



## COMPARATIVE REVIEW OF MANAGEMENT-OPERATIONS AND MAINTENANCE ORGANIZATION FINANCING OF IRRIGATION SCHEMES IN OTHER COUNTRIES AND TURKEY

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### Abstract

The objectives of financial management in the irrigation scheme Management-Operation and Maintenance (MOM) can be listed as facilitating the efficient use of assets belonging to the irrigation organization, managing financial assets for the benefit of its members, determining the financial status of the organization, establishing and protecting the trust of its members, and ensuring the existence and sustainability of the organization. In addition, the institutional structure and effectiveness of an irrigation organization is largely related to success in its financial management. For this reason, the creation of a new irrigation organization using cost-effective technology is more preferable to the use of more expensive technology. Irrigation organizations make different types of expenditure when providing irrigation services for farmers. Within these expenditures, it is essential to make a distinction between economic expenditures involved in the regulation of irrigation services and financial (accounting) expenditures. The most important element of irrigation MOM financing consists of MOM expenses spent for per unit area by irrigation organizations and personnel expenses. Poor irrigation system is in part a result of insufficient allocation of resources. The quality of MOM of irrigation system is affected not only by the amount of resources made available to operate and maintain systems, but also by the institutional arrangements under which they are provided. Financially autonomous agencies, dependent for a significant portion of their revenues on farmer's payment of irrigation service fee, have a greater incentive to provide good irrigation service than do financially dependent agencies that receive their budget from the national treasury. This study reviewed the financing methods of irrigation MOM services and its elements in other countries and Turkey.

**Keywords:** irrigation scheme, irrigation financing, irrigation MOM costs, and MOM personnel costs

### Introduction

Financial subsidies for water resources development and management, and irrigation Management-Operation and Maintenance (MOM) services have long been a popular policy tool (Tiwari and Dinar 2002). Therefore, this situation has led to the subsidization of water resources, which is one of the most important inputs of irrigated agriculture (Scheierling *et al.*, 2006; Fan *et al.*, 2008; Ward, 2010). While there are many challenges related to water issues such as increasingly scarce water resources (FAO, 2012), related food safety issues (FAO, 2015) and water-related environmental stress (Gilboa *et al.*, 2015; Guse *et al.*, 2015), efforts required for sustainable development of water resources management still continues. Approaches to irrigation financing require understanding of a country's relevance to irrigation issues. These issues were enumerated as: increasing the efficiency of using national food production, government revenues and water resources, increasing the production of farmers who make a living from agriculture, fulfilling regional and national

objectives (Rogers and Bhatia, 2002). The objectives of the financing policy regarding the organization of irrigation MOM are to improve irrigation systems performance, irrigation investment decisions, the government's financial position, and to ensure a balanced distribution of income among users (Koç and Bayazıt, 2015). In the irrigation sector, the 1990s are highlighted as a process where intensive studies were carried out on the performance of irrigation systems, whose construction was completed and the organization services of MOM were carried out. In many evaluations made, although the income obtained by the farmers who benefit from irrigation services and the supports planned to be made with irrigation in economic terms are known, there is a common opinion about the need to improve irrigation performance. Generally, the deficiencies in the operation-maintenance and management of the irrigation system are shown as an important reason for the poor performance and insufficient MOM financial resources not at the desired level of the provided services (Koç, 2001). It is widely thought that a

substantial increase in irrigation fees, which constitute primary revenues of irrigation MOM, will directly result in better MOM organization services and improve overall performance of the system. Although it is thought that higher irrigation fees should be taken into account in order to carry out the desired level of MOM organization services in the sample irrigation systems examined. There is no guarantee that higher irrigation fees will directly improve the MOM and overall performance of the system (Koç, 2003). In practice, irrigation fees are usually determined below MOM cost (Molle, 2009) and financial support from public funds is common. In many cases, this has led to unsustainable financing, under-utilization of resources and adverse environmental impacts for organizations managing irrigation schemes (Renzetti and Dupont, 2015). The concept of MOM organizational costs has a flexible use, which usually includes the sum of all costs related to the maintenance of irrigation and drainage facilities. For this reason, there are great differences between the studies which are considered as the organization services of the MOM in an irrigation system and the MOM studies of another irrigation system having the different technology. Only these two elements show that there is a wide distribution among irrigation systems MOM costs for any of the studied countries. In this study, the financing methods of the MOM organizations established for the purpose of carrying out the MOM services in Turkey and other countries, business resources, expenses, primary and secondary incomes, and the managerial controls of the resources used, has been examined.

