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Up-scaling Water Saving Technologies in Rice Cultivation under Corporate Social Responsibility

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Abstract: Rice crop being the major consumer of water, the water use efficiency of growing rice crop is low compared to other field crops. The promising technologies on water saving in rice were advocated to the farmers on corporate social responsibility basis by upscale and popularization of these techniques among poor land holding farmers in rice growing locations of Villupuram district of Tamil Nadu State in India. The main objective of the study was to bring awareness among farmers on water saving technologies in rice production, thereby increasing water usage efficiency and enhanced grain yield. Field demonstrations were carried out in 25 locations each separately in Villupuram district for up scaling water saving technology in rice cultivation like System of Rice Intensification (SRI) and Alternate Wetting and Drying Irrigation (AWDI). SRI compared with conventional transplanted rice (CTR) and AWDI with flood irrigation as farmers' practice. The bio-metric observation data was recorded in the demonstration field plots. The average mean data was computed and used for analysis. SRI has showed higher yield attributes viz., Productive tillers (19) and 174 number of grains/panicle over CTR, besides enhanced water productivity of 0.63 kg/m^3 by minimizing the no. of irrigation to 19 and quantum of water requirement (9800 m^3/ha). Increase in the grain yields up to 19.44 percent over CTR obtained with water saving made the farmers confident on the water saving technologies. Among the irrigation methods *viz.,* flood irrigation and AWDI, 9.4 percent yield increase with 30.4 percent water saving as recorded under AWDI method of irrigation management in lowland rice cultivation. Popularization of water saving technologies in rice cultivation has created greater awareness on water quantification and need based water management among the farmers in the project area.

Keywords: Rice crop, Water saving technology, Up-scaling.

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Introduction

Rice is a traditional food grain crop which is being grown from time immemorial in India which is predominantly grown in Tamil Nadu by accounting nearly 65% of the irrigated area. Of late, water scarcity due to climate change led variations in rainfall distribution and less profitability, the area under rice cultivation is shrinking every year with increasing productivity (Thiyagarajan, 2005). Surface water is key source of irrigation wherein irrigation tanks supports the rice farmers in their command area of traditional paddy growing zones in southern India. The paucity of water in the surface storage structures like tanks and reservoirs threatens the sustainability of lowland rice ecosystem. There is greater competition for sharing of the existing water resources from industrial and domestic sector which necessitate for economizing the water usage in agriculture sector. Decline in availability of water for rice farming has become a global concern and need water saving techniques with renewed attention (Bouman and Tuong, 2001). System of Rice Intensification is a resource efficient production system being adopted very well in Asian countries for the past one decade with promising results on rice productivity (Uphoff, 2013). Tamil Nadu Agricultural University has taken SRI and AWDI as one of the water saving technology in IOCL funded project with the objective of enhancing the crop and water productivity.

Material and Methods

Project was implemented in Villupuram district of Tamil Nadu under irrigated ecosystem to maximize the crop and water productivity by adoption of various water saving technologies as farmers participatory approach. North-east and South-west monsoons that contribute to the total annual rainfall. The normal rainfall of the district is 1213.3 mm.

The farmer's participatory demonstrations were conducted in 50 farmers holding in different villages of Viluppuram district during Samba season (September 18 to January 19). The soil type in the study area were clay loam, medium in available soil nitrogen, low to medium in available phosphorus and high in available potassium. Tank and wells are the key sources of irrigation. Water saving technologies like System of Rice Intensification and Alternate Wetting and Drying Irrigation were demonstrated in 0.4 hectare area by comparing with farmers existing practice in rice cultivation with same varieties.

1. *System of Rice Intensification (SRI)*

SRI demonstrations were conducted in 25 farmers holding in an area of 0.4 hectare which was compared with Conventional Transplanted Rice (CTR) @ 20 x 10 cm spacing. The major components of SRI *viz.,* lesser seed rate of 7.5 kg/ha grown in mat nursery transplanted at young age (14 - 15 days) as square planting of 25 x 25 cm with one seedlings /hill, mechanical weeder for weeding (15, 30,45 DAT) and intermittent irrigation (2.5 cm depth) was adopted. Conventional transplanted rice (CTR) includes adoption of 30 - 35 days old seedlings planted at randomly with continuous submergence of irrigation water at 5 cm depth until harvest of the crop was practiced. Water quantification at field level based on the water depth study and number of irrigation in each treatment, to work out water productivity (Mishra and Saloke, 2010).

