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Water use Efficiency in Bangladesh Agriculture: Management and Water charging issues

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Abstract

Improving the performance and efficiency of water management in agriculture could save water from existing uses. Better management of irrigation water and appropriate water charging possibly willenhance greater efficiency in water use. It is necessary to improve the performance and operations of the existing irrigation systems in Bangladesh for improving water use efficiency. This study used the review of existing literature on irrigation water use efficiency and water pricing in Bangladesh agriculture. It is found that performance and operations of the existing irrigation systems in Bangladesh is too poor in terms of water use efficiency. Moreover, low water pricing is causing excessive and inefficient use of water. Improved management of surface and ground water irrigation and appropriate pricing strategies are suggested for achieving physical and economic efficiency in water use.

Keywords: ***water use efficiency, water management, water charging***

Introduction

The need for efficient, equitable, and sustainable water allocation policies in water resources management has become important with growing scarcity and increasing competition among different water using sectors (Cai, Ringler and Rosegrant 2001). With the increasing competition for water among neighboring farmers and competition between agricultural and nonagricultural water use, the efficiency of water use is brought utmost consideration. The crops can be grown with limited quantities of water rather than unlimited quantities of water that is often caused for waterlogging and salinization of agricultural lands. To improve the efficiency in water use a more sophisticated water management is essential rather than traditional water use. Efficient use of water for crop production is now often a major goal in designing and management of irrigation systems (Burt et al. 1997). Besides, aagricultural water pricing plays a significant role in promoting water use efficiency and cost recovery (Akter 2007). Lower water price may leads the inefficiency in technical water use for irrigation. Irrigation water price in Bangladesh is low and does not reflect the actual value of water. The main aim of this paper is to review the existing literature on management and

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water charging in agricultural water use and to stretch an idea of improving water use efficiency in Bangladesh.

Efficiency issues of water use in agriculture

The term water use efficiency is often misstated. Irrigation efficiency is described by various terms and is used to describe how efficiently irrigation water is applied and/or used by the crop (Environment Canterbury n.d.). Incorrect usage of these terms is common and can lead a misinterpretation of how well an irrigation system is performing (Irmak et al. 2011). "The physical efficiency compares the volumes of water delivered and consumed; economic efficiency relates the value of output and opportunity costs of water used in agricultural production to the value of water applied. A further definition compares the water applied to the biomass or yield output" (Cai, Ringler and Rosegrant 2001). It is not always clear the relationships between these various measures of water use efficiency but all of these efficiency concepts can be useful for irrigation water management and have important policy implications (ibid).For understanding water use efficiency three points are highlighted in a report published by Land and Water Australia (2003):

Firstly, all measures of water use efficiency are essentially physical, referring to either technical efficiency or to, at best, partial measures of economic efficiency.

Secondly, there are multiple measures of water use efficiency each focusing upon a particular issue and objective.

Finally, while irrigators are price and cost conscious, ultimately whether or not an irrigator seeks to increase their water use efficiency depends on whether doing so will improve income, lower risks or reduce labour input, or improve the trade-offs between these.

The possible benefits of water use efficiency for on-farm and within irrigation schemes include operating and pumping cost savings, improved environmental performance of irrigation systems, restore river flows and groundwater recharge and the potentiality of irrigating a larger area with a given volume of water (Environment Canterbury n.d.).

Surface water and Groundwater management in Bangladesh

The public sector dominated water resource development started with the construction of Flood control and Drainage (FCD) and Flood control, Drainage and Irrigation(FCDI) in late 1950s and early 1960s. The Water and Power Development Authority (WAPDA), one of the major government agencies is responsible for building large scale water management projects in Bangladesh. It built 6,519 kilometres of dykes including 3,674 kilometres of sea dykes, 6,095 large and small sluices, 1,276 large regulators, 6,419 kilometres of drainage and irrigation canals, two cross dams reclaiming 1,24,000 hectares of new land, one barrage to protect 2.84 million hectares from upland and tidal flood hazards and brought 1,92,000 additional hectares under irrigation (UNDP in Rahman 2002). Water management in Bangladesh only meant to flood control, drainage and irrigation (Chadwick & Datta, n.d). It

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Volume 1, Issue 12, May 2015

is true that the FCD and FCDI were constructed to protect infrastructure human and animal lives from flood damage. However, benefits of these capital intensive projects regarding irrigation water management were relatively low. Public sector investment in capital intensive large scale FCD and FCDI projects were failed to achieve their objectives. The lack of funds for operation and maintenance was the major constraint of these projects. The capital cost of surface water system ranging from USD 500 to 1800 per hectare. To develop 100,000 hectare of irrigated area in the Teesta Barrage project required USD 250 million in 1985 (Chowdhury 2010a). The projected benefits of the large scale projects were ambitious and never achieved. The cost recovery of the completed projects was almost zero. Absence of inter-sectoral communication of water sector with other sectors caused the failure of large scale projects. Ignoring the need for water in other sector such as fisheries, inland navigation and environment brought sufferings inside and outside the project areas.

