

Original Research Article

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Frontline Demonstration on Water Saving technology-Alternative Wetting and Drying Irrigation Method in Rice Cultivation for Bhadra Command area of Davangere District, India

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ABSTRACT

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Alternative Wetting and Drying (AWD) is a technique or a tool called “pani pipe” where we can save the water up to 20-30% and also reduces the greenhouse gas emission up to 25-45%. ICAR-Taralabalu Krishi Vigyan Kendra, Davanagere conducted the Frontline demonstrations in kharif, during 2024 and 2025 in the rice transplanted regions of Bhadra command area of Davanagere district on AWD technology against the Farmer Practice (Submergence) with an objective of reduction in the cost of production, saving the water without effecting the crop yields. The technologies were mechanical transplanting along with AWD and integrated crop management practices were followed in the demonstration plots. The extension gap and technology gap were 2.71 qha⁻¹ and 10.27 qha⁻¹ respectively. The higher yield, higher gross return, net return and benefit cost ratio were 54.73 qha⁻¹, Rs.153380 ha⁻¹, Rs.73690 ha⁻¹ and 1.83 respectively recorded in demonstration plot against the farmers practices of continuous flooding. Reduction in the cost of production and higher yield led to increase in gross and net returns, water saving (20.45%) in demo plots. This had created awareness among the farming community and inspiration to other paddy growing farmers in the command area to adopt the technology.

Introduction

Rice (*Oryza sativa* L.) is an important food crop of India. 50 to 60% of population depends on the rice as a staple food. It provides 43% calorie requirement for more the 70% of Indians. India is the second-largest producer of rice globally, accounting for nearly 20% of global production. In India rice is grown in an area of 51.2

million ha the production and productivity of 152 Mt and 2929 kgha⁻¹ respectively (2024-25) (Anonymous, 2024). In Karnataka rice is cultivated in an area of 1.3 million hectares, production of 42.1 lakh tonnes and productivity of 3400 kgha⁻¹. Rice is cultivated in the low land consuming more amount of water for raising of nursery, puddling, transplanting and maintaining the water level of 5cm depth throughout the cropping period. In paddy

fields there will be additional loss of water through percolation, evaporation and seepage. To produce one kg of rice, the amount of water required is about 4000 to 4500 liters (Kishore mote 2021). Farmers are shifting to different methods of paddy cultivation to save the water with hindering the crop yields. Mechanical transplanting with alternative wetting and drying technology will save the water up to 20-30%. Mechanical transplanting will also play a key role in saving water as there is no land preparation for nursery raising which requires 40 mm of water and reduces the cost on transplanting. Traditional method of manual rice transplanting requires an average of 364 man hour per hectare (Jagvir Dixit and Khan, 2011). Method of irrigation to reduce the water without hindering the yield of the rice crop is AWD. This method of irrigation in the rice system will reduce the water inputs by 23-30% as compared to farmer's practice of submergence or continuous flooding. AWD technology will save the water, reduces the methane emission and it will indicate the time of irrigation to the crop. In Davangere district rice is grown in an area of 45,000ha in Bhadra command area, where they are growing the paddy with high cost of inputs, indiscriminate use of canal water for continuous flooding and lack of awareness on the AWD technology of irrigation through the pani pipe.

Materials and Methods

Frontline Demonstration were conducted in the irrigated low land paddy growing areas during the kharif season for two consecutive years for 2024 and 2025 of Halebathi, Kariganuru, Belavanuru, Kadaranahalli and Chandranahalli by ICAR- Taralabalu krishi vigyan kendra. Davanagere district in an area of 50 ha. Demonstrations were conducted with integrated crop management practices with mechanical transplanting and AWD technology (when water level in pani pipe drops to 5 cm below soil surface) against the farmers practice of growing paddy with continuous flooding (Table 1).

An implement of 30 cm length of plastic pipe with 10-15 cm diameter is buried in the paddy field with 20 cm inside the soil with perforated holes around the pipe with 5mm interval, so that 10 cm of pipe remains above the soil surface. Remove the soil inside the plastic pipe and allow the water to percolate into the pipe through the holes as well as for water to flow easily in and out (Sudharani *et al.*). This implement in AWD technology helps to monitor the water depth in rice field. Initial

stages of crop growth, fields submerged (roughly 3–5 cm) for the first two weeks after transplanting to allow seedlings to establish and to suppress the weeds. When the water level in the pipe reduces to 5cm below the surface of the soil, irrigation was given to re-flood the field to a depth of 5cm at vegetative or tillering stage. During panicle initiation and flowering, the field should be kept submerged (1-5 cm) to avoid yield loss, known as "Safe AWD." Do not allow the soil to dry completely.

