Research and Proposal on the Irrigation Modernization Framework in Red River Delta, Vietnam

Vu Hai Nam

Abstract

The purpose of this research is to develop an Irrigation Modernization Framework (IMF) for irrigation systems in Red River Delta (RRD) to support the implementation of the National Program on Restructuring the Irrigation Sector (PRIS) in Vietnam. The IMF will be built with the Service-Oriented Management (Daniel, et al., 2002) that includes the Irrigation Modernization concept (FAO, Bangkok, 1997). The IMF will also be developed based on the inheritance of the results of the Irrigation Modernization research such as Rapid Appraisal Process (RAP), Mapping System and Services for Canal Operation Techniques (MASSCOTE) with the combination of the situation of the irrigation sector in Vietnam. The research analyzed the demand, achievements, and constraints of implementing the PRIS in Vietnam. Based on that, the research proposed a suitable IMF to apply for the irrigation system modernization in RRD in particular and in whole the country in general. The expected outcome of the research will help the manager of irrigation systems to build and clear roadmaps for modernizing irrigation on both hardware (infrastructure) and software (management) to improve the efficiency of irrigation exploitation with Service-Oriented to support the implementation of the PRIS in Vietnam.

Keywords: Service-Oriented-Management (SOM); Irrigation Modernization Framework (IMF); Rapid Appraisal Process (RAP), MASSCOTE.
Introduction

Status of irrigation sector in Vietnam

Nowadays, there are many irrigation systems of all scales over the country, of which about 904 medium and small schemes with 200 hectares commanded area of each and about 110 schemes with over 2,000 hectare commanded area of each [3]. The allocation of irrigation scheme with over 2,000ha command area and irrigated agriculture area by regions was shown below in figure 1.

Figure 1: Allocation of irrigation scheme with over 2,000 ha of command area and irrigated agriculture area by region in Vietnam

However, due to the inadequacy of its capacity compared with application requirement, lack of technical personnel, low investment rates, asynchronous, backward technology and management methods and unreasonable decentralization..., performance of water resources management in the irrigation systems is not high [3]. The baseline assessment in 8 irrigation in VIAIP project shows the System irrigation efficiency indicator is under 40% and Field irrigation efficiency indicator is about 50% in average. This is one of reasons makes the project was donated by the WB.
State policies on irrigation sector in Vietnam

In the context of Vietnamese Government issued a national program on restructuring of the country's economy, including the National Program on Restructuring the Agriculture Sector was approved in Decision No. 899 / QD-TTg dated June 10, 2013 by the Prime Minister, Ministry of Agriculture and Rural Development (MARD) issued the National Program on Restructuring Irrigation Sector (PRIS) in Decision No. 794 / QD-BNN-TCTL April 21 2014 with the goal of "Improving the efficiency of irrigation sector restructuring the agricultural sector towards higher added value and sustainable development; meet the development of the economic - social sectors; improve disaster prevention and adaptation to climate change; contributing to the modernization of agricultural infrastructure, rural and new rural development".

National program on restructuring the irrigation sector [4] has given the tasks to be achieved including: (i) strengthening and developing infield irrigation, associated with building a new rural; (ii) strengthening the organizational management and exploiting irrigation works; (iii) developing an active irrigation agriculture towards modernization; (iv) developing infrastructure irrigation for intensive farming and aquaculture with main species in the Mekong Delta, the coastal regions in the Central Vietnam; (v) improving safety level in disaster prevention, storm, flood, lake dam safety. Proactive prevention, avoidance or
adapted to minimize losses and protect the safety of citizens, ensure the stability and development of production in terms of climate change ...; (vi) improve the effectiveness of disaster risk management and dam safety by applying advanced technology and capacity forecasts, disaster warnings, preferably non-structural solutions; and (vii) improve the efficiency of management and exploitation of works of rural water supply in a sustainable way both in terms of infrastructure, management model and financing.

