AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly Magazine
Volume 5, Issue 2
www.agriallis.com

Article Id
AL04203

ALTERNATE WETTING AND DRYING IN RICE: AN OVERVIEW

Odisi Netaji

Email
netajiodisi143@gmail.com

Centurion University of Technology and Management, R. Sitapur, Odisha, India

Almost half of the world population depends on rice as it is a staple food and it is critically important for global food security. Approximately 90% of worldwide rice is grown as well as produced and consumed in India. In India rice is 1st most important and extensively grown is under irrigated. As we know that the water requirement of rice is more than other cereals and it consumes 2\3 of total irrigation water used in agriculture. Generally, 3000 to 5000 litres of water is required to produce 1 kg of rice. Throughout the world, Water is a fast becoming a valuable commodity as an increasing population and it widely use it for the household, industrial and agricultural purposes. By 2025, 15 to 25 Mha of irrigated rice fields suffers from water scarcity. The share of water for agriculture is likely to go down from 80% to 60%. The plenty of water used in rice is lost as percolation and surface runoff which includes in water requirements. The project demand of rice in India by 2050 is estimated to be 197.40 MT for increasing population (ICAR – NRRI). However, climate change induced rainfall variability which results in decreasing groundwater levels. To overcome from water scarcity and to meet the project demand production of rice, scientists of IRRI have developed water-saving technologies. One of these technologies is AWD (Alternate Wetting and Drying) is a water saving technology for lowland irrigated rice.

Alternate Wetting and Drying

Alternate wetting and Drying is an irrigation management practiced in rice for irrigated lowland rice. It was first developed by IRRI and first begun in China and India in 1980 and 1990 (Mushtaq *et al.*, 2006). Soil moisture is maintained at 0-40 kPa by applying irrigation, this is known as AWD. The AWD practice involves intermittent flooding (Alternate cycles of drying and re-flooding) and controlled irrigation. In AWD the rice field is allowed to dry for a period of certain days before being flooded again. Hence the field is alternately flooded and left dry. Implementation of AWD irrigation management involves by monitoring the depth of water in the field using field water tube. This AWD is followed 10 days after transplanting in case of puddled rice (which helps plants to recovery from transplantation shock) where as in case of direct seeded rice the AWD is followed when the plant height attains 10 cm tall until first heading (when many weeds are present at early crop stage of growth). After irrigation the rice field should be allowed to dry until the ponded water level in the field water tube reaches 10 cm below the soil surface, Then the field is flooded again to a depth of 5cm before allowing water level to drop again upto 10 cm below the soil surface in the field water tube. When the flooded water has dropped to 15 cm below the surface of the soil, Irrigation should be applied to reflood field with 5cm of flooded water, this practice is known as safe AWD. Safe AWD is stopped form 2-3 weeks until the weeds have been suppressed by the flooded water. Some studies reveal that 15 cm threshold limit will not cause any yield declinations.

These cycles of wetting and drying varies from 1 to 7 days depend on the soil texture, irrigation capacity, rainfall, soil moisture, rice crop growth stage, weather and field conditions. The peak period of water requirement in rice is falls between tillering to grain filling, so the field should not be left fully dried at this stage, water stress at this stage which could be results in potentially severe yield loss. After flowering before grain filling safe AWD should be applied. Particularly at panicle initiation and grain filling full flood is maintained.

AWD associated with SRI (System of Rice Intensification) results in greater yields and efficient use of water. One of the most promising factors for decreasing water requirement and methane emission and protecting soil structure is cultivation of aerobic rice with AWD management practices. Aerobic rice is developed by crossing low yielding upland rice varieties and high yielding lowland rice varieties. It is the direct seeding of rice in non-puddled, non-flooded and non-saturated conditions. In ARS (Aerobic Rice System) rice is directly seeded on a dry bed and irrigation is applied at an interval to maintaining the soil moisture.

