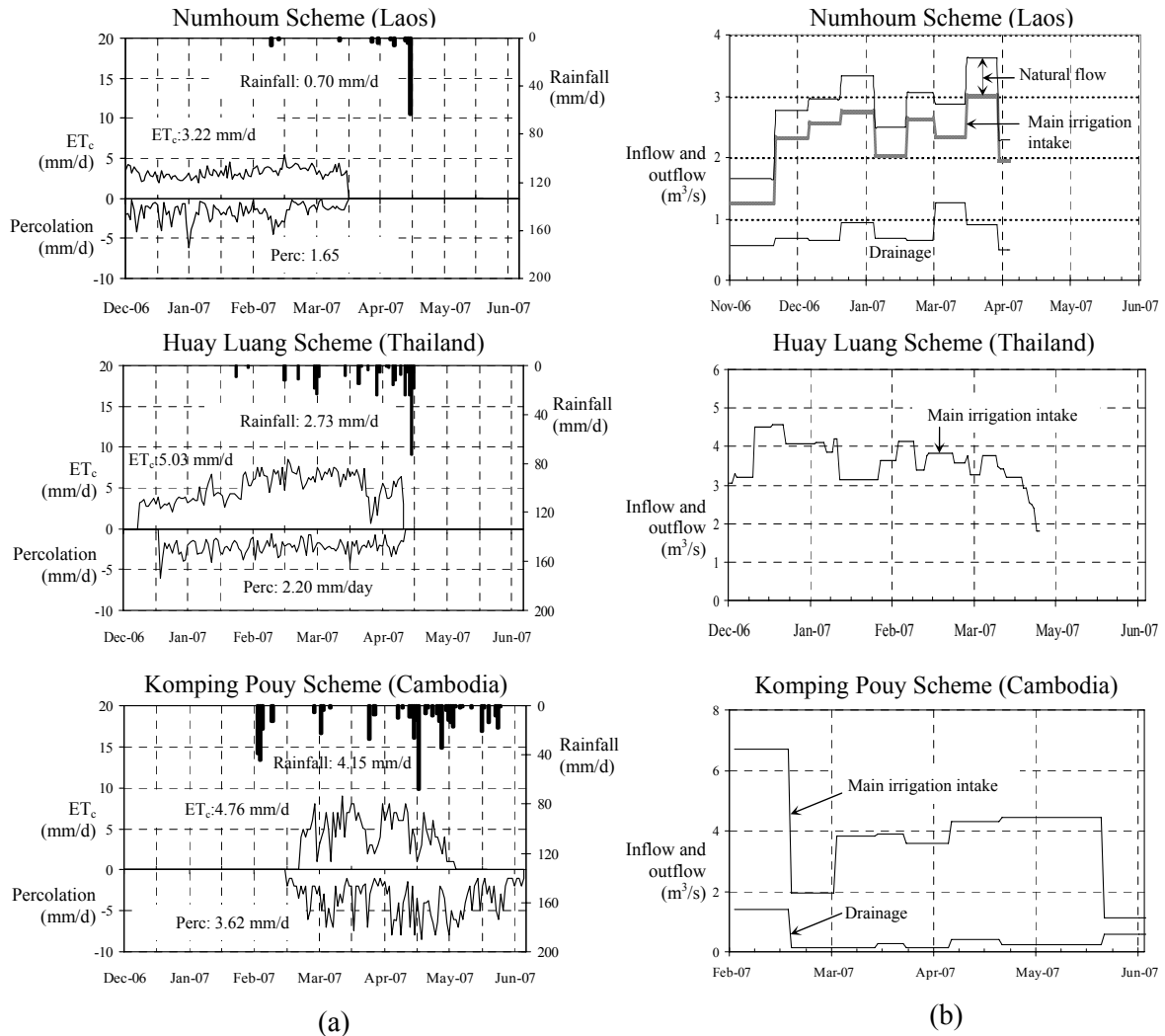


Figure 4: Data observed in the fields

Percolation: Percolation rates were recorded near the same time as ET_c . The same as the ET_c values, the percolation rate is low in Numhoum with an average of 1.65 mm/d. The highest value observed was January and middle of February with more than 3 mm/d and the lowest value is observed at the late stage of the crop season. Percolation in the Huay Luang scheme seems constant through the whole season, except at the beginning which averaged 2.2 mm/d. The observed data is slightly higher than the standard value (2 mm/d) in Northeast Thailand which is determined by the Royal Irrigation and Department (RID) of Thailand.

