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Effect of water saving technology through alternate wetting and drying for boro rice cultivation

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Abstract: An initiative was taken through The Improving Irrigation Market System (IIMS) Project to promote Alternate Wetting and Drying (AWD) technology at Bogra and Gaibandha districts in 2009-10 year of boro rice to reduce water loss and saving the cost of irrigation for rice production. A total of 65 rice farmers set demonstrations in mentioned districts on AWD. The farmers supplied irrigation water in demo rice field by maintaining the AWD water table. The study showed that on average 21 numbers/frequencies of irrigation used in AWD technology practice from 15-20 days after transplanting to reproductive stage, whereas farmers practiced was 26 numbers. The average five irrigation applications were saved during the boro rice season. According to the data, on an average 15.86 hour/acre of irrigation time was saved (is equal to 12 liter diesel-fuel consumption: 0.750 liter/ hour). The value of 12 liter diesel was about Tk 550/acre saved and it was on an average 19.5 % irrigation cost reduced in the AWD plot compared to control plot. Benefit of the AWD method showed that on an average the direct financial benefit was saved Tk 550/acre. It was also indicated that AWD practices' yield increased compared to farmer practices. Average yield 2292 kg/acre on AWD plots and 2230 kg/acre for control plots. So yield increased 62 kg/acre (2.7%) in AWD plot compare to control plots.
Key words: Water, AWD, boro rice, wetting, drying

Introduction

Water loss is a key issue of irrigation sector and it is effect to irrigation cost, irrigation coverage and foreign currency. The principal losses of irrigation water from rice fields are evapo-transpiration, seepage and percolation. There is a strong relationship between standing water depth in the plot and the seepage and percolation rates. The higher standing water depth is the higher is the seepage and percolation rate (Bhuiyan, 1982, Ritu and Mondal, 2002). The seepage and percolation at the field level are affected by paddling and standing water depth status of the rice fields and the crop growth stages (Ghani, 1978). The irrigation water can be reduced by decreasing the relatively large and unproductive losses from seepage, percolation and evaporation and AWD can drastically diminish these losses (Rubenito *et al.*, 2005). The country has about 9.94 million hectares of cultivable land, out of which about 63% is brought under irrigation by using surface and underground water for crops production especially for boro rice production (BADC, 2010). The remaining 37.55% land remains outside irrigation coverage due to not only lack of development of irrigation facilities but also due to on-farm water distribution and management practices of the existing facilities (Sattar *et al.*, 2009).

The Alternate Wetting and Drying (AWD) is a water saving technology for irrigated rice production and it is appropriate for boro rice cultivation in Bangladesh. In the boro rice field farmer habituated to keep 2-3" standing water by providing 26 numbers (frequency) of irrigation in rice field per season from their long term experience as a result increase their irrigation cost and decline the ground water table and turn in to environment. The Alternate Wetting and Drying (AWD) method is a water saving technology for boro rice developed by IRRI and adopted by BRRI. Through this technology farmers might be reduced 30-40% of irrigation cost. AWD is a mature technology that has been widely adopted in China. It is also a recommended to practice in northern India, and is being tested by farmers in the Philippines. This technology can be reduced the diesel consumption which is a positive externality for the environment. The AWD is a single device that has been designed to observe water level in rice field for deciding the frequency as well as time of irrigation. The increasing scarcity of water means that the cost of its use and resources development is increasing dramatically (Postel, 1997; Rosegrant, 1997). The present investigation was attempted to find out the performance of the AWD on Boro Rice cultivation and its impact on irrigation cost.

Materials and Methods

About 65 Alternate Wetting and Drying (AWD) demonstration were set during 2009-10 in Sonatala, Sariakandhi, Gabtali and Sherpur upazila under Bogra and Gobindhaganj and Palashbari upazila under Gaibandha district. Every farmer received informal training on AWD technology.

