Capabilities of Water Users Associations in Managing Groundwater Pump Irrigation: A Case Study from East Java, Indonesia

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ABSTRACT

MAJOR ISSUES RELATED to the enhancement of benefits from groundwater pump irrigation are resource fixity, size of investment, and costs of transaction associated with effective decisions and operations of Water Users Associations (WUAs). Sustainability of a groundwater pump irrigation system depends to a large extent on the adaptive and innovative capacity of a WUA. This paper outlines the process of adaptation and innovation of WUAs in responding to resource fixity, size, and costs of transaction based upon a case study of groundwater pump irrigation systems in East Java, Indonesia. Based upon organization performance such as pump working hours, areal utilization index, and WUA's savings and revenue, the adaptation and innovation capacity of the WUAs were evaluated and classified. The process of adaptation and innovation is analyzed with reference to crop selection and diversification, water price fixation and pricing procedures, increase of savings, management of external agents and structural changes. On the whole, this research concludes that learning capability of WUAs to recognize the problems, and to find and execute alternative solutions is one of the most important factors pertaining to the sustainability of groundwater pump irrigation.

INTRODUCTION

This study is limited to groundwater pump irrigation (hereafter pump irrigation) provided by the Government of Indonesia through a Groundwater Development Project (GWDP) operated by the Department of Public Works. Even though there is a wide range of pump irrigation schemes, the government of Indonesia plays a significant role in the development of deep well pump irrigation.

Groundwater pump irrigation development project provided by the Indonesian Government was initiated in East Java in the early-1970s. By 1990 Indonesia had 853 groundwater pump irrigation schemes (GWPIs) of which 604 were in East Java and the rest distributed in Central Java, West Java, Yogyakarta, Bali, West Nusa Tenggara, South Sulawesi and Central Sulawesi. Out of 604 schemes in East Java, **504** were deep well, 60 intermediate well, and 40 were shallow

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well. The total extent of pump irrigated land in Java are 23,380 hectares (ha), 422 ha, and 144 ha for deep well, intermediate well, and shallow well, respectively (Pakpahan et al. 1992). Even though the pump irrigated land in East Java is only about 2.6 percent of total surface irrigated land in this area, the pump irrigation in East Java serves the largest and oldest areas relative to other regions. Therefore, East Java can be treated as a good social laboratory for studying the dynamics of groundwater irrigation organization (Pakpahan et al. 1992).

Pump irrigation has been turned over to a water users association (WUA) created by the government, after obtaining services for two years from the project. The WUA should provide operation and maintenance (O&M) costs. In addition, the WUA is usually responsible for replacements. A logical consequence of this development is that the WUA has become competent to handle the problems associated with O&M and replacement. Although WUAs have no previous experience in managing GWPI, their adaptability and innovative ability have become the key factors for sustainability of the pump irrigation schemes. This paper seeks to analyze the successes or failures of WUAs in managing the resources vis a vis the prospects for sustainability of pump irrigation.

NATURE OF GROUNDWATER PUMP IRRIGATION

Pump irrigation is characterized by relatively high fixed costs, resource fixity, and considerable costs of transaction. The high fixed cost is reflected by high construction costs. For example, the total cost of deep well construction in East Java in 1990/1991 was Rupiah (Rp) 64.3 million (US$33,840) (Pakpahan et al. 1992). The fixity of resources is indicated by the immobility of the pump and command area. This situation implies that the distribution of surplus is determined by the condition of canals throughout the command areas. Finally, managing the pump irrigation, namely, allocation of resources, distribution of outputs, maintenance of irrigation facilities, handling risks and uncertainty, and so on are not without costs. For an organization, the most important cost is costs of transaction, namely costs of managing internal affairs (coordinating all input suppliers) and costs of conducting external affairs. Such costs include exclusion costs, information costs and contractual costs (Schmid 1987).

Resource fixity, size of investment, and transaction costs of pump irrigation have a direct bearing on the organizational tasks. As indicated above, resource fixity has implications for distribution of surpluses or land rent. Immobility of asset and land rent differential provide opportunities to maintain water price discrimination depending on the location.

Size of investment implies the cost structure associated with the organization. The higher the size of investment, the larger the output required. It means a certain size of operation should be achieved for the investment to be economical. Otherwise, it will be too costly to operate the pump. This implies that the entry of customers into and the exit from a pump irrigation system have their repercussions on the organization. In other words, exit will create losses to the organization, therefore, to be sustainable the organization should be able to manage the prdblems associated with the exit of customers with the support from other participants.

The most important activity in any economic venture is transaction. Within the organization transaction is governed administratively, and between organizations transaction is conducted through the market process. Nature of the goods will affect the kind and magnitude of costs of transaction. High exclusion cost which is associated with nature of the goods will increase the free rider problem. Information problem will increase disputes. The higher the intra-organizational transaction costs, the lower the real output produced by the organization and the real value of the output transacted. Therefore, volume of the goods being transacted will decline. Differences in decision rules adopted by an organization will create different performance

of the pump irrigation as far as they have different abilities to control sources of interdependencies such as resource fixity or immobility, economies of size, and transaction costs.