2. *Alternate Wetting and Drying Irrigation (AWDI)*

AWDI demonstrations were conducted in 25 farmers holding in an area of 0.4 hectare which was compared with Flood irrigation (continuous submergence of irrigation water). Alternate Wetting and Drying Irrigation (AWDI) is a water-saving technology that farmers can apply to reduce their irrigation water use in rice fields without decreasing yield. In AWD, irrigation water is applied, a few days after the disappearance of the ponded water. Hence, the field is alternately flooded and non-flooded. A practical way to implement AWD safely is by using a 'field water tube' (*Pani pipe*) to monitor the water depth on the field. After irrigation, the water depth will gradually decrease. When the water level in the water pipe has dropped to about 15 cm below the surface of the soil, irrigation should be applied to re-flood the field to a depth of about 2.5 cm.

The Field Water Tube (Pani pipe)

The field water tube is made up of 30 cm long plastic pipe and should have a diameter of 10 - 15 cm so that the water table is easily visible, and also it is easy to remove soil inside. Perforate the tube with many holes on all sides, so that water can flow readily in and out of the tube. Hammer the tube into the soil, so that 15 cm protrudes above the soil surface. Take care not to penetrate through the bottom of the plough pan. Remove the soil from inside the tube so that the bottom of the tube is visible (Plate 1).

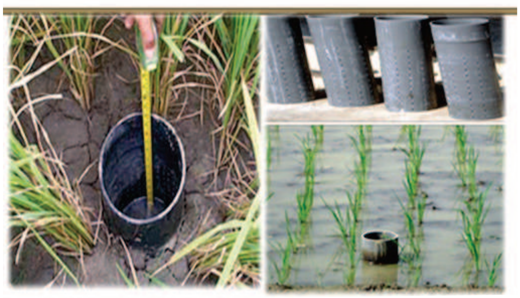

Plate 1: Field water tube specification and field installation view

The biometric observations were taken in 5 plants per demonstration in the field at different stages and was pooled for statistical analysis. Demonstrations were conducted in Randomized Block Design with each farmer field taken as replication. Net income and benefit cost ratio were arrived based on the cost of cultivation per hectare with market grain price of Rs.14/kg rice to arrive at the gross income. The data were subjected for statistical analysis by following standard statistical method (Gomez and Gomez, 1984).

Results and Discussion

Demonstrations conducted with the active participation of farmers during 2018-19 to quantify the water saving and influence on cropproductivity in rice cultivation. Results emanated from the demonstrations are given hereunder along with the scientific relationship with the observed parameters taken at different stages are discussed appropriately.

Yield Attributes and Grain Yield

SRI Vs CTR

Results showed that SRI performed superior in terms of having 20 productive tillers/hill, 190 filled grains/panicle and grain yield of 6.17 t/ha over CTR of 9 productive tillers/hill, 149 grains/panicle and grain yield of 5.13 t/ha (Table 1). SRI cultivation has edge over the CTR to the tune of 19.4 % increased yield over CTR. Planting of young seedlings under optimal growing condition is responsible for accelerated growth rate in SRI plants as these make possible to complete more phyllochrons before entering into their reproductive phase. Completion of more phyllochrons at early stage resulted in more productive tillers per hill and grain number per panicle as grain yield. These results are in tandem with the findings of Nemoto *et al.,* 1995 and Pandian *et al.,* 2014. From the above results, also found that the conversion of tillering to productive tillers are more in SRI over conventional planting.

Table 1: Establishment methods on yield attributes and Grain yield (pooled value of 25 demonstrations

Establishment method	No. of productive tillers/hill	No.of grains/ panicle	Grain yield (t/ha)	Net income (Rs/ha)	BCR (Rs.)	Water Requirement (m^3/ha)	Water productivity (kg/m^3)	Litre of water/kg of grain producti
CTR	9	149	5.13	24,841	1.68	12,960	0.40	2,534
SRI	20	190	6.17	40,030	2.18	9,800	0.63	1,593
S.Ed	0.69	4.3	0.18	-	-	-	-	-
CD (p= 0.05)	1.4	9.4	0.39	-	-	-	-	-