AWD Technology: Alternate Wetting and Drying (AWD) is a water saving technology that boro rice farmers can apply to reduce their water use in irrigated field. AWD is a single device that has been designed to observe water level in rice field for deciding the frequency and time of irrigation. A tube can be made from 30cm (12 inch) long plastic PVC pipe and have a diameter of 10 cm or more so that the water table is easily visible (Photograph 1). Make a pore/hole in the tube on all sides up to 20 cm from bottom and top 10 cm as usual. Different NGOs, Department of Agricultural Extension (DAE), Bogra and Gaibandha are working to promote AWD at farmers' level.

Fixation of AWD in rice field: About 15-20 days after transplanting the boro rice, set 8-10 AWD device/acre considering high and low of rice field. Then the AWD device installed with 10 cm above from the surface and the remaining 20 cm of the perforated pipe placed in depth of the soil (Photograph 2). Remove the soil from the AWD device of 20 cm in depth of soil. When excessive weeds were present, AWD postponed for 2-3 weeks until weed suppressed in rice plot.

Irrigation by observing AWD water layer: Each selected 65 plots were divided into two parts, one part was irrigation maintained by AWD practice and the other part was irrigation maintained by farmer practice.

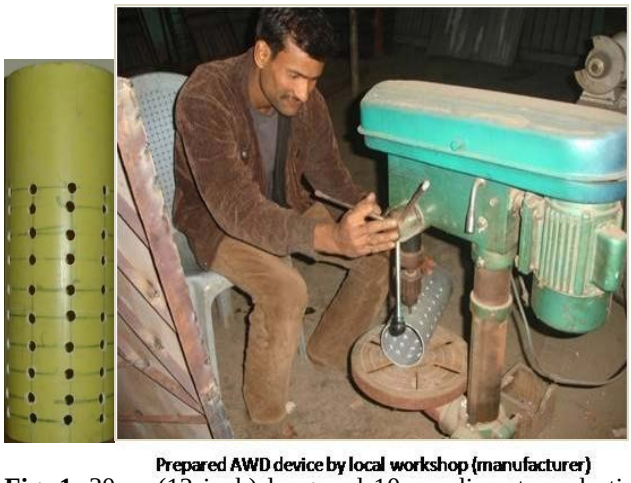

Fig. 1. 30cm (12 inch) long and 10 cm diameter plastic PVC pipe are making for observing water table

A practical way monitored the depth of standing water on the rice field by observing AWD water layer. The AWD device set 15-20 days after planting. The depth of standing water gradually decreased after irrigation, when standing water dropped in to 15 cm below of AWD tube from the surface soil, irrigation was re-applied in the field up to 5 cm. This thumb roll followed up to flowering stage. Just after transplanting, the minimum irrigation water level in the rice field was maintained at 2-4cm up to 15-20 days and the same principle is continued also flowering to milking stages. The water level again dropped up to 15 cm below from soil surface in rice ripening stage. The water level in the PVC pipe was monitored everyday and water status was also monitored in the farmer plots. Irrigation was supplied when water level was reached at 15 cm below of the PVC pipe from the surface level. The demonstration basic information, irrigation frequency, irrigation time, fuel consumption etc data were taken by the farmer for evaluation of the system. Crop cut sample was harvested from five different locations in each plot taking 1 sq .m area in each location. Yield was adjusted at 14% moisture content. The one format was developed for collecting the data and oriented the farmer how they collect and preserve the data. After collecting the data a computer data base was prepared.

Fig. 2. AWD device installed in the soil

Results and Discussion

Irrigation cost: For Boro rice season irrigation cost is an important issue. The AWD water saving technology played good role to reduce the irrigation cost. Costs including variety, insecticides, fertilizers, tillage, weeding etc same of AWD demo and control plot but only studied on irrigation effect by using AWD technology.