Besides, this national program also provides performance orientation, including: (i) Improving the efficiency of management and exploitation of irrigation systems; (ii) Developing irrigation for crops; (iii) developing irrigation infrastructure serving aquaculture; (iv) improving the safety level for reservoirs; and (v) improving capacity of natural disaster prevention.

The main measures for the implementation of tasks in the project with the above direction including: (i) Improving the quality of irrigation planning, strengthen the management comply with the content planning Innovation the planning, review of national irrigation plan, plan and plan for prevention of natural disasters, dam safety; (ii) Improving the institutional policies; (iii) adjusting the structure of public investment; (iv) innovation of science and technology activities; (v) strengthen the State management apparatus for irrigation; and (vi) training human resources, strengthening international cooperation.

Currently, a number of solutions serving the effective implementation in the scheme restructuring of irrigation sector is also built to focus on many different aspects, may include: (i) "National program on improvement of the performance of existing irrigation and drainage systems " focused on solutions to improve management efficiency exploiting irrigation works [3]; (ii) "Training programs on improvement of knowledge, specialized skills on management and exploitation of irrigation schemes" focuses on aspects of capacity building in management and exploitation for all levels of management from clue to on-farm [5]; and (iii) "Program on development of on-farm irrigation," focusing on building development, institution and technology ... at the on-farm level.
Rationale of the Research

Nowadays, Rapid Appraisal Process RAP and MASSCOTE method can assist preparing strategic plan on Irrigation Modernization [2], which was recommended in the irrigation sector restructuring master plan as well as applied in some irrigation systems in Vietnam under ODA projects in order to support irrigation managers develop vision and plan of system improvement. Besides, non-structure measures supported for on-farm irrigation development (PIM program) are also integrated in the orientation of irrigation development for comprehensive irrigation sector restructuring.

MASSCOTE is an approach for assessing the process, effectiveness of performance as well as developing modernization plan for irrigation scheme. MASSCOTE is developed by FAO with the general content consisting of all aspects in irrigation management to make a standard Frame aiming to improve procedure of operation of irrigation scheme on the basis of extensive experience with irrigation modernization programs in Asia between 1998 and 2006.

RAP/MASSCOTE, which included clear and specific guidance on assessment of water delivery services of irrigation systems, were proposed to be an appropriate tool in the irrigation sector restructuring master plan as well as master plan on improvement of irrigation management performance issued by the Ministry of Agriculture and Rural Development. However, beside the achievements, the development of strategic plan on Irrigation Modernization by MASSCOTE has not had specific guidance on preparing detailed implementation plan of Irrigation Modernization strategy such as:

- Activities of improvement and modernization of infrastructure as well as management are still isolated within an internal irrigation system whilst they do not reveal interconnection between irrigation management levels.
- Although plans and strategies of irrigation modernization involve related concepts, they are still localized within scope of the system and do not

---

1FAO Irrigation and Drainage paper 63
take into account the context of Integrated Water Resources Management with river basin approach.

- Responsibilities and relationships between irrigation management levels (from national level to farm level) in terms of institution, technique, monitoring and evaluation, etc. are not addressed specifically and clearly in the strategic plan on Irrigation Modernization with MASSCOTE method.

- An appropriate monitoring and evaluation system for Irrigation Modernization has not been developed and proposed.

In order to deal with the problems above for improving comprehensive performance of irrigation management toward the orientation of the irrigation sector, it is necessary to study and propose a framework of Irrigation Modernization in the context of Integrated Water Resources Management with river basin approach in multiple ways as follows: (i) Responsibilities and relationships between irrigation management levels (national, river basin, irrigation system, subsystem and farm levels); and (ii) The aspects related to irrigation management such as water management, institution, technique, monitoring and evaluation, etc. will help to develop, implement, monitor and evaluate comprehensively and effectively the strategic plan on Irrigation Modernization.