The BADC another government agency established in 1961 took over the responsibilities of minor irrigation sector development. The groundwater based minor irrigation using DTW and STW overcome the water scarcity problem in dry season winter. The Bangladesh Agricultural Development Corporation (BADC) operated the DTW through rental system and charged subsidised price for irrigation water to the farmers. The BADC became unsuccessful in irrigation water management due to default rental fees and problem in maintenance and repair service of DTWs.

Private sector involvement in irrigation sector started in early 1980s through the withdrawal of rental system of Deep Tube wells (DTWs). Previously mentioned, public sector managed minor irrigation specially the DTWs and Low Lift Pumps (LLPs) under the rental system of BADC were found not successful. Inefficient rental system and lack of repair and maintenance of irrigation equipment were the constraints of the success of public sector led minor irrigation projects. However, the Barind Multipurpose Development Authority (BMDA) in northwest Bangladesh operates 4000 rental DTW units and another project managed by DAE in southern Bangladesh rents LLP's and power tiller to the farmers are found successful due to conscious management and satisfactory services to the farmers. The rental recovery of BMDA and DAE projects were 95 percent and 90 percent, respectively (Rahman 2002).

A policy changes from public rental system of DTWs to private selling system and withdrawal of imports restriction of irrigation equipment resulted dramatically increase the irrigation equipment and irrigation area coverage in Bangladesh. The operation of minor irrigation equipment and area under Shallow Tube wells (STWs) and LLPs were tremendously increased. Hossain (2009)showed that the privatization of minor irrigation sector helped to mobilize the private savings for irrigation investments, removed delaying in equipment installation repair and maintenances, lowered water charges by increasing

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competition in the water market and capacity utilization of the machines are increased. The small and medium farmers could afford to invest in small irrigation equipment like STWs and LLPs. On the other hand, the use of DTW is decreasing due to high capital cost and maintenance.However, DTW based irrigation is found in in Barind tract areamainly supported by subsidiesas the aquifer is not reached by the STWs.

Water use efficiency in Bangladesh agriculture

Low physical and economic efficiency of water use still a problem in agriculture in spite of significant expansion of irrigated agriculture since 1960s in Bangladesh. Previous water resource development policies targeted to expand the irrigation areas, to improve institutional arrangements and mode of water use rather than bringing water use efficiency in the irrigation projects. Increasing efficiency (physical and economic) both in farmer's level and system level of irrigation projects was always ignored in those policies. One of the main aims of National Water Policy is to increase water use efficiency (physical) through various measures including drainage water recycling, rotational irrigation, adoption of water conservation crop technology and conjunctive use of groundwater and surface water. Water use efficiency is extremely low in agriculture sector due to water loss in irrigation channels, over use of water in rice fields and lack of technical knowledge of farmers. On an average, 25-30 percent of irrigation water is used by crops and rest of the water is lost because of faulty design of flood irrigation system (Karim 1997, Mondal 2005 in Mondal 2010). In their analysis they mainly refer the physical efficiency of water use.

Chowdhury (2010a) emphasized to increase the efficiency of irrigation water. She showed that Bangladeshi farmers comparatively more efficient using labor, fertilizer, and ploughing with power tiller than that of use of irrigation water. Moreover, efficiency of privately owned STWs and LLPs were higher compare to the farmers using canal irrigation projects and publicly owned DTW projects. She found that there was no increase in the amount of output as a result of increasing irrigation expenditure. This means that inefficiency of water use still exists in irrigation water. She identified that irrigation charging system is a factor responsible for the overuse of irrigation in private sector. Mandal (2003) also showed that the water use under DTW operated area is less efficient compare to the water use in STW operating projects.

The large irrigation projects in Bangladesh have been built on the philosophy of "protective irrigation" technology that protects crops, human and animal lives from flood. In the large scale projects, the areas supplied by irrigation were significantly less than planned. Moreover, the farmers were receiving insufficient water to cover the full water requirement of the land in an average rainfall year. Papademetriou et al. (eds. 2000) discovered some limitations of large irrigation project including the different objectives of individual farmer with the scheme management, few control structure of irrigation systems, high maintenance cost and low level

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of irrigation services. These factors brought inefficiency in large scale projects with unreliable water delivery, water logging, salinity and insufficient cost recovery.

From the above discussions it is clear that, the farmers in Bangladesh are not technically efficient in using irrigation water. Large parts of the country already suffering from the shortage of water in their crop fields but some farmers are using excess water.

Water use efficiency in agriculture has been extensively researched for many years but unfortunately the studies on allocative[1] or economic efficiency in water use in very thin in Bangladesh (Chowdhury 2010a). It is very difficult to find an applicable solution for improving the efficiency in water use due to different context and huge variations in agricultural practices. Technical efficiency can be achieved through suitable crop selection, proper irrigation scheduling, alternative irrigation methods, and using different sources of water for irrigation. It should be noted that increasing technical efficiency lead to economic water use efficiency as long as the marginal benefits of additional water use are larger than the marginal costs of additional improvements (Cai, Ringler and Rosegrant 2001).