The highest percolation rate among the pilot schemes was recorded in Komping Pouy with an average of 3.62 mm/d for whole dry season crop. The rate fluctuates through the crop season

reaching 6 to 7 mm/d at the peak time in the middle of April, but lower than 2 mm/d from the middle of March to the end of April.

Surface inflows and outflows: Figure 4 (b) presents daily surface inflows and outflows of scheme boundaries. In the Numhoum scheme, the lowest water supply was at the initial cultivation stage, nursery, and land preparation periods. The water supply steadily increased after transplanting (December to the middle of January). It declined between the middle of January to March when farmers apply fertilizer. The peak rate of 3 m³/s occurs in the middle of March at the crop flowering stage. The total surface inflows of this scheme (Table 1) are 31.56 MCM which accounts for 82.95% from main canal intake, while 16.98% comes from natural rivers, and only 0.05% from precipitation. The total outflows are 16.47 MCM of which more than 50% is outflow flow from drainage canals. It is observed that the trend of surface outflow changes in accordance with inflows from the main canal from the beginning to the middle of February; that is, the more irrigation water supplied, the more water is drained out. It is important to save irrigation water from the reservoir by observing the peak outflow occurring in the middle of February. The significant difference between water demand and supply during this period is important data observed which can help to improve water management.

In the Huay Luang scheme, the inflow was considered only at the main intake by the irrigation canal while natural streams were not counted because these are not used for irrigation water within the command area. There is no drainage canal since the end spill points of canals are designed connecting to the paddy field. Therefore, outflows are also not considered and are assumed to equal the natural river inflows. The peak water supply of 4.6 m³/s was observed in January during land preparation and the minimum supply of 3.1 m³/s occurred in February. The water supply begins to decline at the end of the cultivation period when the harvested stage starts. The total inflows given in Table 1 are 48 MCM, around 80% is from main intake, and the remainder is from rainfall.

In the Komping Pouy scheme, the inflows were observed at both canals and natural streams. However, the streams were dry because of the limited rainfall in dry season. The inflow from stream lines will be calculated later during wet season observation. Only inflows from the main canal are counted in this calculation. As shown in Figure 4(b), the project takes water as a peak rate of nearly 7 m³/s at the beginning during land preparation period while the peak drain also occurred in the same period. The project takes minimum water in February with only 2 m³/s. The total inflows are calculated as 50.94 MCM, mainly from main canal. The total outflows in Table 1 are 20.99 MCM with a large proportion caused by ET. The surface outflow is largely dependant on irrigation water. Large volumes of irrigation water is unused and drained out at the beginning. To save water, the project staff should reduce water supplied in this period.

4.2 Water balance

Table 1 summarizes components of all inflows and outflows. The inflows are mainly from irrigation canals, with only small contributions from rainfall (e.g. 0.05% for the Numhoum scheme, 20.40% for Huay Luang, and 13.13 % for Komping Pouy). There is no inflow from natural rivers except in the Numhoum scheme with approximately 17% of total inflows. The large proportion of outflows occurs by drainage at Numhoum, while it is largely caused by ET at the Huay Luang and the Komping Pouy schemes. Less occurs through deep percolation with 17% of total inflows in the Numhoum scheme, 27% in Huay Luang, and 32 % in the Komping Pouy schemes.

Table 1 also reports the available water supply within the command area - 15.08 MCM, 28.30 MCM, and 29.96 MCM for the Numhoum, Huay Luang, and Komping Pouy schemes respectively. These volumes are used to calculate water productivity. With unit of available water supply, the Numhoum and the Huay Luang schemes are similar at 74.89 m³/ha/day and 77.63 m³/ha/day. These schemes use intensive water management to allocate sufficient water through whole command area. The Komping Pouy scheme, however, is more than double at 156.26 m³/ha/day.

Figure 4(b) shows that nearly 7 m³/s is supplied at the peak time in February while 3 m³/s in the Numhoum scheme although with similar size of the command area.