At the ripening stage follow the AWD method of irrigation for 1- 2weeks and dry the filed completely which helps in harvesting and grain maturity. The other integrated management practices were followed as per the recommendation of the KSNUAHS, Shivamogga. The large scale frontline demonstration was conducted to study the technology gap between the potential yield and demonstration yield. The yield data were obtained from both the frontline demonstration plots and farmer practice plots. The data was further analyzed by using statistical tools. The technology gap, extension gap, net returns and benefit cost ratio were calculated as given below (Ayyadurai Pachamuthua *et al.*, 2024)

1. Technology gap = Potential yield - Demonstrated yield
2. Extension gap = Demonstrated yield -Yield under existing practice
3. Net returns (Rs./ha) = Gross return (Rs./ha) – Gross Cost (Rs. /ha)

$$4. \text{Benefit Ratio} = \frac{\text{Gross Return (Rs./ha)}}{\text{Gross Cost (Rs./ha)}}$$

Results and Discussion

An alternative wetting and drying method of irrigation management was carried out in the lowland rice ecosystem. In this AWD method the rice fields are allowed to dry for a few days, and we can even observe the crack in the soil before being flooded again to 5cm of submergence. The AWD irrigation method is to monitor the depth of the water in the field water tube (pani pipe). There will be a reduction in the production of methane (30-50%) due to the AWD irrigation method reducing the amount of time where the rice fields are flooded (Kishore Mote *et al.*, 2020).

Table.1 Technologies details adopted in the FLD (AWDI) v/s Farmers Practice (Submergence)

Si. No	Technology	Improved Practices	Farmer Practices	Gap in Adoption (100%)
1.	Seed rate	10-12 kg	20-25 kg	100
	Seedlings	Raised in Pro trays	Seed bed	100
2	Transplanting	Mechanised transplanting	Manual transplanting	100
3	Seed treatment	Bio fertilisers – <i>Azospirillum</i> and <i>Phosphate Solubilizing Bacteria</i> @ 500g/ha.	No Seed treatment	100
4	Fertiliser Application	RDF: 100:50:50 NPK kg/ha ZnSO ₄ @ 10 kg/ha	150: 75:30 NPK kg/ha ZnSO ₄ @ 10 kg/ha	50
5	Irrigation Method	Alternative Wetting and Drying (AWD) – Pani Pipe	Flooding or Submergence throughout the crop period	100
6	Plant protection Measures	Installation of Pheromone traps and timely spraying of Insecticides	Scheduled spraying method	50

Table.2 Showing the Productivity, Yield, Extension gap and technology gap in FLD (AWDI) against Farmer Practice (Submergence)

Year	Area (ha)	No of Farmers	Potential yield (qha ⁻¹)	Yield (qha ⁻¹)		% increase over in FP	Extension yield gap qha ⁻¹	Technology gap qha ⁻¹
				AWDI	FP			
2024	10	10	65.00	54.75	52.01	3.18	2.75	10.25
2025	40	25	65.00	54.71	52.03	5.14	2.68	10.29
Average	50	85	65.00	54.73	52.02	4.16	2.715	10.27

Table.3 Statistically Analysed Yield and Yield Attributing Characters in AWDI and FP in Rice

Samples	Yield q/ha 2024		Yield q/ha 2025		Test weight (g) 2024		Test weight (g) 2025	
	AWDI	FP	AWDI	FP	AWDI	FP	AWDI	FP
1	54.75	52.75	53.50	52.50	16.9	14.2	16.7	13.9
2	52.92	54.65	56.25	50.62	16.2	13.9	16.9	14.1
3	53.10	51.10	58.12	52.50	17.2	13.9	16.3	13.6
4	60.22	52.20	54.37	49.68	16.9	14.3	16.5	13.5
5	60.50	52.01	51.62	52.50	17.1	13.6	16.8	13.8
6	56.55	44.05	59.80	48.75	17.5	13.9	16.6	14.1
7	50.60	52.05	50.62	50.62	16.8	14.9	16.5	14.3
8	51.90	52.55	56.20	54.37	16.9	14.7	16.7	14.5
9	53.55	55.60	52.30	56.25	17.3	13.1	16.15	13.7
10	53.45	53.10	54.28	52.50	17.1	12.9	16.8	13.6
Average	54.75	52.00	54.70	52.03	16.99	13.94	16.9	13.5
<i>S Em +/-</i>	2.55		2.10		0.41		0.17	
<i>CD (5%)</i>	8.17		6.73		1.32		0.54	

Table.4 Economic analysis of Alternative Wetting and Drying Irrigation (AWDI) against the Farmer Practices (FP-Submergence) of paddy Frontline Demonstration conducted at Bhadra Command area of Davanagere District.