**Research’s objectives:**

**Overall objective**

The overall objective of this research is to contribute to improve the efficiency of irrigation management in accordance with requirement of restructuring the irrigation sector through development of an Irrigation Modernization Frame with Service-Oriented Management.
Specific objectives

- Research on irrigation modernization in the world and in Vietnam.
- Proposal and development of an Irrigation Modernization Frame for irrigation systems in the Red River Delta.

Research Methods

Necessary data for the research

The necessary documents and statistic for the research include:

- Data of current situation about the quantity and scale of irrigation systems in whole the country and in each region in Vietnam (especially of the Red River Delta);
- Data of command area of those systems mentioned above;
- Document on policies and programs of government/irrigation sector relating to exploitation management of irrigation scheme such as: (i) “Scheme of restructuring agriculture sector”; (ii) “Scheme of restructuring the irrigation sector”; (iii) “Scheme of improving the performance of existing irrigation and drainage systems”; (iv) “Program of training knowledge and specific skills of exploitation management of irrigation and drainage systems”...
- Documents on activities (projects, researches…) relating to improving, upgrading and modernizing irrigation work systems such as: (i) “Vietnam Water Resources Assistant Project - VWRAP”, (ii) “Vietnam Irrigated Agriculture Improvement Project - VIAIP”; (iii) “Strengthening Water Management and Irrigation scheme Rehabilitation – ADB5”… funded by WB, ADB, JICA...
- Researches on irrigation modernization in Vietnam and over the world;
- Data of roles and responsibilities of relating parties in irrigation management as well as issues in water distributing operation in some irrigation systems in Red River Delta.

**Data collection methods**

Documents and data mentioned will be collected through (i) state management offices/agencies under MARD; (ii) projects on improving and upgrading and modernizing the irrigation schemes; (iii) researches relating to irrigation modernization; and (iv) site visit on some irrigation systems Red River Delta.

- Data of the quantity and scale of national and regional irrigation systems will be collected through WRD under MARD, the highest state management agency of irrigation sector. Currently, researcher are working for the Vietnam Academy for Water Resources (VAWR) belong to MARD, and thus can collect such data by officially documents from VAWR;

- Documents relating to schemes/master project in irrigation sector can be collected on the internet or purchased via websites to provide the legal documents, or can be passed from the VAWR to MARD via officially documents;

- Documents relating to projects on improving, upgrading and modernizing irrigation systems will be collected in the Central Project Office (CPO) under MARD via officially documents from the VAWR;

- Documents of researches relating to irrigation modernization over the world will be collected from colleagues under international organizations researching on irrigation such as FAO, WB, Cal Poly by business relationships of researcher in the network;

- Documents of researches relating to irrigation modernization in Vietnam will be collected by the relationships of researcher with other irrigation researchers;
• Documents and data of the roles and responsibilities of related parties in irrigation management as well as water distributing operation in some systems of Red River Delta will be collected by site visit.

Tools applied

These following tools will be applied in the research

**Document research**

- Review of literatures and other researches on irrigation modernization in the world to find the matching points with conditions of Vietnam;
- Review of recent irrigation modernization activities in Vietnam to figure out the achievements and lessons learned to support the development of the overall Irrigation Modernization Frame;
- Researching the projects on improvement, upgrading irrigation systems with irrigation modernization oriented to find the achievements as well as lessons learned in irrigation modernization in Vietnam.
- Reference of relating researches in Vietnam to support building an irrigation modernization frame;

**Data analysis**

- After being collected, data of irrigation systems (quantity, scale, command area) will be summarized and analyzed with MS Excel program;
- After being collected, detailed data such as indicators evaluating the performance of irrigation systems with modernization-oriented (irrigation services indicators, operation indicators at different level of irrigation canal, exploitation management indicators…) will be summarized and analyzed to get the secondary results. The collecting and analyzing will be done with MS Excel program.
Site visit

- Site visit in some selected irrigation systems to clarify the roles and responsibilities of each irrigation management level in accordance with requirement of the modernization frame.
- In addition, the site visit also provides preliminary assessment of irrigation infrastructure as well as operation capacity at different levels of the irrigation scheme.