The results found that, there was water saving up to 24 percent over conventional method of planting with flood irrigation. Water productivity also, worked out to find out the efficiency of water on grain yield and litres of water required to produce per kg of grain (Figure1). Under conventional method of rice cultivation, 2,534 litres of water is required to produce one kg of grain but 1,593 litres is sufficient in SRI. Higher yield from SRI crop establishment method has showed, higher net income Rs.40, 030 / ha with benefit cost ratio of Rs.2.18 than the conventional method of crop establishment. The incremental income of Rs.24, 841/- per hectare have been obtained through SRI method to produce per kg of grain under SRI (Table1). Ravichandran *et al.*, 2015 found that SRI has more economic gain over conventional planting of rice in Tamil Nadu.

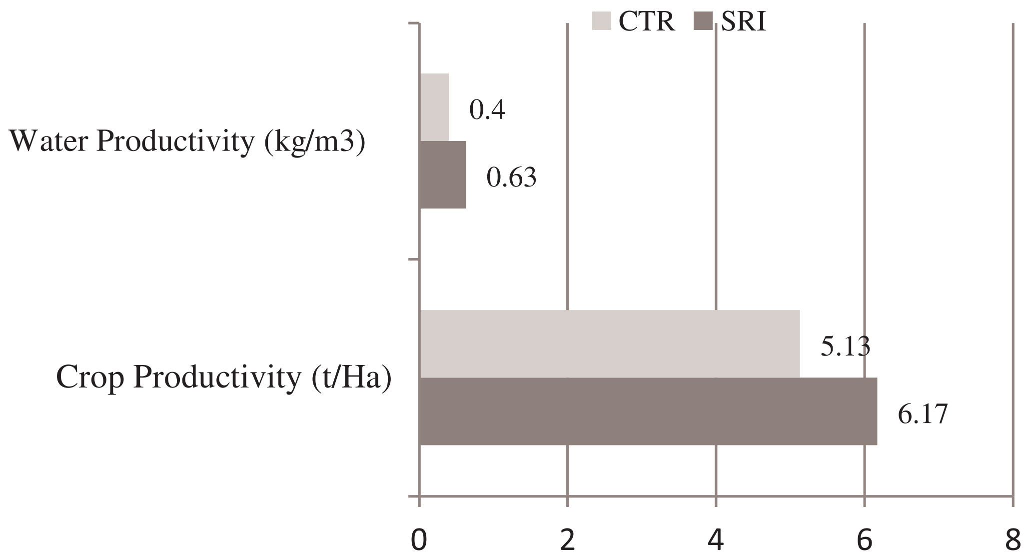

Figure 1: Crop and Water Productivity influenced by Crop establishment methods

AWDI Vs Flood Irrigation

Irrigation methods *viz.*, Flood irrigation and alternate wetting irrigation were demonstrated simultaneously in 25 farmers field and the accrued results showed that AWDI performed superior in terms of producing 15 productive tillers/hill, 180 filled grains/panicle and grain yield of 5.66 t/ha over flood irrigation in conventional method with 10 productive tillers/hill, 155 grains/ panicle and grain yield of 5.14t/ha (Table 2). AWDI has edge over the flood irrigation to the tune of 9.83% increased yield (Figure 2).

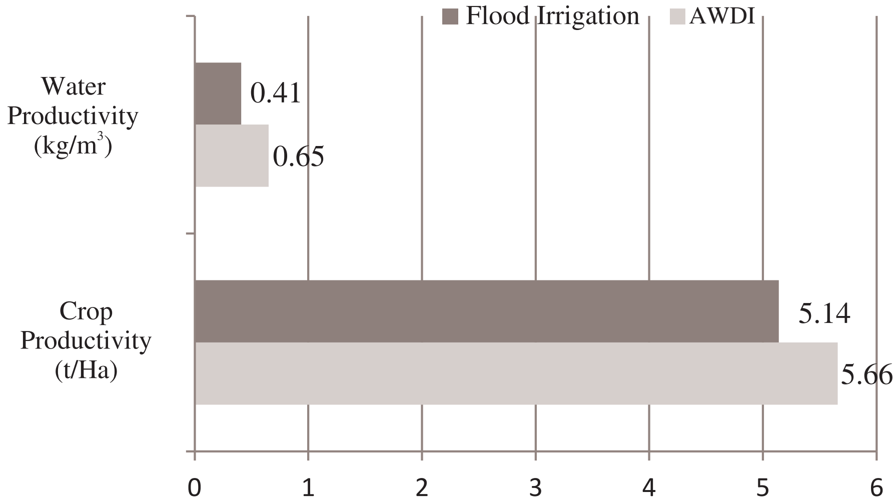

Figure 2: Crop and Water Productivity influenced by Irrigation Methods

Table 2: Irrigation methods on yield attributes and Grain yield (pooled value of 25 demonstrations)