As the field is alternately wetted and dried, there is a chance of increase in weed growth, Weeds are the major problem in AWD. The critical period for weed competition on transplanted rice is 30-45 days after transplanting. Ponding in the fields about 2weeks after transplanting shows lesser weed growth (Richards and Sander, 2014). Weed infestation was more in AWD fields compared to the flooded plots, As weed infestation is more in AWD plots, the farmers harvest fewer yields when compared to non-AWD plots (Neogi *et al.*, 2018). Timely application of herbicides and weed management practice in AWD fields favours good yields.

The nitrogen requirement is high in rice and most of the applied nitrogen in the form of urea is lost through surface runoff, leaching in flooded conditions. Application of nitrogen fertilizers just before flooding is beneficial.

Suitable Field Conditions for Implementing AWD

1. Selected field should be free from weed pressure at crop growth stages.
2. Generally practiced in lowland rice growing areas where field should be drained within 5 days.
3. Followed in low rainfall areas, were high amount of rainfall delays AWD management, if rainfall exceeds evapo-transpiration, the field will be flooded and unable to dry during growing period.
4. Light texture and sandy loam soils are not suitable, as they drain quickly.
5. Heavy clay texture soils are suitable as they have high water holding capacity.
6. Selected field should be fewer incidences towards pests and diseases.
7. Land should be properly levelled, and improper levelling leads to uneven distribution of water, fertilizers and extra weed growth.
8. Salt affected soils are not suitable.

Practical Indicator of Implementing of AWD: Field Water Tube

A practical way for implementing Alternate wetting and drying (AWD) is by observing the depth of water by using field water tube or perforated tube or pani pipe. This tube helps the farmers to monitor the water present below the soil surface.

The field water tube is made up of plastic pipe or bamboo, for better observations plastic pipe is preferred. Take a plastic pipe of height 30 cm in length and with diameter of 15cm. The bottom of the tube (20) cm length drilled with holes on each and every side, and that holes should having diameter of 0.5mm with a distance of 2cm away from one another.

After, the tube can place in the field, close to the bund not less than 1m away from the bund. If we placed the tube nearer to the field, farmers can easily take observations.

Bury the field water tube vertically up to 20cm and remaining 10cm protrudes above the soil surface, after dipping remove the soil / mud present in the tube for visible of bottom of the tube. When water level falls below 15cm then the field is reflooded up to 5cm. The threshold limit of 15 cm will not cause any yield declines. Roots of the rice plant will be able to take up water from saturated soil and perched water level in the soil surface (IRRI).

Advantages of AWD

1. Continuous flooding results in increase of pests, disease of rice which cause yield reduction. AWD control incidence of pest and disease infestation when compared to continuous flooding. Alternate wetting and drying (AWD) is practiced to manage the brown plant hopper which transmits "Rice grassy stunt virus" in rice which is characterized by narrow, erect, yellowish green leaves. A study reported less insect infestation from stem borer in AWD method than over flooded method of rice cultivation (Hasan *et al.*, 2016).
2. It increases water use efficiency by decreasing water requirement, AWD saves water 35 to 70%, without any significance yield loss when compared to conventional system of cultivation of rice (Singh *et al.*, 1996). AWD saves up to 660 litres of water per kg of paddy.
3. Safe AWD doesn't decrease the yield. It decreases the pumping costs, fuel costs for irrigation which enhances returns.
4. Globally 13 to 15% Anthropogenic GHG emissions came from agriculture sector. Cultivation of rice under fully flooded conditions emits nearly 20 to 40 Mt of methane every year. AWD is the most promising factor that mitigates methane emission by 50% when compared to flooded rice.
5. AWD alters availability of macro and micro nutrients; it also increases the availability of phosphorous, AWD promotes higher zinc availability compared to conventional method of cultivation of rice.
6. Decreases arsenic uptake by paddy fields.
7. Decreases nitrogen leaching.
8. AWD reduces lodging of plants in paddy fields.

Disadvantages

1. Delay in AWD management practices during grain filling, flowering, tillering results in greater reduction of yields.

2. Denitrification is more in AWD fields because when drying more nitrate is formed, which is lost during flooding.
3. Weed population is more in AWD fields than flooded fields.
4. AWD may increase salinity in the fields.

