



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; SP-8(10): 275-278
Received: 13-07-2025
Accepted: 21-08-2025

Megha PV
Department of Soil Science,
KSNUAHS, Shivamogga,
Karnataka, India

Salimath SB
Department of Soil Science,
KSNUAHS, Shivamogga,
Karnataka, India

Biradar GS
Department of Agricultural
Extension, KSNUAHS,
Shivamogga, Karnataka, India

Sharanappa Kuri
Department of Agronomy,
KSNUAHS, Shivamogga,
Karnataka, India

Anjali MC
Department of Soil Science,
GKVK, Mandya, Karnataka, India

Farmer's response under conventional system and alternate wetting and drying method of paddy cultivation in Karnataka: From flooded fields to sustainable yields

Megha PV, Salimath SB, Biradar GS, Sharanappa Kuri and Anjali MC

DOI: <https://www.doi.org/10.33545/2618060X.2025.v8.i10Sd.4098>

Abstract

The study aimed to assess farmer's adoption responses and management practices under conventional system and Alternate Wetting and Drying (AWD) method in the major paddy-growing areas of Harihar taluk, Davanagere district, Karnataka. A total of 150 farmers were selected, comprising 75 under each system and data were collected through personal interviews using a structured schedule. The study evaluated varietal preference, seed rate, nutrient application, irrigation frequency, pest and disease management and yield performance. RNR-15048 was the most adopted variety in both systems, though AWD farmers increasingly preferred water-efficient types like Nandyal Sona and Sampath Gold. Adherence to the recommended seed rate was higher under AWD (89%) than the conventional system (84%), reflecting greater awareness of input efficiency. Nutrient application generally exceeded recommendations in both systems, but AWD farmers applied comparatively lower nitrogen and phosphorus, with balanced potassium use. Irrigation days declined by about 35 per cent under AWD (20 days) compared to conventional (31 days), indicating major water savings. Pesticide and fungicide use also decreased, reflecting reduced pest and disease incidence under intermittent aeration. Grain yield under AWD averaged 74.10 q ha⁻¹ compared with 52.54 q ha⁻¹ under the conventional system, showing a 41 per cent increase. Overall, the AWD method proved to be a sustainable, resource-efficient and yield-enhancing alternative, improving water-use efficiency, optimizing inputs and supporting climate-resilient rice production across Karnataka.

Keywords: Alternate Wetting and Drying (AWD), Paddy cultivation, Farmer Adoption, Water-use Efficiency

Introduction

Rice (*Oryza sativa* L.) is a central staple and livelihood crop across India and its production systems exert a major influence on regional water demand, input use and greenhouse-gas emissions (FAO, 2023). Irrigated rice in India occupied roughly 47.8 million hectares and produced about 137.8 million tonnes in the 2023-24 crop year (USDA FAS, 2024). Conventional system of paddy fields, maintaining a standing water layer for most of the crop season, remains the dominant practice in many rice landscapes because it suppresses weeds, moderates the crop microclimate and is well-understood by farmers (Bouman *et al.*, 2007) [4]. However, continuous flooding is highly water-intensive, can accelerate groundwater depletion in water-stressed regions and sustains anaerobic soil conditions that favor methane production and alter nutrient dynamics (Chapagain and Hoekstra, 2011) [11]. These environmental and resource pressures have increased interest in water-saving rice management options that are practical and acceptable to farmers (Carrijo *et al.*, 2017) [5].

Alternate Wetting and Drying (AWD) is an intermittent irrigation strategy designed to reduce seasonal water use while maintaining or improving yield and reducing methane emissions (Bouman *et al.*, 2007) [4]. Fields are typically allowed to drain until the water level drops to about 10 cm below the soil surface, monitored using simple perforated 'pani-pipes', before being reflooded. AWD introduces aerobic phases that improve root aeration and change redox-

Corresponding Author:
Megha PV
Department of Soil Science,
KSNUAHS, Shivamogga,
Karnataka, India

sensitive nutrient transformations (Belder *et al.*, 2004) [3]. When implemented correctly, AWD can reduce irrigation volume and the number of irrigation events without significant yield penalties (Carrijo *et al.*, 2017) [5].