Nature of groundwater is spatially not homogenous. We classified groundwater into deep aquifer and shallow aquifer and volcanic terrains and limestone terrains. Within these categories, we focus our study on pump irrigation in the regencies of Kediri and Nganjuk which represent volcanic terrains, and Madura Island which represents limestone terrains.

WUA PERFORMANCE

The capabilities of the WUAs are determined on the basis of their achievement (performance) that has a strong bearing on the sustainability of a pump irrigation system. Resource allocation is very significant in this context.

Resource Allocation

Land Utilization Index (LUI) and Pump Operation (PO)

Performance of resource allocation in pump irrigation is indicated by LUI and PO. LUI is defined as summation of irrigated land throughout a year divided by designed area, and PO is defined as pump working hours per year. Both LUI and PO reflect the capabilities of WUA in dealing with pump size, resource immobility, and transaction costs. The lower the value of LUI and PO given a certain size of investment, the lower the capabilities of a WUA.

Table 16.1 shows that high performance of pump irrigation utilization has been achieved by tubewell TW66 in Madura with LUI 2.35 and PO 2,395 hours, while the lowest performance has been found in TW174 in Nganjuk with LUI and PO 0.68 and 446, respectively. These figures correspond to values of cropping intensity, namely 295 percent and 167 percent for the earlier and the latter case, respectively.

This finding implies that the organizations which are characterized by low LUI and PO have low capability in managing areas of operation, therefore, they cannot control size of investment and immobility of assets. In general, WUAs that run deep well pump irrigation has better performance than that of organizations associated with shallow aquifer environments. Such environments create difficulties for the organization to deal with exit of the customers due to the entrance of private pumping into the areas or farmers investing on pumps in their own land. Even though there is a legal base for protecting the boundaries of the organization, the current performance implies that the existing transaction costs are too high to be enforced relative to the value of commodities being considered.

Conflict Resolution

Management of pump irrigation is management of conflicting interests. Conflicts between current and future generations can also arise as a consequence of scarcity of water resources. In general, where markets do not exist, conflict resolution over water resources is usually accomplished by administrative processes such as the preparation of water distribution schedules across blocks of irrigation. The higher the degree of scarcity, the higher the demand for administrative capacity.

In pump irrigation, the effective demand for water is reflected by LUI. Low LUI means low effective demand for pump irrigation water (low effective demand for water does not mean low need or low availability of water). It also means that a low degree of administrative procedure is required. For example, instead of the WUA creating a tight schedule of water distribution, water allocation is performed on the first-come first-served basis. Nganjuk is a case in point where this basis is preferred to block scheduling. On the contrary, in Kediri and Madura where LUI is quite high, water is allocated according to a block schedule.

Table 16.1. Designed extent, LUI and PO according to aquifer and location in East Java, 1991.

Aquifer/location	Code	Areal design (ha)	LUI	PO (hour)
Deep well				
Nganjuk	TW152	43.93	1.29	1,751
	TW174	44.12	0.68	446
Kediri	TW10	49.21	1.40	2,120
	TW61	37.95	2.00	1,389
Madura	TW09	23.50	0.81	950
	TW66	44.20	2.35	2,395
	TW97	32.70	2.00	2,018
	TW102	32.30	1.80	658
Nganjuk	TW116	20.54	1.02	513
	TW117	22.82	1.31	1,756
	TW138	20.75	1.20	1,631
	TW153	32.97	1.19	1,007

Source: Pakpahan et al. 1992.
Notes: LUI = Land utilization index.
PO = Pump operation.
TW = Tubewell.

Pump irrigation in Sidowareg Village, Kediri Regency, has a unique feature, namely, there are 11 units of groundwater pump irrigation in one village. The first tubewells, TWIO and TW12, were developed in 1972 and started operation in 1974. At the beginning, there was one WUA for one unit of pump. After operating for almost ten years, and after experiencing a breakdown, they found out that they cannot replace the pump by their own resources. At this juncture, a federation like organization has been created through the initiation of the GWDP. Under this setup the WUA has more power to manage the resources, particularly in dealing with assets, uncertainty, and conflicts.

Pump irrigation technically provides opportunities for water markets to operate well. It is possible because metering problems and exclusion costs are relatively low. Therefore, the price of water becomes a very important instrument for rationing while inducing an efficient water resource use. The base of pricing can be on criteria such as the cost of operation, time, crop, area, or a combination of these.

Usually, the water fee is determined on the basis of average cost that has to be borne by the WUA in providing a given quantity of water. That cost includes operational, maintenance, and organizational costs.

The implementation of water fees based upon the above costs takes a variety of forms. The condition stipulated by GRDP is that the collection of water fee should be based on a time rate. In the field situation, however, there are some modifications and/or advancements made by the organization.