A farm is said to be economically efficient when it is technically and allocatively efficient. Improving the technical efficiency in water use, crop water requirement, irrigation scheduling and alternative method of irrigation can be helpful in farm level and irrigation schemes. Moreover, cop selection, non-agricultural use of water, seasonal water allocation and water application in different growth stages of crops can attain allocative efficiency in water use. Economic efficiency will be achieved with same time when technical efficiency and allocative efficiency are attained. Improvement of Irrigation efficiency also help to enhance technical efficiency creating options for achieving economic efficiency through allocation of water in highest valued uses.

It can be argued that technical or physical efficiency of water use cannot give guarantee of using water in more beneficial way. Economic efficiency actually includes the price and incentives and their impact for moving to the crops that will generate the maximum return. Whereas the irrigation efficiency only considers the beneficial water savings could not be used in more beneficial way.

Water charging and improving economic efficiency

Economic efficiency of water use can be also considered from points of optimal use, pricing and cost recovery of irrigation water supply. Akter (2007) also showed that farmers are charged much lower price than what they are willing to pay in a region where irrigation water is a scarce resource.

[1] Allocative efficiency relates to water uses resulting in maximum possible net benefit to society.

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Currently, water use in surface water based irrigation project is economically inefficient because water prices do not reflect total marginal costs including opportunity costs and external costs. Low price also lead to inefficient use and unsustainable lifting of water from some groundwater aquifers. Therefore, it is important to charge appropriate price for irrigation water in agriculture.

Rogers , Silva and Bhati (2002) showed the calculation of full cost of irrigation water. The full cost includes full supply cost, full economic cost and environmental externalities. The full supply cost is the addition of operational and maintenance cost and capital cost of existing infrastructure. Opportunity cost of depriving other potential users and economic cost of externalities are included in economic cost.
Toan , Crase and O'Keeffe (n.d.) reviewed the water charging policies in different developed and developing countries. They described that most of the developing countries water fee is subsidized and low as to cover the operation and maintenance costs. Actually governments bear the capital costs of irrigation projects for a variety of reasons other than economic optimization, such as rural development and for water and food security objectives (Molle and Berkoff, 2007).

In Bangladesh, the service fee of water supply is too low and set at 3 percent of incremental output from irrigation in the surface water irrigation schemes (Faruqee and Choudhry 1996). Moreover, this fee is cannot fully cover the operation and maintenance cost. However, BWDB decided in 1983 to levy direct user tax based on the area irrigated directly by the user to generate adequate revenue for operations and maintenance (Hussain 2004). In case of groundwater based minor irrigation farmers are paying a cash fee for irrigation services to suppliers, though some continue to pay a proportion of the crop amounting to 25 percent of the yield of the harvest (ibid). The flat seasonal fee charged, crop sharing payment method for irrigation expenditure and the indivisibility of use of shared tube wells lead the over use of water in irrigation (Chowdhury 2010a).

According to OECD (2010, p.37), "Water charges can, in principle, be used to recover the full costs or value of water". Raising water charges can improve efficiencies in water use and bringing economic and environmental benefit by reducing pressure on water resources (ibid).
Generally, the irrigation supply authority in Bangladesh are found charging the water price to cover operation and maintenance costs and as much of the capital costs and collection is satisfactory in groundwater based irrigation projects but collection rate were found very minimal in large surface water irrigation projects. It is true that if the capital investment is considered as capital cost in large scale projects then it is difficult to recover cost by only charging price of irrigation water rather than valuing the socioeconomic return and full economic cost of water. In this case government can justify subsidizing the price of irrigation water. According to Hakim, Parker and Ghani (1990), the farmers were profitably using

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groundwater for irrigation and paying more fees (cover full supply cost) compare to irrigation water used in surface water based irrigation projects. So, there is still opportunity exist to charge at least the same that the farmers paying for using groundwater.

Conclusion

The water management in Bangladesh was largely facilitated by public sector and started surface water irrigation. Later, groundwater irrigation covered most of areas in the country. It is true that the food production has dramatically increased due to this expansion of irrigation. However, the water use efficiency in agriculture is still low in spite of changing different mode of irrigation for last four decades. Studies on water use efficiency in Bangladesh agriculture is very limited due to lack of data on the amount of water use in farm level or system level.Farmers are profitably use groundwater irrigation and paying higher price for irrigation compare to surface water irrigation. The optimum use of irrigation water should be an important strategy for achieving economic efficiency of water use in agriculture. The efficiency condition equalizes the discounted marginal products of water across space and time. An efficient allocation of water resources maximizes the net social benefits and this economic criterion can be used to determining the optimal water use in different seasonal crop production in Bangladesh. The overall development of countries agriculture sector can be achieved by the year round use of irrigation facilities and optimal allocation of available water resources.

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International Journal of Business Quantitative Economics and Applied Management Research
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Volume 1, Issue 12, May 2015

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