Conclusion

Growing more rice with less water is important for global food security for increasing population. AWD may help the farmers to grow rice with less water. This management also helps the farmers to bring more area under cultivation of rice which ensures increase in rice production. Implementation of this practice in fields that promotes sustainability in the field of agriculture.

References

Ali MA, Hoque MA, Kim, PJ. 2013. Mitigating global warming potentials of methane and nitrous oxide gases from rice paddies under different irrigation regimes. Ambio 42: 357–68.

climatechange.irri.org /ghgmitigation.irri.org

http://www.knowledgebank.irri.org

IRRI. 2013. Tackling climate change and addressing water scarcity through AWD. Los Baños, Philippines: International Rice Research Institute

Ishfaq, M., Farooq, M., Zulfiqar, U., Hussain, S., Akbar, N., Nawaz, A., & Anjum, S. A. (2020). Alternate wetting and drying: A water-saving and eco-friendly rice production system. *Agricultural Water Management*, *241*, 106363.

Lampayan, R. M., Rejesus, R. M., Singleton, G. R., & Bouman, B. A. (2015). Adoption and economics of alternate wetting and drying water management for irrigated lowland rice. *Field Crops Research*, *170*, 95-108.

Mote, K., Rao, V. P., & Anitha, V. (2020). Alternate wetting and drying irrigation technology in rice.

Price, A. H., Norton, G. J., Salt, D. E., Ebenhoeh, O., Meharg, A. A., Meharg, C., ... & Davies, W. J. (2013). Alternate wetting and drying irrigation for rice in Bangladesh: Is it sustainable and has plant breeding something to offer? *Food and Energy Security*, *2*(2), 120-129.

Rejesus, R. M., Palis, F. G., Rodriguez, D. G. P., Lampayan, R. M., & Bouman, B. A. (2011). Impact of the alternate wetting and drying (AWD) water-saving irrigation technique: Evidence from rice producers in the Philippines. *Food Policy*, *36*(2), 280-288.

Siopongco JDLC, Wassmann R, Sander BO. 2013. Alternate wetting and drying in Philippine rice production: feasibility study for a Clean Development Mechanism. IRRI Technical Bulletin No. 17. Los Baños, Philippines:

Subedi, N., & Poudel, S. (2021). Alternate wetting and drying technique and its impacts on rice production. *Tropical Agrobiodiversity (TRAB)*, *2*(1), 1-6.

Tan, X., Shao, D., Liu, H., Yang, F., Xiao, C., & Yang, H. (2013). Effects of alternate wetting and drying irrigation on percolation and nitrogen leaching in paddy fields. *Paddy and Water Environment*, *11*(1), 381-395.

Yan X, Akiyama H, Yagi K, Akimoto, H. 2009. Global estimations of the inventory and mitigation potential of methane emissions from rice cultivation conducted using the 2006 Intergovernmental Panel on Climate Change Guidelines. Global Biogeochemical Cycles 23.

Ye, Y., Liang, X., Chen, Y., Liu, J., Gu, J., Guo, R., & Li, L. (2013). Alternate wetting and drying irrigation and controlled-release nitrogen fertilizer in late-season rice. Effects on dry matter accumulation, yield, water and nitrogen use. *Field Crops Research*, *144*, 212-224.

Zhang, H., Chen, T., Wang, Z., Yang, J., & Zhang, J. (2010). Involvement of cytokinins in the grain filling of rice under alternate wetting and drying irrigation. *Journal of Experimental Botany*, *61*(13), 3719-3733.

Neogi, M. G., Uddin, A. S., Uddin, M. T., & Hamid, M. A. (2018). Alternate wetting and drying (AWD) technology: a way to reduce irrigation cost and ensure higher yields of Boro rice. Journal of the Bangladesh Agricultural University, 16(1), 1-4.

Hasan, K., Abu Habib, M., Abdullah, D. B., & Afrad, S. I. (2016). Impact of alternate wetting and drying technique on rice production in the drought prone areas of Bangladesh. Indian Research Journal of Extension Education, 16(1), 39-48.