Adoption of AWD in farmer fields depends as much on socio-economic and institutional factors as on its agronomic benefits (Lampayan *et al.*, 2015) [13]. Farmers' decisions are shaped by perceived yield risk, familiarity with traditional practices, availability and cost of irrigation (fuel or electricity), labour constraints, and varietal preferences. Limited awareness, uncertainty about implementation and local water-distribution rules can hinder uptake even where AWD offers clear water or cost savings (Lampayan *et al.*, 2015) [13]. Conversely, evident cost savings and strong institutional support can increase farmer confidence and drive the long-term adoption of AWD practices.

2. Materials and Methods

A study was carried out in major paddy-growing areas of Harihar taluk in Davanagere district, Karnataka. A total of 150 farmers were selected, comprising 75 farmers each practicing conventional system and AWD method of paddy cultivation. The study aimed to document and compare farmer's responses on management practices under the two irrigation systems. Data were collected by personal interviews of paddy growers. Their responses were considered for the purpose of the study. The collected data were tabulated, analyzed and presented in tables for clear interpretation. Descriptive statistics, including mean,

range and standard deviation, were calculated as per Sundararaj *et al.* (1972) [23]. A structured interview schedule was designed with questions on:

1. Variety adoption (number and percentage of farmers)
2. Seed rate (kg ha^{-1})
3. Total nutrient input (N, P_2O_5 , K_2O , S)
4. Number of irrigation days
5. Pesticide and fungicide applications (solid kg ha^{-1} / liquid ml ha^{-1})
6. Grain yield (q ha^{-1})

3. Results and Discussion

3.1 Adoption of varieties

In conventional paddy cultivation, RNR-15048 was the dominant variety, accounting for 90 per cent of the area, followed by Annapoorna (5%), MS-2 (4%) and Nandyal Sona (1%) (Table 1). Under the AWD method, RNR-15048 remained prevalent, though reduced to 66%, while Nandyal Sona (17%), Sampath Gold (9%), Annapoorna (7%) and MS-2 (1%) showed increased adoption (Table 1). Farmers predominantly adopted improved medium-duration varieties, favouring RNR-15048 for its short cycle (120-125 days), blast resistance and high yields (Shankar *et al.*, 2022) [21]. AWD adoption shifted toward water-efficient options like Nandyal Sona and Sampath Gold, mirroring trends in resource-conserving systems (Weerakoon *et al.*, 2011) [26], underscoring variety selection's role in enhancing resilience and efficiency.

Table 1: Per cent varietal preference of farmers under conventional system and AWD method of paddy cultivation

Paddy Variety	System	
	Conventional (75)	AWD (75)
RNR-15048	90 (67)	66 (49)
Annapoorna	5 (4)	7 (5)
Nandyal Sona	1 (1)	17 (13)
MS-2	4 (3)	1 (1)
Sampath Gold	-	9 (7)

*Values in the paranthesis indicates number of farmers

3.2 Seed rate

The recommended seed rate for paddy is 25 kg acre^{-1} (62.5 kg ha^{-1}). In conventional system, 84 per cent adhered to the recommended seed rate, while 16 per cent used higher rates (Table 2). Under AWD method, adherence was higher at 89 per cent, with 11 per cent exceeding the recommendation and none below it (Table 2). This elevated compliance, particularly in AWD, underscores effective extension services and awareness of optimal practices. Nonetheless, overuse in both systems (16% conventional, 11% AWD) signals lingering gaps from traditional habits or risk aversion (Pal *et al.*, 2018) [16]. Targeted education on seed rate benefits for AWD-compatible varieties could enhance sustainability and full adoption.

3.3 Total nutrient application through inorganic fertilizers and organic manures

Major fertilizers included blends (16:20:0:13, 20:20:0:13, 20:20:0:0), DAP, urea, SSP, MOP and ZnSO_4 , with FYM and sheep penning as primary organics. The nutrient application pattern exhibited notable variation between the conventional and AWD systems (Table 3). In the conventional system, the mean nitrogen application was $162.12 \pm 26.15 \text{ kg ha}^{-1}$, ranging from 115 to $197.68 \text{ kg ha}^{-1}$, while phosphorus application averaged $157.27 \pm 32.53 \text{ kg ha}^{-1}$ (range: 98.84-197.68). The corresponding mean potassium and sulphur applications were $37.00 \pm 24.49 \text{ kg ha}^{-1}$ (0-75) and $42.76 \pm 12.78 \text{ kg ha}^{-1}$ (0-55), respectively. Under AWD method, comparatively lower mean nutrient applications were observed, with nitrogen at $141.94 \pm$

26.73 kg ha^{-1} (98.84-185.33), phosphorus at $126.70 \pm 16.37 \text{ kg ha}^{-1}$ (100-185.33), potassium at $50.00 \pm 4.49 \text{ kg ha}^{-1}$ (45-55) and sulphur at $33.47 \pm 12.10 \text{ kg ha}^{-1}$ (0-40). Both systems exceeded recommendations ($100:50:50 \text{ N:P}_2\text{O}_5:\text{K}_2\text{O ha}^{-1}$) by overapplying N and P for yield security (Mboyerwa *et al.*, 2022) [14]. This overapplication of P persisted in AWD, driven by precautionary mindsets against deficiencies (Alam *et al.*, 2023) [32]. Meanwhile, K and S often fell short due to inconsistent management practices (Dobermann *et al.*, 1998) [7]. Sulphur deficiencies were exacerbated by gaps in extension support (Sachdev and Sachdev, 2002) [18]. Blends dominated, reflecting farmer's preferences for convenient formulations (Lakitan *et al.*, 2018) [11]. Larger farms applied higher N rates, contributing to variability under flooding (Takeshima *et al.*, 2015) [24]. This divergence was common among rice farmers applying NPK (Joshi, 1992) [9]. Organic use remained sporadic, limited by slow agronomic benefits (Khaliq *et al.*, 2006) [10]. Rising labor costs reinforced reliance on synthetics for immediate yields (Rahaman *et al.*, 2020) [18], favoring quick gains over long-term soil health.

Table 2: Seed rate adopted by farmers under conventional system and AWD method of paddy cultivation

Seed Rate Category	System	
	Conventional (75)	AWD (75)
Recommended (62.50 kg ha^{-1})	84 (63)	89 (67)
Higher than recommended	16 (12)	11 (8)
Lower than recommended	-	-

*Values in the paranthesis indicates number of farmers

Table 3: Total quantity of nutrient input through fertilizer applied by farmers under conventional system and AWD method of paddy cultivation

System		N	P ₂ O ₅	K ₂ O	S
		kg ha ⁻¹			
Conventional	Range	115-197.68	98.84-197.68	0-75.00	0-55.00
	Mean	162.12	157.27	37.00	42.76
	SD ±	26.15	32.53	24.49	12.78
AWD	Range	98.84-185.33	100.00 -185.33	45.00-55.00	0-40.00
	Mean	141.94	126.70	50.00	33.47
	SD ±	26.73	16.37	4.49	12.10

3.4 Total number of irrigation days

Conventional systems required 29-33 irrigation days (mean: 31 ± 1) over the crop cycle, versus 18-22 days (mean: 20 ± 1) under AWD (Table 4). This 35 per cent reduction highlights AWD's water-saving potential without yield loss, aligning with reports of up to 30 per cent fewer irrigations while sustaining or boosting outputs (Omwenga *et al.*, 2014) ^[15]. Optimized dry periods in AWD minimize percolation and enhance productivity (Sujono *et al.*, 2011), promoting cost-effective, sustainable water management over traditional flooding.

Table 4: Total number for irrigation days under conventional system and AWD method of paddy cultivation

System		Irrigation days
Conventional	Range	29-33
	Mean ± SD	31 ± 1
AWD	Range	18-22
	Mean ± SD	20 ± 1

3.5 Pest management

Pesticide applications under conventional and AWD systems are detailed in Table 5. In conventional cultivation, solid pesticides averaged 13.36 kg ha⁻¹ (range: 0.32-32.12), while liquids averaged 542.99 ml ha⁻¹ (111.20-864.85). Under AWD, solids were slightly lower at 12.68 kg ha⁻¹ (0.25-24.71), with liquids reduced to 277.99 ml ha⁻¹ (98.84-617.75). Conventional flooding increased pest pressures from yellow stem borer, brown planthopper, stem borer and leaf folder, necessitating intensive chemical use (Lampayan *et al.*, 2016) ^[12]. AWD altered pest dynamics, curbing populations and slashing liquid pesticide needs by up to 30 per cent through water-mediated control (Carrijo *et al.*, 2017) ^[5], advancing sustainable integrated pest management.

Table 5: Pesticide application by farmers under conventional system and AWD method of paddy cultivation

Pesticide formulations		System	
		Conventional	AWD
Solid	Mean (kg ha ⁻¹)	13.36	12.68
	Range (kg ha ⁻¹)	0.32 - 32.12	0.25 - 24.71
Liquid	Mean (ml ha ⁻¹)	542.99	277.99
	Range (ml ha ⁻¹)	111.20 - 864.85	98.84 - 617.75

3.6 Disease management

Fungicide applications under conventional and AWD systems are detailed in Table 6. In conventional cultivation, solid fungicides averaged 0.46 kg ha⁻¹ (range: 0.37-1.85), while liquids averaged 771.10 ml ha⁻¹ (494.20-864.85). Under AWD, solids declined to 0.33 kg ha⁻¹ (0.30-0.86), with liquids at 494.20 ml ha⁻¹ (370.65-741.30). Conventional saturation intensified fungal pressures from blast, bakanae, sheath blight and rot, prompting high-dose fungicide use to counter yield losses (Savary *et al.*, 2019) ^[20]. AWD's drying intervals disrupted spore germination, narrowing disease complexes and

slashing applications for precision control (Bouman *et al.*, 2007) ^[4], fostering sustainable management.

Table 6: Fungicide application by farmers under conventional system and AWD method of paddy cultivation

Fungicide formulations		System	
		Conventional	AWD
Solid	Mean (kg ha ⁻¹)	0.46	0.33
	Range (kg ha ⁻¹)	0.37 - 1.85	0.30 - 0.86
Liquid	Mean (ml ha ⁻¹)	771.10	494.20
	Range (ml ha ⁻¹)	494.20 - 864.85	370.65 - 741.30

3.7 Yield levels

Grain yields across varieties under conventional and AWD systems are shown in Table 7. Under conventional cultivation system, grain yield of paddy varieties varied considerably, with RNR-15048 recording from 38.92 to 74.13 q ha⁻¹, Annapoorna from 49.42 to 57.82 q ha⁻¹, Nandyal Sona 54.03 q ha⁻¹ and MS-2 ranging from 49.42 to 61.28 q ha⁻¹, resulting in an overall mean yield of 52.54 ± 8.07 q ha⁻¹. In contrast, under AWD method, yield performance was markedly higher, with RNR-15048 ranging from 58.51 to 86.73 q ha⁻¹, Annapoorna from 67.61 to 81.54 q ha⁻¹, MS-2 from 61.16 to 93.90 q ha⁻¹ and Sampath Gold from 63.01 to 87.77 q ha⁻¹. The overall mean yield under AWD was 74.10 ± 8.05 q ha⁻¹, representing an approximate 41 per cent increase over the conventional system. AWD consistently boosted yields via enhanced root traits and phenology (Price *et al.*, 2013) ^[17]. It yielded 5-12 per cent increases and water savings in Asian lowlands (Belder *et al.*, 2004) ^[3]. Nitrogen synergies further amplified efficiency (Abid *et al.*, 2022) ^[1]. They also boosted productivity (Mboyerwa *et al.*, 2022) ^[14], affirming AWD's role in sustainable intensification.

Table 7: Yield levels of different varieties under conventional system and AWD method of paddy cultivation

System	Varieties	Grain yield (q ha ⁻¹)
Conventional	RNR-15048	38.92-74.13
	Annapoorna	49.42-57.82
	Nandyal Sona	54.03
	MS 2	49.42-61.28
Mean ± SD		52.54 ± 8.07
Range		38.92-74.13
AWD	RNR-15048	58.51-86.73
	Annapoorna	67.61-81.54
	MS 2	71.17
	Nandyal Sona	61.16-93.9
	Sampath Gold	63.01-87.77
Mean ± SD		74.10 ± 8.05
Range		58.51-93.90

4. Conclusion

The study demonstrates that AWD method offers a sustainable, resource-efficient and yield-enhancing alternative to

conventional system in paddy cultivation. Farmers adopting AWD practices showed significant improvements in water-use efficiency, input optimization and pest-disease management, without compromising productivity. The reduction in irrigation days by nearly one-third, coupled with a 15-41 per cent increase in grain yield, highlights AWD's potential to improve water-use efficiency while maintaining profitability. AWD displayed better adherence to optimal seed rates, improved choice of water-efficient varieties and reduced dependence on pesticides and fungicides. Overall, AWD-driven method represents a critical step toward sustainable rice intensification balancing ecological stewardship, input efficiency and economic viability.

References

- Abid AA, Zhang Q, Adil MF, Batool I, Abbas M, Hassan Z, *et al.* Nitrogen optimization coupled with alternate wetting and drying practice enhances rhizospheric nitrifier and denitrifier abundance and rice productivity. *Front Plant Sci.* 2022;13:927229.
- Alam MS, Khanam M, Rahman MM. Environment-friendly nitrogen management practices in wetland paddy cultivation. *Front Sustain Food Syst.* 2023;7:1020570.
- Belder P, Bouman BAM, Cabangon R, Guoan L, Quilang EJP, Yuanhua L, *et al.* Effect of water-saving irrigation on rice yield and water use in typical lowland conditions in Asia. *Agric Water Manage.* 2004;65(3):193-210.
- Bouman BAM, Lampayan RM, Tuong TP. *Water Management in Irrigated Rice: Coping with Water Scarcity.* Los Baños (Philippines): International Rice Research Institute (IRRI); 2007.
- Carrijo DR, Lundy ME, Linquist BA. Rice yields and water use under alternate wetting and drying irrigation: a meta-analysis. *Field Crops Res.* 2017;203:173-181.
- Chapagain AK, Hoekstra AY. The blue, green and grey water footprint of rice from production and consumption perspectives. *Ecol Econ.* 2011;70(11):749-758.
- Dobermann A, Cassman KG, Mamaril CP, Sheehy JE. Management of phosphorus, potassium, and sulfur in intensive, irrigated lowland rice. *Field Crops Res.* 1998;56(1-2):113-138.
- Food and Agriculture Organization (FAO). *The Future of Food and Agriculture - Drivers and Triggers for Transformation.* Rome: Food and Agriculture Organization of the United Nations; 2023.
- Joshi DV. *A Study on Paddy Cultivation Pattern by Tibetan Rehabilitants and Their Socio-Economic Characteristics, Mundgod Taluk, Karnataka.* M.Sc. (Agri.) Thesis. Dharwad: University of Agricultural Sciences; 1992.
- Khaliq A, Abbasi MK, Hussain T. Effects of integrated use of organic and inorganic nutrient sources with effective microorganisms (EM) on seed cotton yield in Pakistan. *Bioresour Technol.* 2006;97(8):967-972.
- Lakitan B, Hadi B, Herlinda S, Siaga E, Widuri LI, Kartika K, *et al.* Recognizing farmers' practices and constraints for intensifying rice production at riparian wetlands in Indonesia. *J Life Sci.* 2018;85:10-20.
- Lampayan RM, Palis FG, Flor RJ, Singleton GR. Impact of alternate wetting and drying (AWD) on rice pest and the environment. *Phil J Crop Sci.* 2016;41(1):65-72.
- Lampayan RM, Reyes RM, Singleton GR, Bouman BAM. Adoption and economics of alternate wetting and drying water management for irrigated lowland rice. *Field Crops Res.* 2015;170:95-108.
- Mboyerwa PA, Kibret K, Mtakwa P, Aschalew A. Rice yield and nitrogen use efficiency with system of rice intensification and conventional management practices in Mkindo irrigation scheme, Tanzania. *Front Sustain Food Syst.* 2022;6:802267.
- Omwenga KG, Mati BM, Home PG. Determination of the effect of the system of rice intensification (SRI) on rice yields and water saving in Mwea irrigation scheme, Kenya. *J Water Resour Prot.* 2014;6(10):895-901.
- Pal G, Bhaskar KU, Kumar SJ, Sripathy KV, Agarwal DK. A study on sources and management of paddy seed in Eastern Uttar Pradesh, India. *J Econ Manag Trade.* 2018;21(7):1-7.
- Price AH, Norton GJ, Salt DE, Ebenhoeh O, Meharg AA, Meharg C, *et al.* Alternate wetting and drying irrigation for rice in Bangladesh: Is it sustainable and has plant breeding something to offer? *Food Energy Secur.* 2013;2(2):120-129.
- Rahaman A, Hasan MK, Islam MR. Factors affecting adoption of BRRI released Aus rice varieties in Mymensingh District. *Int J Agric Econ.* 2020;5(5):198-206.
- Sachdev P, Sachdev MS. Role of sulphur in rice production. *J Nucl Agric Biol.* 2002;31(1):1-13.
- Savary S, Willocquet L, Pethybridge SJ, Esker P, McRoberts N, