# APPLYING KNOWLEDGE MANAGEMENT FOR IRRIGATION PERFORMANCE IMPROVEMENT IN LARGE IRRIGATION SYSTEM IN INDONESIA

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## ABSTRACT

Following the development of irrigation system infrastructures, the irrigation management becomes the next focus. The challenge irrigation management is related to human resources and their knowledge management. The problems occurred in human resources and knowledge management may threaten the sustainability of irrigation system. Some efforts to develop knowledge system in irrigation management system has started to develop. The objective of this paper was to analyse the development of knowledge management system in three different cases of irrigation management. This paper is based on irrigation from system approach and cycle of knowledge management implementation. The cases were Clean Irrigation Movement in Yogyakarta Province, Operation and Maintenance of Irrigation system of Lodoyo Irrigation System in East Java, and Irrigation Management Unit in Colo Irrigation System Central Java and East Java Provinces. From the cases, it was learnt that knowledge of individual in irrigation management determines the advancement of irrigation system and its sustainability. The success of institution is in management of its knowledge that influences the success of irrigation management.

**Keywords:** irrigation management, knowledge management, human resources, irrigation performance, operation and maintenance.

## 1. INTRODUCTION

Irrigation is a major adaptation action of agriculture. Recently the irrigation system in Indonesia has been developed rapidly, especially the infrastructures. However, following the development of infrastructure, management is highly required to produce high performance in a sustainable way. The biggest challenge in irrigation management is related to human resources and their knowledge management.

The organization structure as well as carrier path systems in government offices lead to inadequate knowledge on irrigation operation and maintenance of irrigation staffs. Employment system and career path systems allow staff shifting or promotion among different job descriptions. Therefore the motivation to learn about irrigation operation and maintenance is low.

In addition, the culture of sharing among irrigation management staff has not been developed well. Because of heavy work load, everybody tends to accomplish their own job. They do not share their experiences and knowledge to each other. Under

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the employment system, this challenges the sustainability of knowledge in the institution responsible to irrigation management.

The problem of human resources and their knowledge management is not only happening in the government institutions but also at farmer level. The Water Users' Association (WUA) is responsible to manage irrigation system in tertiary level and is allowed to participate in main system management. However, farmers are mostly old. The capability of older people to learn new knowledge is usually low. Moreover the knowledge sharing between generations is not running smoothly.

University as Gadjah Mada (UGM) researchers, especially who are interested in irrigation management, have conducted research in accordance to development of knowledge management in irrigation operation and maintenance. The development processes have passed through tortuous steps which may be different from one case to another. The objective of this paper was to analyse the development of knowledge management system in three different cases of irrigation management.

## 2. METHODS

### 2.1 Theoretical Background

Irrigation is an important input into food production and this is a national level policy priority. Irrigation system performance can be evaluated using a nested system approach (Small & Svensend, 1992). This approach considers the irrigation system as a part of the irrigated agriculture system which is a component of the agricultural economic system, rural economic system, and political economic system, respectively. Irrigation water as an output of an irrigation system becomes an input for downstream irrigated agriculture systems. Therefore good-performance, high efficiency irrigation systems may force improvement of wider system performance.
In this paper, a systems-based approach was taken to draw a boundary around the sphere of influence whereby water and irrigation related policies and management directly contribute to the irrigation performance. This irrigation-water management system can be visualised in Figure 1 with 5-Pillars of Irrigation Services that underpinning the production system(Burton, 2010; World Bank, 2015; PUPR, 2014).

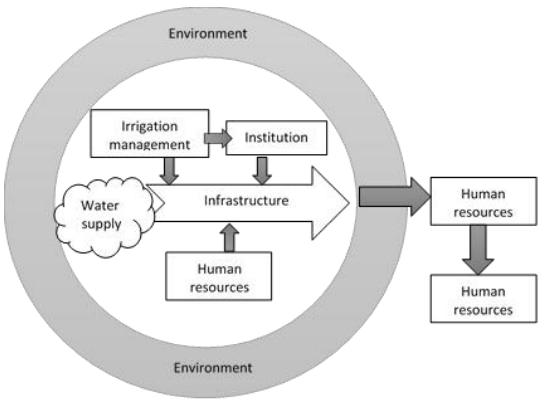


**Figure 1.** Five pillars of irrigation management

Five pillars of irrigation services consist of water supply, infrastructure, irrigation management, institution, and human resources. These pillars encapsulate the determinants of a good level of service that supplies water to the field and hence the irrigation services. This recognises the importance of taking a holistic and systematic approach and that there are many factors starting with water availability and its supply through reservoirs-rivers-weirs-canals before it reaches the farmers. Recently, the

understanding of human as a centre of irrigation management is increasing. In the future, the role of wise and knowledgeable human resources, will play an important role. The Ministry of Public Works and Infrastructures accommodates this concept in the Principles of Indonesia Irrigation Modernization (PUPR, 2014).