Developing general IMF

The content of the framework proposed irrigation modernization will include (i) The process of implementation of irrigation modernization includes the activities required for the implementation of relevant aspects of the modernization of irrigation; and (ii) the role and responsibilities of the parties involved in the modernization of irrigation systems.

The construction of Irrigation Modernization Framework approach based on (i) Management service oriented and (ii) Modernization of irrigation. Therefore, the basic content of the modernization framework will be based on steps taken for irrigation system modernization to manage service oriented as shown in Figure 6 below with a process comprising the steps of: (i) Assessment of irrigation system performance; (ii) Developing the strategic plan of irrigation system modernization; and (iii) Monitoring/ Evaluation & Adjustment. Besides, the contents of steps should also include the roles and responsibilities of stakeholders in the formulation and implementation of Modernization plans. The process of IMF as figure 3 below.
Assessment of performance of irrigation system

Modernization is a process of improving the management and infrastructure to meet water distribution services to end users. Therefore, assessment of performance of irrigation system will include an assessment of (i) Quality of service provided by irrigation systems; and (ii) Performance of irrigation infrastructure as well as management from the system to the field level. Currently, RAP/MASSCOTE is used to evaluate performance of some irrigation systems with commanded area more than 2000 hectares all over the country.

Development of strategic plan on irrigation modernization

In this step, it is necessary to build the vision for the irrigation system with specific goals to be achieved to meet the requirements of socio-economic development of specific local and agricultural development. Besides, the goals of the irrigation systems also need to achieve the required orientation and development of the sector.

Then, a strategic plan of irrigation system modernization is built based on the goals and requirements of rehabilitation/improvement, with focuses on three
specific contents: (i) Improve policies in irrigation management; (ii) Modernize the management of the system operation; and (iii) Improve infrastructure in accordance with the irrigation modernization orientation. The strategic plan of irrigation modernization should also specify the roles and responsibilities of stakeholders including: (i) State management agencies at the central level and local level; (ii) Irrigation system management units; (iii) Consultants; (iv) On-farm irrigation management units; and (v) People/end water users on the contents of the strategic plan of irrigation modernization. The strategic plan should also clearly demonstrate the activities of short-term and long-term in the roadmap of irrigation modernization to provide reasonable and explicit contents for the implementation of the strategic plan.

The implementation of the strategic plan of irrigation modernization will need mobilization and rational use of human resources, finance ... in accordance with the predefined work content. The contents which can be done by internal resources should be prioritized; the contents which cannot be done by internal resources should be called for support of other stakeholders such as governments, State management agencies.

**Monitoring and evaluation – Adjustment**

The monitoring and evaluation (M&E) should be carried out regularly during the implementation of the strategic plan on irrigation modernization with the aims: (i) Ensure the plan is implemented in accordance with the pre-defined roadmap; and (ii) Promptly amend goals as well as the problems to improve the strategic plan on irrigation modernization to fit the general context. During this period, the M&E system should be developed and used for the implementation of the strategic plan on irrigation modernization; or development and application of Benchmarking system; or application of rapid assessment procedures RAP and MASSCOTE method to assess the performance of irrigation system after a period and consider the level of rehabilitation/improvement to meet requirements of service.
Applying IMF for An-Thi irrigation system

Introduction of An Thi irrigation system

An-Thi irrigation system in Hung Yen Province located in the North of Vietnam is starting construction after 1954. The An-Thi Irrigation Management Enterprise (IME) at district level, a branch of Hung Yen Irrigation Management Company (IMC) at provincial level, manages the overall system. At commune level, 21 Agricultural Service Cooperatives (ASC) of each commune manage the on-farm irrigation system. The system has the task of providing irrigation water to 8752 hectares of summer-autumn and winter-spring crop of An-Thi district.