#### **Irrigation Systems (MOM Organization Financing)**

Financing policies, in which institutional arrangements for irrigation MOM organizations are determined, are linked to four main elements. These elements include: allocating resources for irrigation MOM organization, using resources to perform MOM services, obtaining resources from water users, and controlling the resources used (Rogers *et al.*, 1998). Those excluded from the third financing policy have a limited impact on improving the MOM costs. The impact of MOM organizational financing policy on institutional regulation is greatly influenced from the way responsibilities are organized for these four elements. The important distinction is between financial autonomy (full or partial) and financial dependency conditions. With financial autonomy, an irrigation MOM organization has at least partial responsibility for all four elements. In particular, it has control over the resources obtained from water users. In this context, the irrigation MOM organization has control over the partial or complete allocation of resources to perform MOM services. In the condition of financial dependency, the irrigation MOM organization does not have control over the revenues from water users, and is dependent on the resources allocated to MOM services from the general government budget (Koç, 2003). The social dimension of MOM organizations varies to the behaviors of water users, and the economic and technical dimension varies to the institutional structure

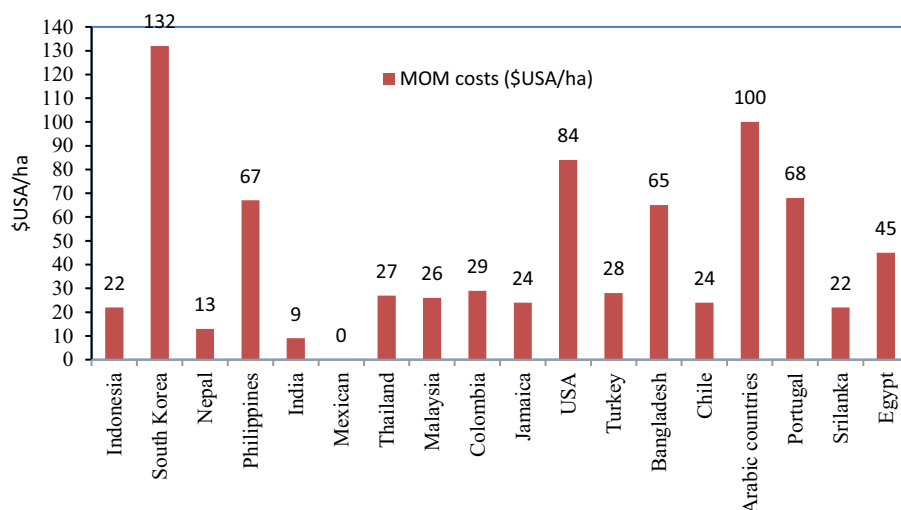
of the organizations which perform MOM services (IIMI, 1989). Irrigation MOM financing policy has the potential to improve irrigation investment decisions and the government's financial position, to increase the resources required for MOM, improve the operational efficiency of irrigation facilities, create more necessity and cooperation for MOM, feel more responsible for water users of irrigation managers and to increase water use efficiency by individual water users (ADB, 1986). In a World Bank study, where many irrigation projects were evaluated, it noted that the irrigation MOM organizations which are responsible for collecting irrigation fees and who remain with them to fulfill the MOM organization of irrigation systems have generally the best performance (Duane, 1986). Potentially, the fact that irrigation systems have different physical elements (water source, water intake structure, conveyance and distribution systems), bringing MOM services to social stratas at different development levels and the need for resources at different levels of MOM organizations. When Irrigation Associations (IAs) are established in irrigation systems managed by public institutions and MOM services are transferred to users, the cost of MOM will decrease considerably. Because water users especially use their workforce much more effectively, there is no significant cost increase as a result. In this context, the low-cost MOM organization is a model that transfers tasks to the lower levels that can effectively perform tasks and fulfill responsibilities at the highest level (Koç, 2007, 2017). Financial autonomy of organizations that carry out irrigation MOM organization services is a requirement to improve performance (Koç *et al.*, 2006). During the processes in which irrigation systems are operated by the public institutions, due to the loss of water charges provided from irrigation systems in the general revenues, a link between the return of high costs in public projects and improved MOM studies could not be established. Even if the income has increased substantially under the current circumstances, there is no guarantee that the MOM allowances will increase at the same rate. In fact, there is no organic relationship between the allocation provided from the State budget and the performance of the MOM organization. However, it is important when an organic link is established between the organization's MOM expenses and performance on one hand, and collected MOM revenues and services provided on the other hand. In numerous studies conducted by organizations such as the World Bank, Asian Development Bank and International Management Institute, it revealed that the level and quality of the MOM services improve if the institution collecting the water charges has the authority to spend these revenues for MOM services. The full recovery of the MOM costs is important in terms of ensuring the financial continuity of irrigation systems (GAP, 1993).