Table1: Water balance components

Water balance in the scheme level	Pilot schemes		
	Numhoum	Huay Luang	Komping Pouy
Precipitation, ΣR (MCM)	0.02 (0.07%)	9.79 (20.40)	6.69 (13.13%)
Inflow			
Intake from main canal, ΣI (MCM)	26.18 (82.95%)	38.21 (79.60%)	44.25 (86.87%)
Natural rivers, ΣN (MCM)	5.36 (16.98%)	0.00 (0.00%)	0.00 (0.00%)
Total inflow	31.56	48.00	50.94
ΣET (MCM)	4.90 (29.75%)	14.33 (72.74%)	9.31 (44.36%)
Outflow			
Percolation, ΣP (MCM)	2.74 (16.64%)	5.37 (27.26%)	6.78 (32.30%)
Drainage, ΣD (MCM)	8.83 (53.61%)	0.00 (0.00%)	4.90 (23.34%)
Committed flow, ΣC (MCM)	0.00 (0.00%)	0.00 (0.00%)	0.00 (0.00%)
Total outflow	16.47	19.70	20.99
Available water supply, AWS (MCM)	15.08	28.30	29.96
Irrigation days (days)	132	122	132
Actual planted area (ha)	1,525.49	2,987.84	1,452.50
Unit available water supply (m³ /ha/day)	74.89	77.63	156.26

4.3 Conveyance efficiency

Table 2 provides the results of conveyance efficiency in the three pilot schemes which was conducted by recording the flow data in each canal level intensively for the whole irrigation period.

The lowest conveyance efficiency is found in the Numhoum scheme with 69.27%. The scheme has earth type irrigation canals in poor condition, and not rehabilitated in 20 years resulting in much leakage along canals. The value is also low compared with other irrigation schemes in Laos e.g. 87.8% in the Kao Leo II scheme (Thanasak, 1997) and 79% in the KM 6 scheme (Yoshida, 2004). The highest conveyance efficiency was observed in the Huay Luang scheme with 88.46%. Here, the canal system is equipped with a lining and there is good maintenance.

In the Komping Pouy scheme, the conveyance efficiency is 75.44% which is higher than the Numhoum scheme although it has the same earth type canal. The system was rehabilitated in 2002.

Table 2: Conveyance Efficiency

Pilot schemes	E_c (%)
Numhoum	69.27
Huay Luang	88.46
Komping Pouy	75.44

4.4 Overall command area efficiency

Table 3 explains the results of the overall command area efficiency in the three pilot schemes, The water requirements shown in Table 3 are calculated using equations (1) to (4). The ET_c , percolation, and surface inflow and outflows shown in Figure 4 are used to calculate scheme water requirements and water delivered to the fields.

The total requirements calculated for the Komping Pouy scheme is double that of Numhoum although the irrigated areas of these two schemes are similar. This is caused by the high percolation and evapo-transpiration occurring in the Komping Pouy scheme. The effective rainfall is rather high in the Huay Luang and the Komping Pouy schemes where higher rainfall and larger catchment area (irrigated area) in the Huay Luang scheme. The total water delivered to the fields shown in Table 3 is calculated by using equation (8).

The overall command area efficiency is generally high in the pilot schemes compared to previous studies conducted on other irrigation schemes in the same region e.g. 47.17% in the Kao Leo II scheme (Thanasak, 1997), 58% in KM6 scheme in Vientiane, Laos (Yoshida, 2004), 65% in an irrigation scheme in Northeast Thailand (Thong-aram, 1995), and around 40% to 60% at the Chao Praya area of Thailand (Vudhivanich *et al.*, 2002). The reason for the high efficiency in this study is the result of using the water balance approach.

The water balance approach considers the water volume delivered to the fields while taking into account multiple water uses and additional irrigation water reused from natural streams. With this approach, efficiency is defined as the ratio of the net water used by the crops and water delivered to the fields which extracting drained water and deep percolation, while efficiency under the classical concept is determined by net water used by the crops and water input by at main intake from reservoir.

As shown in Table 3, the lowest efficiency appeared in the Komping Pouy scheme with 62.73%. The scheme has a large canal compared to the size of cultivation area which needs large volumes of water to keep water levels high. This results in the low efficiency. Although large volumes of water are supplied into the command area, a downstream water shortage is still observed. Large volumes of water drain out of the command area through drainage canals. Therefore, strict water management needs to be implemented to control water distribution more efficiently.