An-Thi irrigation network belongs to a bigger irrigation network (Bac Hung Hai) which provides water to all Hung Yen province and parts of other adjacent provinces. As a result the “rivers” on An-Thi district are artificial and belongs to Bac Hung Hai network. Water supply is provided by the red river. An-Thi district is surrounded by 4 rivers:

- Kim Son river on the north
- TayKe Sat river on the east
- Cuu An river on the south
- Quang Lang river on the west

There are 3 other rivers are considered as main branches of the network:

- Bun River
- Tam Do River
- Cuu Khuc River
Due to the very mild slope of the canals and river beds, the water level is constant in the entire network. Canal discharges are managed by the pumping stations. Irrigation systems of An-Thi includes 114 pumping stations of which 29 pump stations are managed directly by the IME and 85 field pumping stations are managed by cooperatives. Several pumping stations have been improved by the Government's fund: Ap Bac pumping station was improved in 2010 (replacing all the pumping machines and raising their power); Tam Do pumping station is being rehabilitated (building a corresponding new station) and Bich Trang pumping station will be improved.

The basic parameters of the irrigation system are as follows: 72.75km long main canal, 81.87 km long canal level 2 and 246.7 km long canal level 3. On the main
canal there are 22 regulators and 135 offtakes. Channel systems are mostly land canal, accounting for about 90% of the total length of canal, causing losses of significant amounts of water, affecting irrigation efficiency of overall works.

Dredging works involves many labors and annual execution in the district. Yet, with difficult budget, such dredging works cannot eliminate risk of flood in rainy season and water deficiency in dry season. The IME manages canals that irrigate more than 50 ha or drained more than 100 ha. Original canals with trapezium cross-section are now downgraded seriously and partially filled with deposit and landslide. Consequently, water storage and circulation have been reduced by 30%-40% compared to original design.

**Using IMF for making modernization strategic plan of An Thi irrigation system**

**1. Assessment of An-Thi irrigation system performance**

**Services**

Irrigation: Services of the irrigation system are defined as the original design. In this period, the agriculture plays a key role in the economy, so this is basic service of the irrigation system in Vietnam. Currently, the system provides irrigation service for 2 rice crops (winter-spring and summer-autumn crop) and one winter crop (corn, peanuts, sweet potatoes ...).

Fisheries: There is a very small water area for aquaculture of some individual households signed a contract with the company providing water service for fish farming with very small total area.

Flood prevention: When heavy rains and floods in the basin are put into the main canal, the drainage channels and downstream to avoid flooding residential areas and fields and ensure the safety of canal to avoid flooding through canal causing broken canal.
**Rapid Appraisal Process**

Internal Indicator: The production value of agriculture on the irrigation system of An-Thi at 3,422 USD/ha is in the high average compared to other systems in Vietnam which are studied by us (Figure 4). It thereby found that agricultural production at systems of An-Thi are developing and this is the basis for the development of agriculture in the whole irrigation region.

The value related to water in the agricultural sector in the An-Thi system reached 0.19 $/m³ is also quite high compared to other irrigation systems in Vietnam as describe in figure 5.

![Figure 4: Agricultural production at different irrigation systems in Vietnam in 2014](image1)

![Figure 5: Water productivity at different irrigation systems in Vietnam in 2014](image2)

Sources: Vu Hai Nam, 2016
The others an external indicator of An-Thi irrigation system performance assessment was shown in Annex 1.

Some key points to be found on the system of An-Thi through external indicators as follows:

- The amount of water for the irrigation system is large with worth of 156 million m³ while the needs of the plants in the system is 112 million m³ (ET crop) and Total NET irrigation water requirements is only 69 million m³ and field Irrigation Efficiency reached 66%. This shows that the irrigation system of An-Thi is fairly efficient, water distributed reasonably by pump stations.