#### **MOM costs of irrigation systems in Turkey and other countries**

Annual MOM organization expenses consist of the expenses that must be made each year in order to fulfill the function of the structure and organization. Another

method to examine the possibilities of identifying and reducing costs of the irrigation systems MOM organization is to analyze the weight and rates of MOM business resources in total MOM organization costs. Among the examples of irrigation systems selected from Turkey and other countries, the average MOM expense to the unit area (\$/ha; \$; USA dollars, for the year 2018) and MOM personnel expenses (%) are shown in Figure 1 and 2 respectively (ADB, 1986; IIMI, 1989, 1990; FAO, 1991; IMI, 1994 ; Svendsen, 1991; Sagardoy,

1986; Sagardoy *et al.*, 1986; Koç, 1997; Mandel and Parker, 1985; Vermillion, 1989; Frazao and Pereira, 1993; Koç and Bayazit, 2015; Koç, 2015). The highest MOM cost in irrigation schemes examined in Turkey and other countries realized in South Korea with 132 \$USA/ha, the lowest MOM cost in Mexico, and the average MOM cost was found as 43.63 \$USA/ha in irrigation schemes of Turkey and other countries. Average MOM cost for Turkey was calculated as 28 \$USA/ha (Figure 1).



**Figure 1.** MOM Costs in Turkey and Other Countries

(ADB, 1986; IIMI, 1989, 1990; FAO, 1991; IMI, 1994; Svendsen, 1991; Sagardoy, 1986; Sagardoy *et al.*, 1986; Koç, 1997; Mandel and Parker, 1985; Vermillion, 1989; Frazao and Pereira, 1993)

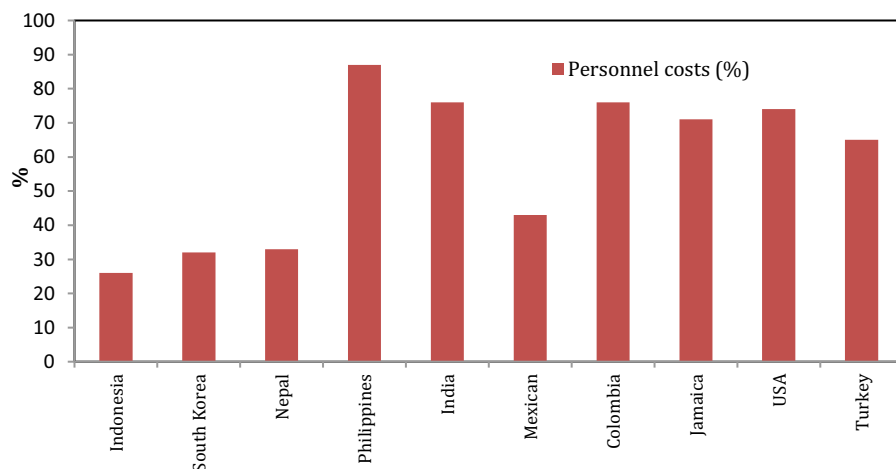
MOM expenses of unit irrigation area are calculated as the ratio of total MOM expenditures to total irrigation area used. Koç (2015) stated that average value of MOM is 101 \$USA/ha in 8 irrigation schemes operated in Büyük Menderes basin-Turkey. Malano *et al.* (2004) defined the average MOM value of the Fuente irrigation network in Spain as 220 \$USA/ha. Çakmak *et al.* (2009) found MOM values ranging from 47 to 109. Yavuz *et al.* (2004) in the Lower Seyhan basins in Turkey, average value of MOM was calculated as 18,7 \$USA/ha. In a study on organizational financing of irrigation systems MOM services, Koç (2001) reported that financial autonomy increases the efficiency of MOM in irrigation by comparing different countries with each other. The MOM value can vary depending on the pumping or gravity of the water source, and the irrigation ratio of the project irrigation area, size of the irrigation area, total irrigation water revenue, whether there is routine maintenance, management organization structure and on physical structure of the irrigation scheme. MOM expenses vary depending on the physical elements of the irrigation systems, technology, period of irrigation operation and whether the periodic studies that need to be made each year are carried out or not. Although the elements that constitute the MOM business resources in irrigation systems are close to each other, MOM costs for per unit area are low in irrigation systems with high irrigation rates, and high irrigation

networks with low irrigation rates (Koç, 1997, 2015).