However, higher efficiencies were observed at the Numhoum and Huay Luang schemes where water is better managed. Although the Numhoum scheme has an irrigation canal in poor condition making it difficult to control water properly, water management at the farm level is actively practiced. The water is reused by taking water from drainage canals and the rotation method is applied for water management between water management zones.

The Huay Luang scheme's canals and irrigation infrastructure are in good condition and they have more advanced skills in water management. The rotation method is applied not only for each management zone, but also in each canal level, from the main down to the farm level. The staff receives government supported incentives for water management activity and this results in a high participation on water allocation monitoring and evaluation leading to the high efficiency. To save water, the project limited the area for rice cultivation, instead promoting non-paddy crops in the command area.

Table 3: Overall command area efficiency

Pilot schemes	Scheme water requirement (MCM)	Effective rainfall (MCM)	Water delivery to the fields (MCM)	Overall command area efficiency (%)	Canal type
Numhoum	9.30	0.12	13.02	70.52	Earth
Huay Luang	24.94	0.69	33.80	71.74	Concrete lining
Komping Pouy	18.52	0.66	28.48	62.73	Earth

4.5 Water productivity

Water productivity results are reported in Table 4. The value of water use efficiency is calculated by values (USD) of the total production per unit of available water supply. The total production from multi-agriculture activities is counted on paddy, vegetables and aquaculture, while the other production is minor and not counted.

The results show that the highest water productivity was obtained in the Huay Luang scheme with USD 0.123/m³. The cultivated area is not mostly dependant on paddy, but also diversification crops (more than 32% of the total area) and aquaculture (5%). Vegetable usually fetch higher prices and consume less water. Vegetable yields are also comparatively high.

The lowest water productivity was observed at the Komping Pouy scheme with USD 0.040/m³. The cultivated area is mainly paddy with a small percent in vegetables (0.5%). Although with the large volumes of available water in the scheme, the total value of production is not high. The yield of paddy is also similar to other schemes, even higher than Huay Luang.

In the Numhoum scheme, water productivity was USD 0.091/m³. The value is also high compared to the Komping Pouy. The cultivated area is combined with vegetable around 1.2% and livestock and aquaculture more than 1.4%. The yield of paddy in this scheme is relative high among three pilot sites. The yields and prices of paddy in each pilot site are similar, while different for vegetables and fish farming. Vegetables usually fetch higher prices than paddy and consume less water.

Table 4: Water productivity

Pilot scheme	Production			Available water supply (MCM)	Water Productivity (US\$/m ³)
	Production Type	Yield (T/ha)	% of total command area		
Numhoum	Paddy	3.88	97.35	15.08	0.091
	Vegetable (cucumber)	2.54	1.23		
	Livestock (fish and chicken farming)	4.07	1.42		
Huay Luang	Paddy	3.50	62.82	28.30	0.123
	Vegetable	18.28	32.19		
	Fish and lotus farm	10.25	4.99		
Komping Pouy	Paddy	3.71	99.50	29.96	0.040
	Vegetable (sweet corn)	2.30	0.50		

Note: production price is based on data from 2006-07

5. Conclusion

In this study, irrigation efficiency and water productivity were analyzed using the water balance approach to gain accurate insights into the quality of water management practiced in the pilot schemes as well as providing data that can be used in other areas in the LMB.

The results showed that all three sites demonstrated a high degree of efficiency even though some schemes have earth type canals in poor condition. The main reason for this is because using the water balance approach which definitely shows the lower volumes of available water delivered to the fields rather than the classical concept. A higher efficiency was observed in schemes with active and strict water management with a high degree of monitoring and evaluation of water allocation. Sites with low efficiency had poorly designed hydraulic structures allowing excessive water into command areas and then drain out without being used.

Water productivity captures the performance of water use by providing total output values per unit of available irrigation water. High water productivity is found in schemes practicing multiple agriculture activities, while the low water productivity is observed at schemes practicing single crop.

Based on the primary results obtained from the efficiency and water productivity assessment, strict and active water management is required to reach the maximum amount of cultivated area without water shortages affecting production. For schemes with too large capacity canals, enlarging cultivated areas where possible needs to be considered; otherwise irrigation water in the canal is drained out of command areas without being used. Combining cultivated area with multiple agriculture activities is also essential for increased water productivity.