Irrigation methods	No. of PT/hill	No.of grains/ panicle	Grain yield (t/ha)	Net income (Rs//ha)	BCR	Water Requirement (m^3/ha)	Water productivity (kg/m^3)
Flood irrigation	10	155	5.14	26,633	1.76	12,690	0.41
AWDI	15	180	5.66	32,863	1.94	8,750	0.65
CD (p= 0.05)	1.68	11.2	0.49	-	-	-	-

The results found that conversions of tillering to productive tillers were more in Alternate Wetting Drying Irrigation (AWDI) over continuous submergence of water. AWDI also owing more number of grains per panicle and 9.83 percent increased grain yield (Table 2). The shallow depth of irrigation as guided through field water tube facilitated the farmers to take decision on when to irrigate and how much to irrigate appropriately.

Simple and affordable tool (field water tube) is much useful for irrigation scheduling in rice cultivation, thereby saving of sizable quantity of irrigation water (3,940 m^3) over continuous submergence of water. An average of 25 plots harvested, recorded 30.94 percent water saving through Alternate Wetting Drying Irrigation than continuous submergence of water (Figure 2). Nyamai *et al*. 2012 opined that practice of alternate wetting and drying irrigation under SRI has potential to save water and maximized the productivity.

Higher grain yield from alternate wetting drying irrigation than continuous submergence of water has showed higher net income (Rs.32, 863/ha) and benefit cost ratio of Rs.1.94 than the conventional method of crop establishment. The incremental income of Rs.6, 709/ha have been obtained through alternate wetting Drying Irrigation.

Conclusion

The water saving through adoption of the technologies helped the farmers to expand additional area under rice cultivation. Increase in the rice grain yields obtained made the farmers, confident on the water saving technologies and to address the water shortages in well irrigation system and also paved way for overall energy saving (electricity in particular) in rice cultivation.

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References

Bouman, B.A.M. and Tuong, T.P. 2001. Field water management to save and increase its productivity in irrigated lowland rice. Agric. Water Management, 49:11-30.

Gomez, K.A. and Gomez, A.A. 1984. Statistical procedures for agricultural research (2nd Ed.). Wiley - Interscience Publication, John Wiley & sons, NY, USA.
Nemoto, K. Morita, S. Baba, T. 1995. Shoot and root development in rice related to the phyllochrons. *Crop Sci*. 35:24-29.

Mishra, A. and Saloke, V. 2010.The Efect of planting pattern and water regime on root morphology, physiology and grain yield of Rice. *J.Agron Crop sci*.196: 368-378.

Nyamai, M., Mati, B.M., Home, D.G., Odaongo, B. and Wanjogu, R. 2012. Improving land and water productivity in basin rice cultivation in Kenya through SRI. *Agr Eng*.14:1-9.

Pandian, B.J., Sampathkumar, T. and Chandrasekaran, R. 2014. System of Rice Intensification (SRI): Packages of technologies sustaining the production and increased the rice yield in Tamil Nadu, India, Irrigation Drainage Sys Eng. 3:115-120.

Ravichandran, V.K., Nayar, V. and Prakash, K.C. 2015. An Evaluation of the SRI on increasing yield, water productivity and profitability; Experiences from TN-IAMWARM Project. Irrigation Drainage Sys Eng.4:137-142.

Thiyagarajan, T.M. and Selvaraju, R. 2005. Water saving in rice cultivation in India. In: Hengsdijk H, Bindraban PS, editors. Water saving in rice production systems. Proceedings of an International workshop on water saving rice production systems at Nanjing University, China, April 2-4, 2005. PRI report no.33:15-45.

Uphof, N., Kassam, A. and Thakur, A. 2013. Challenges of increasing water saving and water productivity in the rice sector: Introduction to the system of rice intensification (SRI) and This Issue. Taiwan water Conservancy, 61:1 -13.