- Land use ratio at 2.06 is relatively high compared to other systems in the world, but compared to other systems in North Vietnam is still low. This is also an opportunity to improve indicators in order to increase the value of agricultural production in the irrigation system.

- The ratio between volume of water supplied to the system from the pumping station and field irrigation need (taking into rain efficiency on system) at 2.26 times is high. This is an opportunity to improve irrigation operation of the system to expand irrigated areas or diversified service with high-quality water supply to increase the value of water used in the system.

- Both field irrigation efficiency and irrigation efficiency throughout the system are pretty high.

*Internal indicators*

RAP internal indicators of the system reflect important factors related to water control and services throughout the irrigation area. The internal indicators and sub-indicators at each level of the system of An-Thi is quantified by the value from 0 to 4 (0 is the lowest and 4 is the highest level) and is shown in Annex 2.
Some key points to be found in the irrigation system of An-Thi through internal indicators as follows:

- The values of claims of distribution service to on-farm water of managers versus realistic surveys when performing RAP are coincident.

- Communication for operating the system is very good.

- The irrigation plan to the service was expected but is still low level of detail. The water measurement work in the main channel is unfulfilled. The system administrators are interested in the work of water meters in service operation system should be fully implemented.Besides, dedicated works water metering should be considered included in the installation on the system to improve the accuracy of water metering work. On the other hand, the work of water meters should also be interested in the distribution channels of the system.

- Management roads along the main channels have poor quality.

- Regulation works on the channel are old and operation is not convenient.

- Offtakes on the main channel and distribution channels have been largely built for a long time and many offtakes have deteriorated. While they play an important role in the distribution of water from the main canal to secondary canals and channels subordinates.

- The operation of the main channels basically depends on experience, no official procedures operating channels (including the regulation works on the channel).

- Quality of distribution channels is very limited. The secondary canals are mainly land channel, accounting for 60%, sod, dirt and sediment is very serious leading to limitations in the distribution of water throughout the system.
- Activities of WUAs at An-Thi irrigation system are not good. The water user organizations in the system have participated in operations to distribute water to farmers.

The internal indicators of An-Thi irrigation system performance assessment were shown in Annex2.

**The capacity of the system**

The capacity of pumping: An-Thi system includes 114 pumping stations designed to irrigate 8752 hectares of agricultural land with irrigation design frequency of 75%. However, until the present time, the irrigation area is approximately 8009 hectares. Thus, the capacity of the An-Thi pump stations system may still continue to exploit in order to increase the area served by the system but need to calculate the water balance for each year. On the main channel, there is no regulation reservoir to store water temporarily in times of abundant water for use in difficult times for watering.

Regulating water at the pumping station: Change the water level daily at intake tank of Ap Bac pump station is small, in the dry season the water level fluctuation is about 5cm, and the biggest value of 0.4 m is in the flood season. However, the flood season usually closed pumping stations, so water level changes affect slightly the capacity of the pump station. Seasonal fluctuations are also affecting the capacity of the system in the main channel. The volume of water ranges from 0.015 mil.m³ in December to 2.2 mil.m³ in June. Pumping capacity is low during high water demand in the month of dry season (winter) and especially in land preparation stage.

The conveyance capacity of main channel: The ability of conveying water in main channel ensures to irrigate 8752 ha by design. Secured height of channels depends on channel segment according to design standards for securing channel. Most of the channels have not been solidified so the ability to transfer water to lower canal level or on farm canal is limited by sedimentation and narrow sections.
The capacity of regulation: The ability to regulate along the main channel is limited. On the entire length of the main channel (72.75 km) there are 22 regulators; the regulators are old. The operation is quite difficult.