In line with the Mekong River Commission's Strategic Plan 2006-2010 which supports the effective use of the Mekong's water and related resources to alleviate poverty while protecting the environment, efficient use of irrigation water is a priority if gains in crop production are to be realized. This study will continuously examine wet season crops in the three pilot sites.

Acknowledgements

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IRRIGATION WATER USE EFFICIENCY IN THE TIDAL IRRIGATION SYSTEM OF THE MEKONG DELTA


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Abstract

Irrigation water use in the Mekong Delta has not been fully identified due to the complexity of the network which links the canal system with natural rivers. This study aims to examine irrigation water use, in particular to determine the water needed for rice cultivation by applying the water balance concept. The study site is the Longhai area of the GoCong irrigation project in Tiengiang province, within Vietnam's Mekong Delta. Data collection and field investigation covered one cropping season (the winter-spring crop) during the 2006-2007 dry season. The water balance at canal level showed that the available irrigation water was 3.5 MCM, but the total volume applied to the field was 5.4 MCM. The study reveals that this gap is filled by recycling the water which returns to the canal after being applied to the field. This reused water accounts for 34% of the total irrigation supplied to the field. The canal system therefore functions as on-farm water storage. This study will continue to monitor water use over a one year cycle, covering three cropping seasons and providing further understanding of irrigation water use in the Mekong Delta.

Keywords: Water balance, paddy field, Mekong Delta, tidal irrigation

Water Use Efficiency in the Tidal Irrigation System of the Mekong Delta


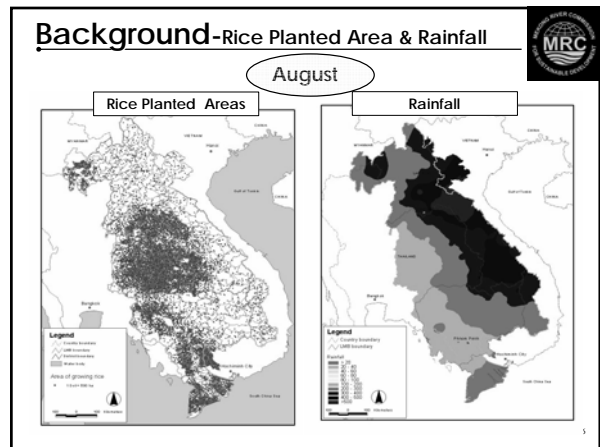
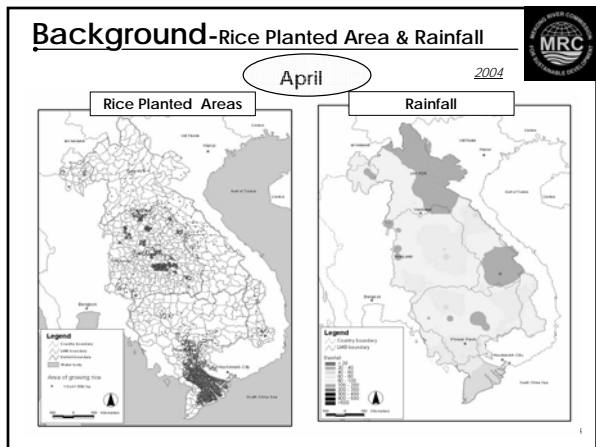
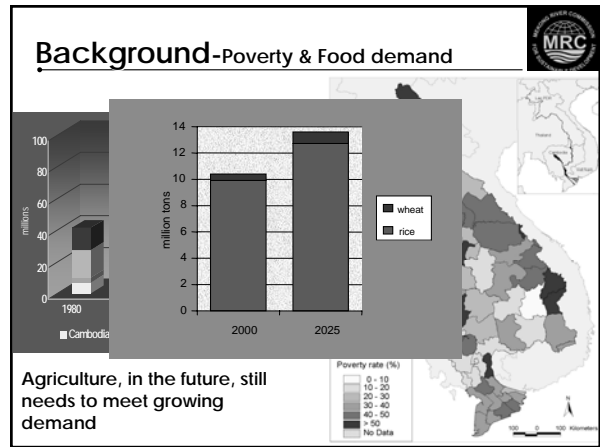
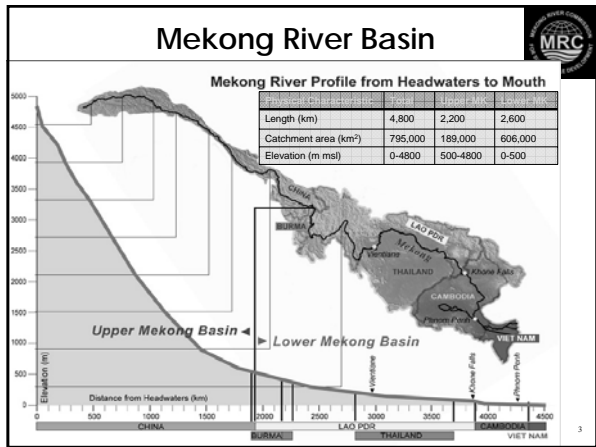