The concept of human capital and knowledge management has risen because the need of organization to encounter the business competition which became higher. Organization members should become learners to establish learning organization. Knowledge management is defined as integrated approach to identify, create, classify, store, share, as well as implement knowledge to improve organization performance by improving its productivity, service quality, or growth(Girard & Girard, 2015). In practice, the implementation of knowledge management consists of knowledge generating, knowledge extraction, knowledge coordination, and synthesis.

Based on the knowledge management implementation, a cycle of knowledge management system for sustainable irrigation has been developed and applied to three cases in three irrigation systems. Knowledge management system for sustainable irrigation consists processes of collection, usage, enrichment, sharing, assessment, and building of knowledge as shown in Figure 2. This study applied knowledge management system based on Figure 2 for three cases namely Clean Irrigation System in Bantul Regency, Lodoyo Irrigation System, and Colo Irrigation System. The implementation of each stage was specific for each case.


**Figure 2.** Implementation of Knowledge Management System for Sustainable Irrigation

## 2.2 Case Study: Bantul District

Clean irrigation movement has been started as a respond of trash which pollutes river and irrigation system(Sulaeman, et al., 2019). Rivers in Yogyakarta are mostly polluted with various types of trash while they are sources of water for irrigation. Farmers were complaining to the government; however, no solution was able to reduce the pollution significantly.

Bantul District is located in the South Part of Yogyakarta Province. Rivers flow from North to South through other district and municipality bring garbage with their stream. Therefore, Bantul farmers are the most sufferers from this problem. The UGM has accompanied Bantul farmers who belong to some Water Users' Association in developing clean irrigation movement. The clean irrigation movement was announced in 2013. It was called movement because it was an informal institution. The clean

irrigation movement used Javanese culture to develop farmers will to participate in the cleaning of their system. The process was announced through mass media to invite people to clean river and other water body. On the other side people were taught to separate trash and sell them to recycle company.

### 2.3 Case Study: Lodoyo Irrigation System

Lodoyo Irrigation System (12,219 ha) is located in East Java. The weir is administratively situated in Blitar District while its irrigated area is spread in Blitar and Tulungagung Districts. Lodoyo Irrigation System was a system to develop irrigation operation and maintenance model based on knowledge management. Management of Lodoyo Irrigation System is under authority of central government which is executed by Brantas River Basin Authority. Brantas River Basin Authority delegates the authority to the East Java Provincial Government. The East Java Provincial Government cooperates with district governments of Blitar and Tulungagung to manage the irrigation system. The district governments provide human resources and execute the daily operation and maintenance. UGM were assigned to design operation and maintenance based on knowledge management in the system.

### 2.4 Case Study: Colo Irrigation System

Colo Irrigation System (26,234 ha) abstracts water from Bengawan Solo River and distributes water through main canal which consecutively divided into Colo Barat and Colo Timur Primary Canals. The headworks of Colo is located in Sukoharjo District and irrigates water to rice fields in Wonogiri, Klaten, Sukoharjo, Karanganyar, and Sragen in Central Java as well as Ngawi District in East Java. Colo irrigation System is under authority central government which is executed by Bengawan Solo River Basin Authority. Since the River Basin Authority has inadequate human resources for field works, they assign farmers, in this case committee member of WUA,to conduct daily Operation and Maintenance activities. In this case, the assigned WUA responsible directly to Bengawan Solo River Basin Authority. UGM was assigned to develop irrigation management unit in the system.

## 3. RESULTS AND DISCUSSION

### 3.1 Case Study: Bantul District

The Clean Irrigation Movement has been declared in 2013 but its process started more than one year before the declaration. For more than six years, the Clean Irrigation Movement has accomplished more than one cycle of knowledge management system as shown in Figure 2. The first cycle has completed by passing all six steps:

1. Collect : Identification of problems and related parties
2. Use : Problem formulation and how farmers reacted to the problem
3. Enrich : Concept formulation of Clean Irrigation Movement
4. Share : Declaration and implementation of Clean Irrigation Movement
5. Assess : Internalization of concept and culture aspects
6. Build/sustain/divest : Strengthening of concept.

