Efficient Water Utilization in High Barind Area Through BMDA Irrigation Management Approaches.

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Abstract

Efficient use of water for crop production is now often a major goal in designing and management of irrigation systems. Besides, agricultural water pricing plays a significant role in promoting water use efficiency and cost recovery. Improving the performance of water application, water distribution system and efficiency of water management in agriculture could save water from existing uses. Better management of irrigation water, water distribution system and appropriate water charging possibly will enhance greater efficiency in water use. It is necessary to improve the performance and operations of the existing irrigation systems in Barind area for improving water use efficiency. This study used to the review of existing situation on irrigation water distribution, water use efficiency and water pricing in Barind agriculture. Irrigation charging system is a factor responsible for the over use of irrigation in the farmers' level. It is found that the performance operation of the existing irrigation systems in Barind area is better in terms of water use efficiency. Improved management of surface and ground water irrigation and appropriate pricing strategies are also suggested for achieving physical and economic efficiency in water use.

Key Words: Efficient Water Utilization, High Barind Area, BMDA Irrigation

Introduction

Agricultural water management in Bangladesh is an important issue for maximizing production. Irrigation water is a prospective well-recognized system for increasing production. But application and management of this have been suffering in the rural areas specially in high Barind areas, thereby making the irrigated agriculture non-profitable or less profitable. Proper land leveling and grading, selection of reliable source of water and its quality for irrigation, design and construction of efficient water distribution system and application of optimum quantity of water at the right time with maximum water distribution efficiency are some of the

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important aspects of irrigation management. Operation of modern implements, tools etc. as deep tube well(DTW),shallow tube well(STW), hand tube well(HTW), low lift pump(LLP) and other indigenous pumps or equipment's and their repair and maintenance are important which must be done under the direct supervision of engineers related to agriculture, the best use of the available facilities and to maximize the production (Majid,1991).

Bangladesh being an agro-based country, the major part of its economy depends on agricultural production. National development will remain a dream without the development of agricultural production. The modern scientific agriculture is a multi-disciplinary approach. Water is one of the vital inputs of crop production and utilization of water resources is of prime importance in modern agriculture.

Many people have the idea that only application of water on the crop field will increase production. But the term 'irrigation' does not at all mean that. Irrigation does not mean mere application of water. It is the application water as and when required by crop taking into account any after effects and providing sustainability of the productive capacity of the land.

The expansion of minor irrigation is a vital component of the agricultural strategy of the government. It consists of mechanized, semi-mechanized and non-mechanized system of irrigation. Recent time different types of irrigation equipment and water distribution systems are introduced for distributing irrigation water to the cultivated land. Minor irrigation programs are playing significant role for producing food grains specially in the Boro season (BADC,2019).

A Review to Objectives

The hydro-climatic condition of Bangladesh is such that there exists two distinct seasons-dry winter and flooded monsoon, in its normal climatic condition. Scarcity of water prevailing in the dry winter (December to April) is a major problem for the cultivation of modern high yielding varieties of crops. This situation calls for optimum use of water for increasing irrigation command area. The misuse of water not only decreases irrigation command area, but also increases cost of production making irrigated agriculture uneconomic.

Barind areas specially high Barind tract is facing this problem. Thus determining the actual crop water requirement and crop water use distribution efficiencies, the optimum and economic use of water can be assured by an irrigation engineer. For designing and managing irrigation, the

government of Bangladesh has emphasized the irrigation development in the country as one of the major issues for attaining self-sufficiency in food by increasing production.

Today it is very often heard that many HTW, STW and DTWs in dry season are not functioning properly in many areas of Bangladesh. In Barind areas the problem is severe. Many tube wells remain out of operation and many are discharging less water than designed capacity, specially during dry season irrigation period. This does not necessarily mean that there is a shortage of water in the underground reservoir.

The problem lies with the choice of well technology, design and construction of wells based on aquifer's capability and planning of wells in the well fields based on water requirements. BMDA has adopted such appropriate technologies from many years back. The optimum number, type and capacity of wells for the identified aquifers, proper selection and setting of pumps, proper construction and development of wells and proper selection of power will ensure the performance of the wells with the best hydraulic efficiency. A well designed and constructed properly will provide troubles-free operation.

Water conservation is a progressively growing issue in Bangladesh with the introduction of high yielding varieties of crop grown under intensive irrigation. The scarcity of water during rainless dry season and very often encountered hydrologic draught has made water conservation critically important. Conserving surface water into reservoir and harvesting surface water to underground during monsoon when there remains sufficient surface water and conserving soil moisture in the crop field, the water resources may be utilized properly.