Year	Gross Cost (Rs.ha ⁻¹)		Gross Return (Rs.ha ⁻¹)		Net Return (Rs.ha ⁻¹)		B:C ratio		No of Irrigations		Irrigation water saved (%)
	AWDI	FP	AWDI	FP	AWDI	FP	AWDI	FP	AWDI	FP	
2024	79820	89625	155504	147698	75684	58073	1.95	1.65	21	26	19.2
2025	75562	88325	151256	139262	71696	50937	1.71	1.58	18	23	21.7
Average	77691	88975	153380	143480	73690	54505	1.83	1.61	19.5	24.5	20.45

Fig.1 Agronomist Explaining on the Mechanised transplating and AWD technology in Paddy



Fig.2 Dr K.P Basavarajappa, Secretary, TRDF visited and interacted with Belavanur farmers



Fig.3 Celebration of field day



Fig.4 Field study



This type of draining method has shown a large impact on methane emissions ([Kazuyuki Yagi et al., 1996](#)). Demonstration of the AWD irrigation method using the low - cost technology of pani pipe (field water tube) in the Bhadra command area of Davangere district.

Yield and yield attributes

The AWD plots recorded grain yields of 54.75 q ha⁻¹ and 54.71 q ha⁻¹ with an average of 54.73 q ha⁻¹ from the years 2024-25 and 2025-26, respectively, when

compared with farmers' practices of 52.01 q ha⁻¹ and 52.03 q ha⁻¹ with an average of 52.02 q ha⁻¹ (Table 2). ([Sharath Chandra M et al., 2017](#)). The demonstration plots recorded the average per cent increase 4.16 over the farmers practice for two years. The increase in the yield is mainly due to the AWD technology, which has improved the aeration in the root zone, improving the number of productive tillers. The highest average test weight recorded in the demonstration plots was 16.99g as against the farmers' practice with 13.94g in 2024-25. Similar trends were also observed in the year 2025

(Table 3). The average amount of water saved in the demonstrated plots was recorded as 19.2% and 21.7% during the years 2024 and 2025. (Table 4) (Ganiginti Pavan Kalyan, *et al.*, 2022). This clearly indicates that the amount of irrigation saved will also directly benefit the crop yield.

Yield gap analysis

The technology yield gap calculated by subtracting the demonstration yield from Potential yield of rice crop. During the year 2024-25 the technology yield gap recorded was 10.25 qha⁻¹ and in the year 2025-26 was 10.29 q ha⁻¹ with an average technology gap of 10.27qha-1 (Table 2) (Ayyadurai Pachamuthua *et al.*, 2024).

Economics

The average higher gross return, net return and benefit cost ratio recorded in the demonstration plots were Rs.153380 ha⁻¹, Rs.73690 ha⁻¹ and 1.83 for two years (2024 and 2025) as against the farmers' practices recorded rs.143480 ha⁻¹ Rs.54505 ha-1 and 1.61 respectively (Table 4). The increased net returns in the demonstration plot are mainly due to a reduction in the gross cost (Rs.77691ha⁻¹) because of mechanized transplanting compared to manual transplanting in farmers practice recorded Rs.88975 ha⁻¹ (Vijay *et al.*, 2024 and Rajesh Shah *et al.*, 2021)

In Conclusion, change in the method of irrigation system in paddy ecosystem will definitely lead to reduction in the emission of greenhouse gases, improves the soil fertility and yields. Alternative wetting and drying along with mechanized transplanting technology in the paddy production system will boon to the farming community where water can be saved upto 20-30%, reduction in the cost of production. Mechanized transplanting will be a boon to farming community to solve the labour crisis and reduction in the pesticide load to the crop. The KVKs are targeting the large sector of farming community by creating awareness and conducting demonstration on these technologies.

Author Contributions

B. O. Mallikarjuna: Investigation, formal analysis, writing—original draft. M. G. Basvanagowda: Validation, methodology, writing—reviewing. T. N.

Devaraja:—Formal analysis, writing—review and editing. D. V. Kolekar: Investigation, writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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