The highest personnel cost in irrigation schemes examined in all countries calculated in Philippines with 87%, the lowest personnel cost Indonesia with 26%, and the average personnel cost as 58,3% for irrigation schemes of Turkey and other countries. Average personnel cost for Turkey realized as 65% (Figure 2). Sagardoy (1989) stated that personnel expenses are generally over 65% in the work resources analysis of the selected irrigation systems in a study conducted by FAO in developing countries. In the irrigation systems in the Büyük Menderes basin, the number of personnel decreased by 50% compared to before the transfer after they were transferred to the irrigation Associations (IAs). In other words, after the IAs were established, the area controlled by the unit personnel increased an average of 2.03 times. There is a sufficient statistical relationship between irrigation network density and the impact of unit personnel service area on project irrigation efficiency. The increase in the irrigation network density and the control of the irrigation area by the sufficient number and qualified personnel increase the irrigation efficiency of the project (Koç, 1997). While a total of 300 personnel were working before the transfer in both Coello and Saldano IAs in Colombia, this number decreased to 184 after the transfer and a 37% decrease was realized. While a personnel

controlled 62.5 ha of area before the transfer, this value increased to 157.7 ha after the transfer (Vermillion, 1989). Personnel costs is defined as the ratio of total personnel expenditure to total MOM expenditure. Koç (2015) found that average personnel cost is 41.3% in 8 irrigation schemes operated in Büyük Menderes basin-Turkey. The number of personnel who will carry out the irrigation MOM service in IAs should be determined according to the responsibilities and objectives of the

IAs. Davidson *et al.* (2003) determined personnel costs varying between 33.8 and 54.1% between 1996-2000 at the Cu Chi irrigation facility in Vietnam. Yavuz *et al.* (2004) reported personnel costs changing between 25.0-69.0% in Lower Seyhan Basin in Turkey. In general, all studies have shown that personnel costs in MOM expenditures are much higher than other MOM expenditures. Personnel costs in IAs are expected to become more stable over the years.



**Figure 2: Personnel Costs in Turkey and Other Countries**

(ADB, 1986; IIMI, 1989, 1990; FAO, 1991; IMI, 1994; Svendsen, 1991; Sagardoy, 1986; Sagardoy *et al.*, 1986; Koç, 1997; Mandel and Parker, 1985; Vermillion, 1989; Frazao and Pereira, 1993)

Work resources for the organization of irrigation systems MOM consist of personnel, equipment, materials and equipment, energy and utilities, buildings and other elements. In addition to the possibilities of reducing the expenditures required to fulfill the MOM services, the possibilities of identifying and increasing the MOM revenues to be used in financing the MOM expenses should be examined carefully. Irrigation financing mechanisms, in other words, MOM revenues required to meet the MOM expenses include direct and secondary income methods. Fees affecting water users in irrigation MOM services are named as irrigation MOM fees. Secondary incomes consist of revenues that are not directly related to the irrigation service carried out. Secondary revenues are generated as a result of institutional arrangements that allow the MOM organization to generate revenues from other sources than government budgets and fees collected from water users. Since irrigation fees to be collected from water users constitute the main component of the MOM revenues, determining the irrigation fees constitutes an important part of MOM financing. Effective MOM cost analysis, while determining irrigation fees must be carefully determined according to the conditions of the country's economy (inflation, devaluation, stagflation, etc.) and the rate required for reorganization expenses (building, construction machinery, workshop, etc.) and the proportional value of water charges, unit of water used and MOM expenses for per unit irrigation area. Theoretically, the water charges that cover the MOM expenses should be slightly higher than the MOM organization costs. This policy allows an additional allowance to cover the loss of unexpected failures in the

physical elements of the irrigation system or some improvements carried out.

IAs in some countries have other input sources than irrigation fees. These secondary sources of income are used to finance irrigation MOM services. In China, IAs can undertake secondary activities income-generation to finance MOM services. Some IAs in Taiwan observed that some existing irrigation channels are unnecessary as a result of the irrigated land turned into non-agricultural use, and they made gains in meeting the MOM expenses by selling the land where these channels are located. In Thailand, small dams are used for fish production by IAs, the revenues provided cover some of the MOM expenses and shared among the users. Secondary income from the sale of non-agricultural water and rental income of properties in South Korea corresponds to an average of  $\frac{1}{4}$  of the total MOM income of the IAs. Secondary incomes were provided by the work machines belonging to IAs providing services to private individuals for a fee in Peru. In addition, it can produce some of the energy required by the irrigation system (as a result of burning agricultural residues). In some channels, favorable conditions are created for the establishment of mini hydroelectric stations. In the USA, the IAs are supported by the government policy to grant rights to IAs for certain types of secondary income, such as the profits of the hydroelectric power plant, the rental income of the project land used for pasture and agriculture (IIMI, 1989).



