

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.

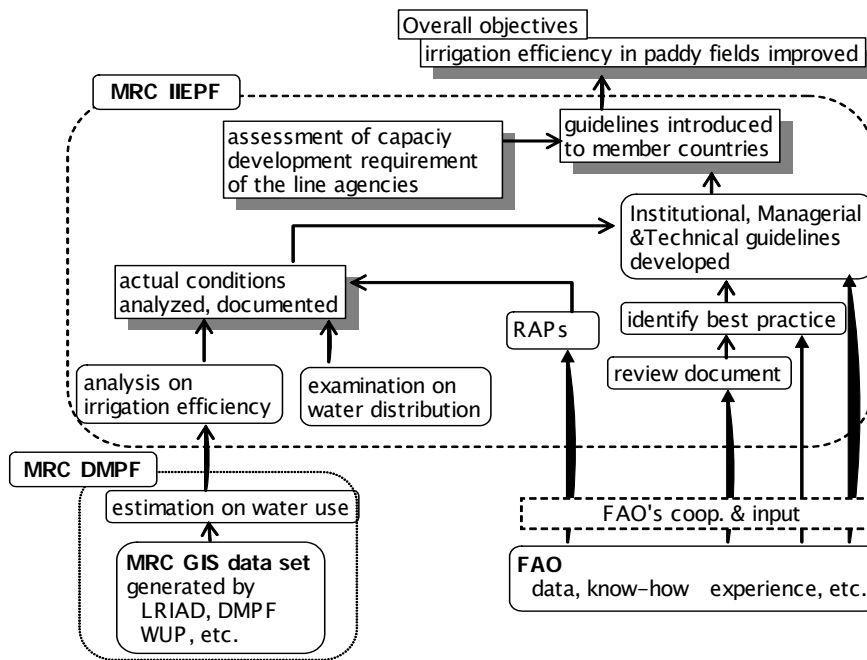
- FAO is the only UN technical organization specialized in agriculture development including irrigation

- 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.

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. Expecting 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

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

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

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

- 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.