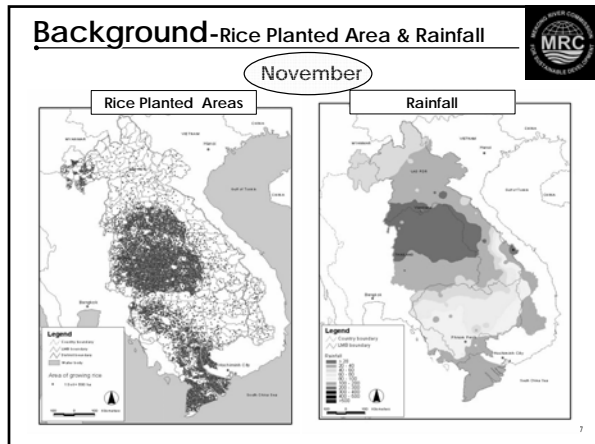
GMS Agricultural Conference Fongsamuth Phengphaengsy (MRCs)
 Nakhon Phanom University, Thailand Okudaira Hiroshi (MRCs)
 9-10 Feb 2008 Team of SIWRR, HCM

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Content

- Agriculture & Irrigation in the LMB
- Objectives
- Pilot Site
- Irrigation in Delta
- Data Collection
- Water Balance
- Efficiency & Water Productivity
- Conclusion

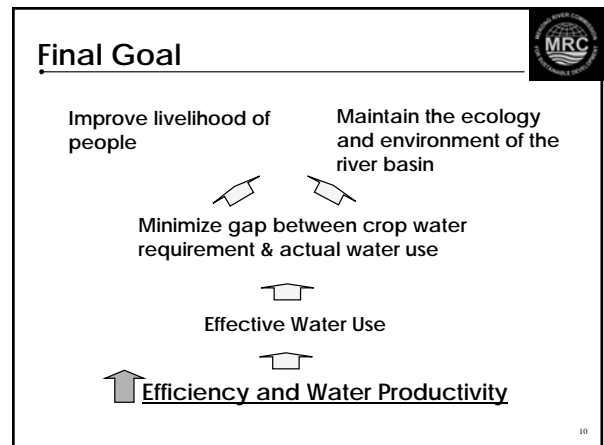


Estimation of irrigation water use in the LMB

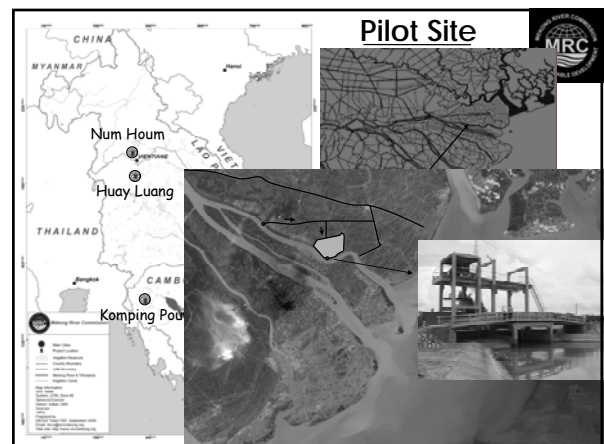
Annual water use (billion m ³)	
Cambodia	2.7
Laos	3.0
NE Thailand	9.4
Vietnam Delta	<u>26.3</u>
Vietnam Highlands	0.5
LMB total	41.8