BMDA, an autonomous body under the ministry of agriculture, is trying to solve these issues and to overcome these problems specially in rural areas of Barind tract of the north western part of Bangladesh and for the ultimate aim of building better Barind. The main aim of this paper is to review the existing irrigation management, water distribution system and water charging system in agricultural water use and to stretch an idea of improving water use efficiency in high Barind area.

Location, Soil Resources and Climatic Conditions

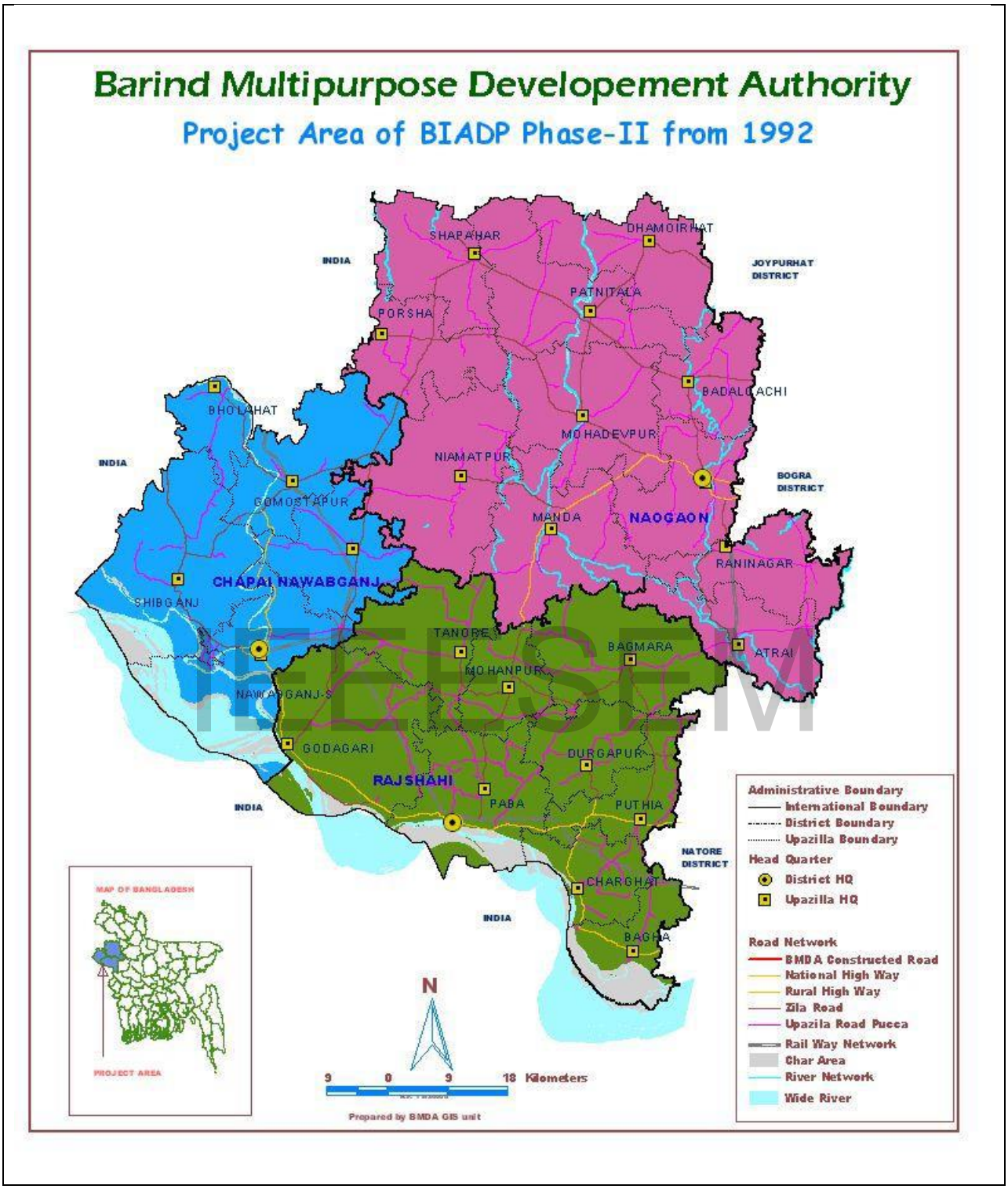
The Rajshahi Barind (Rajshahi, chapai Nawabganj and Naogaon districts) is located in between 24°23' to 25°15' north latitude and 88°02' to 88°57' east longitude. About 55 lac people living in the 7546 sq.km area having its total cultivable land of 5.61 lac hectare out of which 1.99 lac hectares of land has brought under arrangement of irrigation through BMDA's DTW(BADC, 2014). The climate of Rajshahi Barind is extreme in both summer and winter. A typical dry climate with comparatively high temperature prevails in Barind area except for the wet season beginning from mid-June to October.