The capacity of water distribution: The offtakes along the main channel are relatively old, can get enough designed discharge but quite difficult operation. These offtake features are flat valve and manually operation. The offtakes on the secondary channels are severely deteriorated; most of the offtake have no valve operation. The channel is mostly land channels, much sediment channel leads to lower operating efficiency of irrigation system, upgrading the entire canal system is very essential to the delivery of water to on-farm more efficient.

The capacity of water measurement: Currently, the work of measuring water levels and discharge of channels is not yet implemented, thus greatly affect the operational channel, resulting in the distribution of discharge across the offtake was not flexible and accurate.

Canal security: Given the characteristics of the region, An-Thi irrigation area is irrigated and drained entirely by system of pump stations, so that on the whole canals have no overflowing work. Irrigation canal is combined with drainage canal, water will be drained through the drainage channels and flows to the river.

Communication: Communication between the parties concerned (company and its subsidiaries, between branches and irrigation clusters and between the clusters and the operators and between the operators and WUAs) mainly by telephones and mobile phones are very convenient and effective. The operating data is sent to the IMC through phone and email.

Transportation: Transportation along the main channel is not good, can go by car on some canal bank but quite difficult, mostly be traveling by motorcycle.
Perturbation

The objective of perturbation analysis consisting of causes, intensity and frequency is to make use of hydraulic knowledge in identifying and using methods to manage most effectively. Factors causing perturbation in operation of An-Thi system are identified through investigation, assessment of the system including: rainfall, climate change, construction, illegal water delivery in the canal and variation of crop pattern and planting schedule. Causes and factors related to size, location and frequency are described in Table 1.

<table>
<thead>
<tr>
<th>Reason</th>
<th>Magnitude</th>
<th>Position</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rain</td>
<td>heavy</td>
<td>Catchment and CA</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Construction</td>
<td>large</td>
<td>Command Area</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Illegal water delivery</td>
<td>small</td>
<td>Command Area</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Crop and planting schedule</td>
<td>average</td>
<td>Command Area</td>
<td>Sometimes</td>
</tr>
</tbody>
</table>

Sources: Vu Hai Nam, 2016

Water Accounting

The amount of water entering the system includes water from the pumping stations and rainfall across irrigation area. The total water volume in the system in 2014 was 305.89 million m3 in which the water volume was 156.34 million from pumping stations m3 and rainfall throughout the area irrigation is 149.55 million m3.

The entire 156.34 million m3 of water enters the system from the pumping stations is used for agricultural irrigation purposes. Thus, 36.46 million m3 difference between the input and output of the system will: (1) charging into the aquifer for irrigation areas; (2) discharge to drainage systems in irrigated areas; and (3) evaporation (outside ET). The data on drainage and underground water
in the system is not collected, there is no detailed assessment of this factor. Agriculture accounted for mainly in the production activities that use water in the An-Thi irrigation system, moreover, there are a very small area of aquaculture (approximately 1.5%).

**Operation cost**

An-Thi irrigation system is operated by the subsidiary of IMC Hung Yen. The total cost of operating the system is about 13.56 billion VND with total 120 employees, including 104 personnel operating directly on the system. Payroll accounts for a large proportion of 51% of total operating costs, cost of renovation works of 19%, maintenance costs account for 3%, electricity costs for 17%, and administrative expenses accounted for 12%. On the whole, cost for maintenance activities is a small amount compared with the total cost, but because of irrigation fee revenue offsetting meet only at that level, this is also a challenge for the current process modernization of the system.

Figure 6: Allocating operation expenditure of An-Thi IME
2. Developing the strategic plan of irrigation system modernization.