• 8.8% of annual discharge (475 bill. m³)

- ### MRC's strategy & the need of study
- MRC's Strategic Plan 2006-2010 which supports the effective use of the Mekong's water and related resources to alleviate poverty while protecting the environment
 - Efficient use of irrigation water is a priority if gains in crop production are to be realized
 - Irrigation efficiency & water productivity are important indicators of effective water resource management
 - A few analysis of water use efficiency in the region



- ### Study Objectives
- to examine actual conditions of irrigation water use in pilot areas representing irrigation typology of the LMB
 - to assess irrigation efficiency and water productivity in pilot areas by applying water balance approach
 - to understand the trend of water use efficiencies in the region



Irrigation in Delta



- > 1/3 of total cultivated area in country
- Irrigation development plays important role for increasing agriculture production
- Most scheme developed from 1975, intensively in 1995 with 2 main objectives: irrigation devt. & salinity intrusion protection
- ↑ production 6.3 MT (1985) → 17 MT (2000) with 1 or 2 crops → 3 crops/year

- Flat plain (ave. 1m, MSL), small individual farmer's pump & semi-gravity irrigation based on tidal variation at intake
- Complexity of canal network (linked to natural river, combined irrigation & drainage)

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Data Collection



Project (Country)	2006				2007											
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Paddy	W-S						S-A			A-W						
Cash Crops																
Fish & Shrimp	Not inside command area															

- This analysis covers only W-S crop
- Flows monitoring by data logger sensors and current meter
- Daily ET_o , Rainfall, Percolation monitoring
- 5 sample areas for monitoring actual water applied to agriculture fields
- Farmers' interview for total productions and incomes

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Field Activity



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Land Use



Total A: 948.6 ha

Agriculture:

- Paddy: 697.1 ha
- Paddy: 98.56%
- Cash Crops: 1.44%

Canal:

40 ha

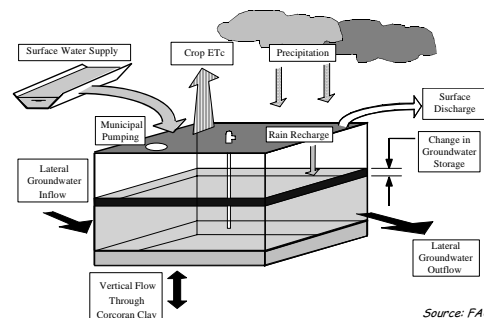
Housing & Road:

201 ha

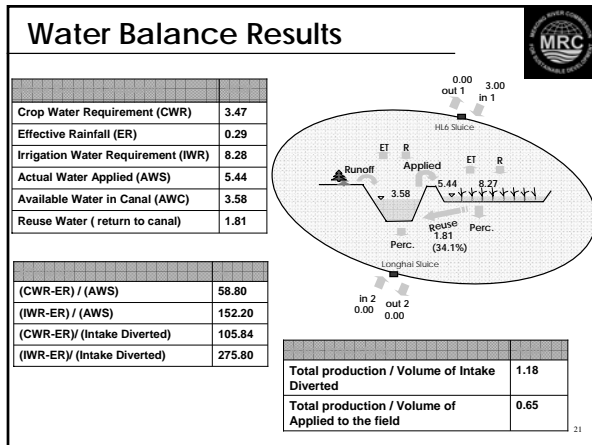
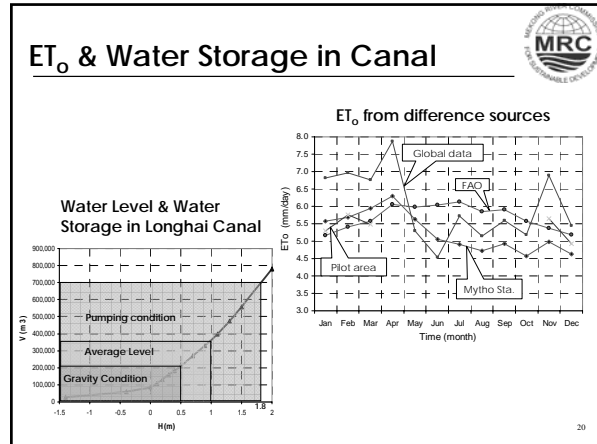
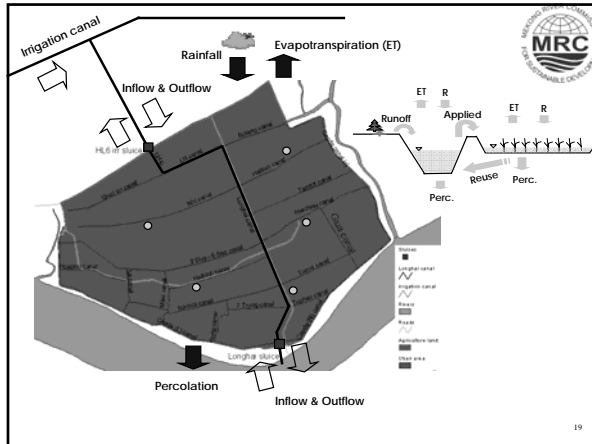