Farmers in Bantul suffered from trash accumulated in streams because Bantul is located in the downstream of rivers flows in Yogyakarta Province. This required extra efforts on Operation and Maintenance of irrigation system. At the beginning, it was important to identify the root of the problems and parties responsible for it. This resulted in the concept of Clean Irrigation Movement which was declared in March

2013. The first cycle was concluded by internalization of Clean Irrigation Movement as part of irrigation operation and maintenance.

Subsequently the process of empowerment continued to second cycle which has completed three steps:

1. Collect : identification of the sustainability problem of irrigation system
2. Use : Problem formulation of influence of river and farmer income for irrigation.
3. Enrich : Relation initiation with river communities and introduction to high value agriculture

The second cycle concerns with the sustainability of irrigation system, therefore the first step was to identify possible threat for irrigation sustainability. The identification found that two main threats were firstly trash in irrigation network came from river system and agriculture produces small profits so that the young generation is reluctant to become farmers. Therefore the next step were to develop relationship with river community and to introduce high economic value crops.

As a complement to the knowledge management cycle, the next step is to internalize collaboration with river communities and develop marketing of high value crops. The next steps will be:

1. Share : Collaboration with river community and initiation of high value agriculture.
2. Assess : Internalization of clean water body concept and development of economic activities.
3. Build/sustain/divest : Institution strengthening.

### 3.2 Case Study: Lodoyo Irrigation System

UGM has been assigned to develop operation and maintenance Lodoyo irrigation system based on knowledge management. This has started by identification of existing knowledge of irrigation management actors, both government officials and water users association. Subsequently, UGM identified the gap between knowledge of irrigation management and the importance of each operation and maintenance process based of regulation. Some significant gaps have revealed some important steps of operation and maintenance activities, especially activities with paper works. This had shown that the knowledge on filing and archives was weak. This step has been followed by formulation of strategies to reduce knowledge gap. Therefore, the case of Lodoyo Irrigation System has passed three steps:

1. Collect: Study on the need of knowledge management in irrigation operation and maintenance
2. Use: Mapping of knowledge and business process of operation and maintenance
3. Enrich: Strategy development of knowledge management in irrigation management.

The next steps should be the implementation of strategies for operation and maintenance of Lodoyo Irrigation System. The operation and maintenance will be assessed to evaluate the strategy. Result of this implementation would be the new approach on irrigation management.

1. Share: Strategy implementation of knowledge management in irrigation management
2. Assess: Evaluation of implementation of knowledge management in irrigation management
3. Build/sustain/dives: Develop new approach on irrigation management

### 3.3 Case Study: Colo Irrigation System

Based on the structure of River Basin Authorities in Indonesia, irrigation management has been carried on by some divisions. Sometimes this condition may lead in the overlapping of duties in the fields. UGM has been assigned to develop an institution to especially cope up with irrigation operation and maintenance. This started by identification of problems, regulation, and business process as well as mapping the results.

Therefore the Colo Irrigation System case has passed two phases:

1. Collect : Identification of problems, regulation, and business process
2. Use: Mapping of knowledge and problems.

The followed process will be formulation strategy to apply knowledge management, implementation of knowledge management to develop irrigation management unit, and evaluation of the implementation strategy. Finally, the strategy may become based for the irrigation management unit. In brief, the following steps are:

1. Enrich: Formulation strategy to apply knowledge management in irrigation management unit
2. Share: implementation of knowledge management based irrigation management unit
3. Assess: Evaluation of knowledge management based irrigation management unit
4. Build/sustain/divest: Development new concept of irrigation management unit

### 3.4 Discussion

UGM has experiences in implementing knowledge management in irrigation management. Generally the steps begin with the identification of knowledge and condition of the problems. From the three cases, it was identified that the knowledge of individuals in the institution were varied. Identification of the existing knowledge including unwritten knowledge is the key for the strategy development and its implementation as the next steps. Knowledge of individuals should be improved towards institutions knowledge because this determines the high irrigation performance and sustainability. Process of implementation, evaluation, and development of new concepts may take a long process. However when the new knowledge is successfully set up in an institution, the irrigation management will proceed towards better condition.

## 4. CONCLUSIONS

From the cases, it was learnt that knowledge of individuals in irrigation management determine the advancement of irrigation system and its sustainability. The success of institution in management of its knowledge influences the success of irrigation management.

## 5. ACKNOWLEDGEMENT

Appreciation is addressed to the Directorate General Water Resources of the Ministry of Public Works and Infrastructure who financially support the research through 'Love the Irrigation Operation and Maintenance' activities. Our gratitude also goes to the Faculty of Agricultural Technology, University as Gadjah Mada for supporting all of our activities. Our thank you are never enough to show our appreciation to all of farmers, WUA, and local government for their participation to the knowledge management cycle as a part of our research.

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