## Conclusion

Irrigation MOM organizational financing mechanisms enable more efficient operation of irrigation systems under financial autonomy conditions. Irrigation primary revenues from water users, and revenues provided from secondary sources by financial autonomy, remain with the MOM organization to carry out the MOM services. The responsibility of irrigation managers for water users increases under conditions of financial autonomy. Because, irrigation systems MOM organization managers are aware that the financial viability of the organization depends on the resources to be obtained from water users. There is need not to increase the secondary income sources too much in MOM financing. This situation significantly reduces irrigation administrators' dependence on payments made by water users and may lead to deficiencies in the level of responsibility of managers. Turkey and other countries are generally thought of having two types of MOM expenses. These are MOM expenses that are realized and desired to be made in line with the available resources. It is very difficult to determine a certain proportional value of MOM expenses according to the technologies included in the irrigation systems. The question of whether the distribution of irrigation systems MOM organization expenses is different in a developed country compared to developing countries has been a subject of discourse to date. We have very little information to explain this issue clearly. However, the indicators suggest that a relatively small proportional distribution for other elements, which remains large for operation and maintenance, may be more appropriate.

In financially dependent MOM organizations, MOM expenditures are realized in line with the country resources, and in financial autonomous organizations with the resources provided from water users. Financial autonomous irrigation MOM organizations should take the financial self-sufficiency ratio as the financial performance indicator in system operation, and determine the costs and revenues of the MOM according to this indicator. The fact that financial autonomous irrigation organizations take care to reduce the costs of MOM to a level which will not disrupt the irrigation services will help to realize if irrigation fees is in the amounts desired by the users.

Proportional variation of MOM personnel costs was realized in a wide range in the analyzed irrigation systems; irrigation systems for developed and developing countries. There is no optimum proportional measure of the personnel expenditure of MOM. In developed countries, fewer staff work with higher salaries, while in developing countries, a larger number of staff with less qualifications work at lower wages. Since personnel expenses constitute the biggest element of total İBY expenses, it has the greatest opportunity to decrease total MOM expenses. Therefore, it should show the necessary care to use the MOM staff effectively. The manpower required in the MOM studies should be put forward effectively in order to identify the number of over or lack of personnel easily. The number

and quality of personnel required by irrigation systems should vary according to the physical size of the system and the technology it contains. In irrigation systems, the number and qualification of personnel that will bring the performance indicators of the MOM to the desired level and optimize the personnel expenses within the MOM expenses should be determined. Personnel expenditures, which have the most important proportion in the MOM expenditures, should be kept at an appropriate level (30-35%) within the MOM budget, taking into account the recommendation of the relevant institutions carrying out the MOM services before the transfer, their own observations and service efficiency. Instead of employing more staff, efforts should be made to carry out services with a smaller number of more qualified and efficient staff.

MOM organizational expenses which occur in selected irrigation systems in Turkey and other countries shows quite a different distribution. This situation stems from the physical characteristics of the irrigation systems, the behavior and income levels of water users benefiting from the MOM service according to countries, the degree of utilization of technological opportunities in carrying out MOM services, whether or not meticulous cost analyzes are carried out, differences in the regional income level and more importantly, the policy of the organization that manages the MOM services. MOM expenditures should be kept at a level that will allow performance of the most appropriate service in line with the available resources. Keeping irrigation costs unintentionally low will result in inadequate and timely delivery of MOM services in the irrigation system. In this context, meeting and fulfilling the services in the following years will lead to the formation of MOM expenses, which will cause economic problems. If it is kept high, it will cause an increase in the rate of irrigation expenses, which is an important input in plant production within the financial autonomous organization structure.

In the analysis of the costs of the irrigation systems, the MOM organization expenses corresponding to unit area with unit water should be taken as a basis and the MOM expenses made by years should be continuously monitored. This will enable the determination of the net ratios required by the elements included in the MOM expenses to carry out the planned studies for each year. Before moving towards increasing the irrigation MOM fees, the possibilities of decreasing the MOM expenses should be considered, and the secondary MOM revenues that will support the irrigation costs should be increased, provided that they do not go beyond the main purpose of the organization. Economic and highly beneficial technological opportunities should be utilized in order to reduce the organizational costs of MOM.

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