Vision of the system modernization

On the basis of performance assessment of the irrigation system, analysis results regarding capacity, sensitivity, perturbation, water accounting and cost of operation in An-Thi irrigation system combining with socio-economic development plan of Hung Yen province in 2020 and orientation to 2030, consultants unified to draw a conclusion regarding vision of An-Thi irrigation system as follows:

<table>
<thead>
<tr>
<th>Vision</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Improving living standard of the community in multiple uses of water by optimizing productivity of water and land on the basis of appropriate, sustainable and eco-friendly water management.”</td>
</tr>
</tbody>
</table>

And specific targets of this vision are:

1. Increasing irrigated area by 2.6%.
2. Increasing land use efficiency by 2.4%.
3. Increasing farmer’s income by 12.5%.

Service to users

The diversity of water services in AnThi irrigation system at present is relatively low in small scale of the system, there are many differences in the level of water services, while irrigation service in agricultural sector is still the key service. Besides, the irrigation system should supplement water service for husbandry and fisheries and it is important to extend scale of services to increase economic value of water in the system.
Demand for operation

To meet the vision of system and planned objectives, services and quality of services supplied by the system at present and in the future, it is necessary to improve requirements of operation in the system and on farm with the key content “Improving canal system management and water delivery service”. And proposed solutions are: (i) Upgrading the canal system in necessary points; (ii) Application of regulating structures, water distribution structures…; (iii) Establishing procedures of system operation reliably and effectively; (iv) Enhancing capacity of system operation; (v) The application of achievements on information technology; and (vi) Strengthening relation with local irrigation organization.

Operation improvement

Improvement of operation for management units toward modernization concentrates on: (i) water resources management; (ii) water regulating; and (iii) canal operation. It is important to establish a comprehensive approach in every management unit to identify challenges and opportunities of modernization appropriately.

Improvement of the system should be considered comprehensively in space (from the basin to the field) and in institution (from system level to on-farm level) regarding above concentrated aspects. In this report, consultants propose key points which should be improved as follows: (i) Pumping stations management; (ii) Command area management; (iii) On-farm management; and (iv) Canal operation.

For each improved factor, specific activities in short term and in the future are also going to be proposed in Annex 3.
3. Monitoring/evaluation - Adjustment

A Benchmarking system will be developed for Monitoring and Evaluation of the irrigation system performance annually.

For long-term permanent, a M&E system should be developed and applied for implementation of the irrigation modernization strategic plan of the system to: (i) ensure the plan is implemented in accordance with the roadmap set out; and (ii) promptly adjust goals as well as the inadequacies happen to adjust strategic plans accordingly Modernization with the general context.

Conclusion and Recommendation

Irrigation modernization is now a major problem in the implementation of National Program on Restructuring Irrigation Sector. With the deterioration of the irrigation systems and changing the approach in the management and exploitation of irrigation works from service to service with the required utilization of water resources multi-purpose building frame modernization is in line with the requirements of industry restructuring irrigation agriculture industry restructuring.

Thus the results of the research on IMF are consistent with the requirement and orientation of the sector and it will help the irrigation manager to set up and implement comprehensively a strategic plan on irrigation system modernization. On the other hand, it also enables the State-owned irrigation management agencies to be more convenient in developing plan of rehabilitation, improvement, and modernization of irrigation systems to meet the requirements of sector development and socio-economic development plan of the country.

An Irrigation Modernization Framework can be built with the service oriented management and Modernization approaches makes framing Modernization plan in detail for the irrigation system suitable for common development trend. Each detail frame Modernization Irrigation in each system will enable management unit
operators know the status of the irrigation system, the upgrade work to modernize the roadmap ... to ensure the required carrier service.

On the other hand, Modernization Irrigation Framework will also help the state authorities were aware of the situation and the operations and development in irrigation systems in the country to serve the review, adjustment and enact appropriate policies to improve the efficiency of management and exploitation of irrigation systems in Vietnam.

In order to disseminate and implement the irrigation modernization framework to enhance the performance of the irrigation system, the next necessary activities are: (i) Submit to MARD to promulgate the irrigation modernization framework to the IMC as a base for planning irrigation modernization toward service-oriented management approach in short-term and long-term; and (ii) Develop the guidance with the tools and training for the IMC and State-owned irrigation management agencies at provincial level on development of irrigation modernization framework.
References