Most WUAs charge the water fee using a time-based approach. In Madura, however, particularly in areas where tobacco is dominant, WUAs also use a crop base, i.e., water fee is determined on the basis of crops being watered. Different water fees are charged for rice, corn and tobacco in TW66; Madura is a case in point.

The cropping pattern in the command area of TW66 comprises of rice-tobacco-corn for the wet season, repeated by two more seasons. By 25 September 1990, rice, which is mostly planted in the wet season and only watered once or twice per season, was charged US$16.67/watering/ha, and corn which is mostly planted at third planting season and usually watered 3 to 4 times a season was charged US$1 1.11/watering/ha. Water fee for tobacco was determined differently, so as to include the whole season. In 1990, water fee for tobacco was US$44.44/ha/season. In the circumstance, farmers had to spend about US$17.00 to US$34.00/ha/season, US$33.00 to US$44.00/ha/season, and US$44.00/ha/crop season for watering rice, corn, and tobacco, respectively. The shares of water input in the total farm budget per hectare for rice, corn, and tobacco thus stood at 5.31 percent, 36.54 percent, and 18.8 percent, respectively.

Area crop-based pricing is found only in TW66, TW94 and TW97, all located in Madura. Rest of the samples are applying time-based pricing schemes. The crop-based scheme is more or less developed upon the knowledge of crop water requirement which is dependent on the type of crop, type of soil and season. Area crop-based pricing mechanism solves to some degree the problems associated with surpluses, and it is fair when canals are not in good quality, i.e., the farmers who operate the land at the tail end of the irrigation system pays on the basis of the extent cultivated independently from the distance of the land to the pump. However, the administrative requirements are more complicated than in the case of time-based pricing.

Outcome Performance

Outcome performance is defined as a performance resulting from the resource allocation strategies applied by the organization. Among others, there are two important outcome performances that contribute to the sustainability of the organization, namely, net return and savings. The higher the net return, the higher the capabilities of the organization to manage the resources; and the higher the savings, the higher the capability of the organization to manage maintenance, risks and uncertainties.

Table 16.2 shows that there are considerable variations in net returns and savings of different TWs. Highest performance in both net return and savings was achieved by TW66 in Madura. This high performance can be attributed to two sources, first, institutional strength manifested by leadership, discipline, loyalty, etc.; and second, relatively high value of crop, namely tobacco. The latter is indicated by non-marginal increase in net return/ha/year that is more than 60 percent, which is much higher than that of in Kediri (46 percent) and Nganjuk (35 percent).

Low performance of the other WUAs is due to bad irrigation facilities which are reflected by low LUI (see Table 16.1 above). In this context, the average pump operation is low. Therefore, net return is also low. Organizational weakness is also responsible for low returns and savings, i.e., the organization has a low ability to control sources of interdependencies.

Table 16.2. Net return and savings of WUAs according to aquifer and location in East Java, 1991.

Aquifer/location	Code	Netreturn (US$)	Savings (US$)
Nganjuk	TW152	115.44	195.56
	TW174	15.44	94.44
Kediri	TW10	590.89	na
	TW61	265.89	na
Madura	TW09	308.83	287.22
	TW66	1,686.50	4,555.56
	TW97	1,287.50	3,418.33
	TW102	615.67	333.33
Shallow well			
Nganjuk	TW116	4.00	na
	TW117	14.06	na
	TW138	64.61	22.17
	TW153	32.56	107.22

Source: Pakpahan et al. 1992.
Note: Net return is defined as total revenue minus total operational cost, but does not include organizational cost.
US$1.00 = Rp 1,800.
TW = Tubewell.
na = Not available.

CONCLUSION

The variation of capabilities of WUAs in managing groundwater pump irrigation is high. Type of aquifer seems to be an important factor that conditions the capabilities of an organization. The shallower the aquifer, the higher the cost for the organization because the cost to the customers are low. The latter is possible because investment cost in shallow aquifer is much lower than that of a deeper one. Therefore, WUA type of organization is only suitable for deep well pump irrigation.

The majority of WUAs experience low performance in the light of the indicators such as LUI, PO, net return and savings. However, they operate the irrigation system under their own sources. In this sense, they have a low-to-medium degree of sustainability. If replacement cost is considered as a part of sustainability of WUAs, serious efforts are called for: (i) to increase area of irrigated land—improve imgation canals, increase working hours, develop group farming, improve pump-farming management, improve cropping pattern, reduce operational cost; (ii) to increase farmers' ability to pay—reduce operational cost, choose high value crops, improve farm technology, economize group farming, reduce transaction costs; and (iii) to increase organizational ability—find a good leader, develop better standard operating procedures, develop better administrative structure, develop skills and knowledge of participants, develop values

conducive to organizational objectives. The case of Kediri in strengthening administrative capacity and the case of TW66, TW94, and TW97 in Madura in both improvement of pricing rules, strengthening organizational capability and other related issues, can be taken as lessons by WUAs to cope with resource fixity, size of investment, and transaction costs.

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