Rainfall in the area varies from about 1500 mm to 2000 mm. Temperature ranges from 4° Celsius to 44° Celsius and relative humidity is about 78%. Out of total cultivable land, 34% is loamy, 10% is sand, 49% is clayey soil and the rest of 7% is other types of soil according to the soil classification as reported by BBS. The elevation above MSL ranges from 12 m to 46 m (Gomostapur of Chapai Nawabganj district) (BMDA, 2005).

Of this total cultivable land, 84% are single cropped, 13% are double cropped and the rest are triple and a small portion are multiple cropped. The cropping intensity is now 200% which was 117% before starting the project in1985. The national average cropping intensity is now reached to 191 % (Ahmed, 2013). In the northwest region, the forest coverage is very low. It is less than 4% compared to overall about 17% of that of the country.

There are three types of land in respect of topography-high land (47%), medium land (38%) and low lying area(15%)(BMDA, 2005). In high Barind area, there are about 80% lands terraced or undulated. Boro crops are being the major cereals in where irrigation demand is very high. Paddy, wheat, maize, potato, mustard, pulses, sugarcane etc. are the major crops grown in this area.

An area map is shown bellow:



Irrigation Approaches

With so many constraints, BMDA started installation of deep tube wells in Rajshahi high Barind areas. With the successful operation of these deep tube wells, BMDA earned reputation of modern and acceptable irrigation management system. Since this system was acceptable by the farmers and for its sustainability, it was replicated in greater Dinajpur in North-Bangladesh Irrigation Project by BMDA and in deep tube wells of other districts which were not functioning well.

At the preliminary stage, BMDA installed deep tube well with diesel engine as prime mover. But due to hazards of repair/maintenance and higher irrigation cost, BMDA started electrification of deep tube wells through Rural Electrification Board (REB). This was done developing electrical networks and sub-station. Vertical turbine pumps and vertical motor were used for pumping. Next time for more modernized submersible pumps is being used and till now.

Earlier deep tube wells were designed in the suitable aquifer placing the strainer below depth of upper well casing. But for the critical characteristics of Barind aquifer in some cases, the strainer was placed inverted way to the upper well casing keeping the depth of tube well as of depth of upper well casing. Such special type of deep tube well is named as inverted deep tube well in BMDA.

For surface water use, though it is scarce in Rajshahi Barind, BMDA has some special approaches. In Rajshahi Barind area there are so many natural drainage canals. Due to time bar these canals are silted up and derelict. During rainy seasons the rain water of this catchment area goes to the nearest rivers way to Bay of Bengal. Keeping this condition in mind, BMDA takes steps to conserve this rain water re-excavating the canal and providing submerged weir (locally called cross-dam). Hence surface water reserve is ensured for supplementary irrigation and also helping for groundwater recharge.

BMDA is re-excavating derelict ponds and digging low land, bils, dighis etc. for irrigation water reservoir and for restoration of rain water for irrigation as well as fish culture. BMDA has also introduced irrigation facility from river by placing LLP and constructing rubber dam with water distribution networks in small river.

Dug well technology is the new invention of BMDA in irrigation sector. These are mainly constructed in high Barind areas where no DTW is possible and used only for vegetable crops and also used for drinking purpose.

An irrigation status of Rajshahi Barind (Rajshahi, Naogaon and Chapi Nawabganj district) is shown below:

Sl,No	Organization/ Agency	Operated irrigation equipments (nos.)			Area irrigated by (in ha)					Irrigation coverage in %
		DTW	STW	LLP	DTW	STW	LLP	Others	Total	
1	BMDA	8527	0	0	284472	0	0	0	284472	55.67
2	BADC	2	0	257	400	0	6834	0	7234	1.43
3	Private	1047	51129	7403	27784	162519	28935	0	219238	42.90
4	Others	0	0	0	0	0	0	0	0	
Rajshahi Barind Total		9576	51129	7660	312656	162519	35769		510944	100

Source: Minor Irrigation Survey Report 2017-18, BADC. DTW= Deep Tube Well, STW=Shallow Tube Well, LLP=Low Lift Pump.

Figure 1: Status of Irrigation in Rajshahi Barind in 2017-18.

The result reveals that total 312656 nos. of irrigation equipment are used and 510944 hectares of land were irrigated in Boro season in the year 2017-18, where BMDA's contribution of irrigation was about 55.67% .

District wise irrigation status and area coverage by irrigation is shown below:

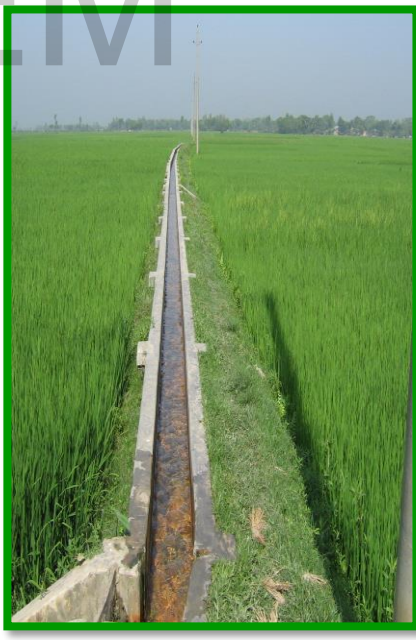
Name of District	Nos. of DTW	Nos. of STW	Nos. of LLP	Area irrigated by DTW (ha)	Area irrigated by STW (ha)	Area irrigated by LLP (ha)
1.Rajshahi	3401	20276	2513	110365	45079	8329
2.Chapai Nawabganj	1619	13953	1910	59870	52535	10442
3.Naogaon	4556	16900	3237	142421	64905	16998
Total	9576	51129	7660	312656	162519	35769

The above figure shows that the net area coverage by irrigation is 89 % of the net cultivable land in which BMDA's contribution is 50.66 %. It was about 35.51 % in 4 years back.

Chronology of Irrigation Water Distribution Systems

Earthen canals-At the early stage, BMDA installed deep tube wells with earthen canals for irrigation water distribution system. Farmers had to construct those canals to divert water to their crop lands. Conveyance loss was very high(about 40%–50%) resulting irrigation cost higher. Besides these, seasonal construction and repair of earthen water flow uncertain and untimely for social involvement in some cases. A research conducted in Godagari upazila shows that the conveyance efficiency in an earth canal is 58.66 %(Rahman et al. 2011).

Lined surface canals-To avoid conveyance loss and to improve irrigation efficiency by lined surface canals like brick built, concrete or ferro cement has been constructed by BMDA. Such surface channel construction need some land of the farmer which in very costly.



Again these lined surface canals were difficult to construct with its alignment in straight due to farmers fragmented land separated in ails which causes higher cost. Also regular maintenance of these types of canals is an issue of financial burden.

Buried pipe line-The critical topography of the north specially of the high Barind area, where land is undulated, led to the approach towards buried pipe line for irrigation systems. This system permits irrigation water to any desired high place. In this system, water is conveyed through underground pipe lines to the crop fields, resulting no land loss. In BMDA in the early stage, cement concrete buried pipe lines were built. Presently, bringing more sophistication in the construction, aiming to minimize irrigation water conveyance loss to zero level, uPVC buried pipe line construction is being practiced. By this system irrigation water can be made available very near to the farmers plot most efficiently.

Surface water irrigation- For surface water use, though it is very scarce in high Barind area, BMDA has taken some special approaches. In Rajshahi Barind, there are so many canals, bils, dighis, ponds etc. Keeping this condition in mind, BMDA has taken steps to conserve rain water by re-excavating these sources and provided submerged weir there. Hence surface water reserves are ensured for supplementary irrigation and also help for underground recharge.

Additionally BMDA has adopted on-farm water management technology through alternate wetting and drying (AWD) method as a water saving technology. Usually farmers are habituated to irrigate their land by flood irrigation for rice production. It is their belief that ‘more depth of irrigation water means more crops to gain’. In this system huge misuse of water incurs excess irrigation cost resulting pressure on energy and groundwater. Realizing the facts scientists of IRRI & BRRI has innovated modern irrigation system named as ``Alternate wetting and drying (AWD)” water saving technology.

In this method paddy field is allowed moisture only to its root zone. Hence irrigation water is applied alternate wetting and drying method. This method is being practiced and introduced by BMDA in farm levels. By this method about 35 % saving of irrigation water/cost is being ensured with 60 to 70 kg additional production of paddy per bigha(Neogi,2013).

Irrigation Charging Systems

To overcome the farmers' problem regarding payment of irrigation cost BMDA tried to have a farmers friendly solution. But it has long history since 1985. Initially BMDA started with irrigation in Public sector with Diesel operated Deep tube wells. Earlier irrigation charge was fixed for a deep tube well amounting Tk. 13500 annually for command area of 60 acre. Among this charge 1/3 (one third) amount was allowed for repair-maintenance of the deep tube wells. In this system farmers group was supposed to pay repair charges beyond amount in 1/3 of irrigation charges. When the repair charges were going beyond the capacity of the group, the pumps were uncertain for operation due to repair problem. Other disadvantages of this system were-farmer are willing to have more water for their plots without knowing the adverse effect of excess flooding which hampers optimum tillering of plants causing decrease of yield. From the experience of success in irrigation charge fixing and realization and some problems faced by diesel operated deep tube wells, BMDA decided to electrify all the deep tube wells and construct lined irrigation water distribution systems and tried to make the system of irrigation charge more effective and introduced coupon system. In the coupon system the irrigation charge is fixed on hourly use basis of deep tube well. The rate varies (TK 100 to 110) with the capacity of the pump delivering water to the irrigation canal.

It is a time-based method of irrigation charge realization in the form of coupon and optimal use of limited water. In this system the farmers have to buy the coupon from the respective BMDA upazila office or nearby coupon dealer selected by the BMDA. The farmers can get irrigation water for any crop as per requirement by giving their coupon to the operator of respective water distribution units (DTW or LLP schemes).

Automation in irrigation (prepaid meter system) is a new water charging system in BMDA. In this system each pump (deep tube wells) is connected with a pre-paid meter. Each farmer has to be provided pre-paid card (user card). The pre-paid card is charged by any amount of Taka (Bangladeshi currency) as per requirement of the farmer from the mobile vending unit(MVU) machine provided by the authority to the vendor or dealer.

A farmer whenever he requires irrigation water for his crop field, he takes his pre-paid card to the deep tube well operator. The operator gets this pre-paid card inserted into the pre-paid meter then the deep tube well is started and water is supplied. When this card is taken off from the meter, the deep tube well stops automatically. So, no one can get irrigation water without inserting the card into the pre-paid meter or without giving irrigation charge.

Suggestions for the Future Actions

The following suggestions are made for the future action which needs to be taken under consideration:

1. Agricultural development in the field is not possible without modernization of agriculture. So all phases agricultural production must be mechanized through appropriate technology and these technologies should be made locally available.

2. Heavy rainfall and local flood water submerge huge crop lands and damage crops. On many occasions these lands remain water logged for several months and delays or eliminated the next cropping season. Also often reduce the productivity of terrace soil due to removal of fertile top soil. It is necessary to find ways and means to get rid of the problems.

3. Every year a large quantity of produced crops is damage due to poor processing, drying, preservation and storage system. This situation demands improvisation of these systems.

4. Improvement of on-farm irrigation management practices and irrigation water distribution are now crucial need for increasing agricultural production. Much attention should be given for improving the performance of existing irrigation water distribution system.

5. So far drought adaption options and ground water stress concern, artificial recharge of ground water and rain water harvesting should be promoted in the area with a positive effect.

6. In order to prevent water logging re-excavation of dighi, bils, ponds, canals, small rivers or digging of new canals should be undertaken.

7. Planned construction of water control structures (embankment, small cross dams, sluice gates etc.) should be undertaken to make reservoirs for preservation of irrigation water.

8. Appropriate technologies such as serial pumping, fog trapping, drip irrigation, use of solar energy may be implemented.

9. Technological progress in rice cultivation is crucial for sustaining food security in Bangladesh. AWD (Alternate Wetting and Drying) is an irrigation regime where the producer allows the rice field to dry intermittently during the rice life-cycle rather than having the field continuously submersed. It is a water saving technology. This technology should be implemented massive way in the field rapidly.

Conclusion

The farmers of the poverty stricken north-western area had no other alternative other than agriculture for their livelihood. When they found deep tube well irrigation cost effective and as a means of job and livelihood, they took it as a source of income generation. They participated with BMDA's deep tube wells activities and BMDA's irrigation system. BMDA with coupon and pre-paid card systems has provided the requirement of irrigation round the year through installed deep tube wells and has rendered facility to utilize irrigation water as and when necessary at farmer's crop field at a reasonable and accepted rate. With the help of coupon and pre-paid card, optimum utilization of irrigation water has been ensured resulting cost saving in crop production. Those farmer-friendly systems have encouraged the farmers to pay irrigation charges in full.

Thus BMDA is maintaining ensured irrigation facilities keeping the equipment ready round the year and being assured of irrigation water the farmers are willing to pay irrigation charge in the form of coupon or prepaid metering system. By this cohesive irrigation management system BMDA proved the irrigation sector sustainable in respect of irrigation hardware and meeting up O & M cost including pay and allowance of the employees of the Authority.

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