In the Table 1 revealed that irrigation frequency (no.) varied and it was 21 for AWD plot and 26 for control plot per season. Since irrigation frequency less in AWD plot than control plot so 15.86 hour save in AWD plot. In general 0.750 liter fuel require for one hour shallow machine operating so 12 liters fuel less used as well as Tk. 547 fuel cost (fuel price: Tk. 46/ liter) reduced than control plot for one acre land (It converted to 29.64 L fuel & Tk1351/hector). Finally concluded that 19.5% reduced the irrigation cost in AWD plot than control plot and it was affected to farmer financial benefit. The same result shared in workshop by Hamid *et al.* (2010) and they shared that AWD technology can reduce 5 number irrigations compared to farmers' practice, save irrigation water by 25 %, and reduce 30 liters diesel / hectors. The similar findings also mentioned by Kurschner *et al*. (2010) and they got the finding that number of irrigations was reduced by 28% on average, while irrigation cost was nearly 20% less for the farmers who adopted AWD and it was such a level of monetary profit.

Water loss: Water loss is a key issue of irrigation sector and it is effect to irrigation cost, irrigation coverage and ground water. The principal losses of irrigation water from rice fields are evapo-transpiration, seepage and percolation. There is a strong relationship between standing water depth in the plot and the seepage and percolation rates (Ritu and Mondal, 2002). The study findings showed that AWD technology played good role to reduce the water loss. In the Table 2 showed that in AWD plot reduced frequency than control plot as a result irrigation time 15.86 hour was lower in AWD plot than control plot. According to thumb role 14 liters water discharge by the 6-8 hp power shallow machine so save water 799344 liters in control plot. It is concluded that 19.5% reduced the water AWD plot than control plot and it was affected to ground water.

The similar results shared by Hamid *et al.* (2010) and Rubenito *et al*. (2005) mentioned that AWD can drastically diminish these losses. They also indicated that AWD saved water 16% in 2002 and 24% in 2003 and it was high 33% in rice field. The relevant findings were the AWD technology over 30% less ground water every year saving its reserve, reducing its abnormal lowering and improving ecology as well as environment and bio-diversity and decreasing desertification rate. About 75% ground water for irrigation and about 74300 Mm^3 ground water is needed annually for irrigation. Ground water table declination is observed. (Islam *et al.* 2008). In Boro season 55% of the applied water was needed for evapo-transpiration and the rest 45% was lost from the field as seepage and percolation (Rashid *et al.*, 2009).

Table 1. Comparison average irrigation cost

No. of Demo	Irrigation frequency (no.) / season/ acre		Irrigation time (hr) / acre/ season		Fuel used (L) / acre/ season		Fuel price (Tk.) / acre / season		Save (Tk.) (reduced irrigation cost)	% of reduced irrigation cost
	Study plot	Control plot	Study plot	Control plot	Study plot	Control plot	Study plot	Control plot		
65	21	26	65.52	81.38	49.14	61.03	2260	2807	547	19.5 %

Table 2. Water losses vs. water save

No. of Demo	Irrigation frequency (no.) / season/ acre		Irrigation time (hr) / acre/ season		Save Irrigation time (hr) / acre/ season	Save water (L) / acre/ season (Reduce water loss)	Save water (L) in (%) (Reduce water loss)
	Study plot	Control plot	Study plot	Control plot			
65	21	26	65.52	81.38	15.86	799344	19.5 %

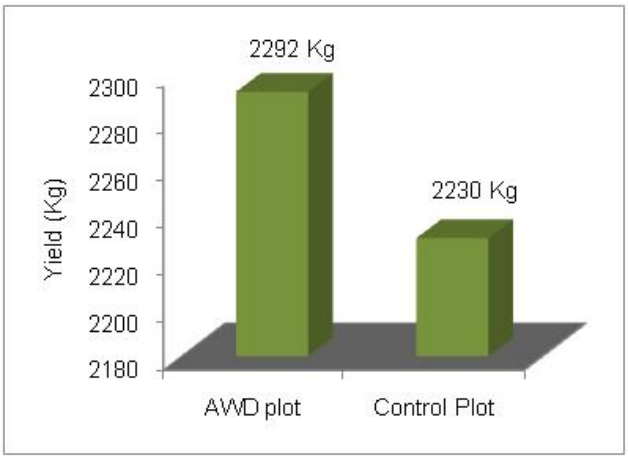

Fig. 3. Yield comparison between AWD and control plot

AWD effect on yield: There was significant effect of rice yield for AWD technology. The graph revealed that 62 kg/acre (153 kg/hector) more yield in AWD plot than control plot. It is compared to 2.7% more yield in AWD plot (Fig. 3). The study finding also guessed that some diseases such as Sheath Blight, Sheath Rot, Bacterial Foot Rot and Tungro attack and also intensity of Brown Plant Hopper (BPH) decreased in AWD plot. The same result shared by Hamid *et al.* (2010) and they shared that AWD technology produced 500 kg more paddy/ha. Another finding indicated the yield of rice increased by about 0.4 to 0.5t/ha, which is equivalent to about 10%. In addition, farmers often mentioned that rice crops under AWD look stronger and healthier, and develop more tillers and panicles (Kurschner *et al.*, 2010). The finding of other study they got the same yield in AWD and contineous flooding plot (Rubenito *et al.*, 2005). It concluded that there is no significant effect yield but it is effect irrigation cost and minimize the water loss.

References

BADC. 20010. Minor Irrigation Survey Report. Ministry of Agriculture. Government of the People's Republic of Bangladesh.

Bhuiyan, S. I. 1982. Irrigation system management research and selected methodological issues. IRRI research paper series no 81, IRRI, Los Banos, The Philippines.

Ghani, M. A. 1978. Studies on seepage and percolation in selected field conditions in Bangladesh. Unpublished Master of Engineering Thesis. Asian Institute of Technology, Bangkok, Thailand.

Hamid, M. A. and Mazid, M. A. 2010. AWD irrigation technology can benefit Bangladesh by US $ 725 million annually in Agri-sector. Proceeding of the workshop by Cereal System Initiatives for South Asia (CSISA)-IRRI Project, Bangladesh.

Islam, M. S. and Rashid, M. H. 2008. Climate Change and Sustainable Irrigation Management for High Value Crops in Bangladesh | Presentation made at the International Symposium on Climate Change and Food Security in South Asia in Dhaka (August 25-29); http://www.wamis.

Kurschner, E., C. Henschel, T. Hildebrandt, E. Jülich, M. Leineweber and C. Paul. 2010. Water Saving in Rice

Production Dissemination, Adoption and Short Term Impacts of Alternate Wetting and Drying (AWD) in Bangladesh. SLE Publication Series–S241.The Dhaka/Berlin.

Rashid, M. A., Kabir, W., Khan, L. R., Saleh, A. F. M. and Khair, M. A. 2009. Estimation of Water Loss from Irrigated Rice Fields. SAARC Agri., 7 (1), 29-42.

Sattar, M. A. and Parvin, M. I. 2009. Assessment of Vulnerability of Drought and Its Remedial Measure for Sustainable T. Aman Rice Production in the selected location of Bangladesh. Proceeding of the 2nd International Conference on Water and Flood Management Organized by Institute of Water and Flood Management, Bangladesh University of Engineering and Technology-2009.

Postel, S. 1997. Last Oasis: facing water scarcity, New York, N. Y. (USA): Norton and Company, 239 PP.

Ritu, S. P. and Mondal, M. K. 2002. Influence of water depth on seepage and percolation rate of rice soil. Proceedings, second annual paper meet, Agricultural Engineering Division, IEB, Gazipur Centre, December 22, Bangladesh.

Rosegrant, M. W. 1997. Water resources in the twenty-first century; Challenges and implication for action. Food, Africulture and the Environment discussion paper 20. Washington, D. C. (USA): International Food Policy Research Institute , 27 PP.

Rubenito, M. M. and Bouman, B. A. M. 2005. Management strategies for saving water and and increase its productivity in low land rice-based ecosystem. Paper presented at First Asia Europe Workshop on Sustainable Resource Management and Policy Options for Rice Ecosystem (SUMAPOL 2005), Hangzhou, Zhijiang Province, P. R. China.