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Water Balance Approach



Source: FAO



- ### Major Findings - Water Balance
- Water diverted into command area meets **36.3%** of total scheme water requirement
 - The rainfall runoff accounts for **8.9 %** of total scheme water requirement
 - Actual applied to paddy field meets **65.7%** of total scheme water requirement
 - Volume of water available in canal lesser than volume applied to the field, gap filled by recycling water returned to canal after being applied
 - Rotation of **1.62-1.81** times during whole season

- ### Major Findings - Physical Functions
- 100% of agriculture area realizes on the water from canal
 - Canal functions as on-farm water storage
 - Large capacity of canal serves multi purposes: irrigation water, salinity flashing & transportation
 - Lower yield when water contain salinity
 - Low productivity when more pump condition is practiced

- ### Major Findings - Management
- Role is to maintain good water quality inside command area & diverting fresh water as much as possible to replace the stagnant condition of water
 - To ensure availability of water in the canal, raising up water level to support gravity condition
 - Conveyance efficiency has no meaning since no control & service by each canal level
 - No requirement of farmer participation in managing water distribution
 - Farmers are informed water availability & involved in small regular maintenance work in their agricultural area

Conclusion & Recommendation

- The irrigation water use in tidal irrigation system has been examined for one season crop, interesting results of recycle use was found
- Applicable approach for water balance at 3 levels: command area level, canal system level, and field level for determining water use in the complexity of canal network
- With the practical trial effort in the small pilot site, the approach is expected to be applicable implemented through the whole condition of the tidal irrigation project in the Delta area
- Study will continue the analysis of other season crops to understand the trend of water use to realize the practical situation of tidal irrigation

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Thank you for your kind attention



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Supplemental information

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Water Requirement

Paddy

$$WR_p = ET_o \times k_c + P + LP$$

Non-paddy crops

$$WR_n = ET_o \times k_c$$

Fishpond

$$WR_f = ET_o \times k_c + P$$

Total Scheme Water Requirement

$$SWR = \sum_{i=1}^n \int_{j=1}^m WR_{ji} \times A_{ji}$$

- ET_o : Potential or reference evapo-transpiration in mm/d
- k_c : Crop coefficient (dimensionless)
- LP : Land preparation in mm/d
- P : Percolation in mm/d
- i : Type of agricultural activity (e.g. paddy, non-paddy, fish farming)
- j : Day
- m : Number of days
- n : Number of agricultural activities practiced within command area
- WR_{ji} : Water requirement (mm/day $\times 10^{-3}$) of crop type (i) at the day (j)
- A_{ji} : Actual cultivated area (m²) of crop type (i) at the day (j)

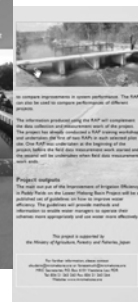
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Project Time Frame

	2005		2006		2007				2008	
	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Preparation stage	█									
Regional Workshop					█					
Scheme Appraisal					█					
Site selection					█					
Field observation					█					
Data analysis					█					
Review documents					█					
Drafting guidelines					█					
Finalizing									█	

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for more Info.



Future Publication:

- Guidelines
- Technical training manual
- Published papers

Completed Publication:

- Project Brochure
- Project document
- Project technical concept
- RAP report
- Posters

<http://www.mrcmekong.org/programmes/AIFP>

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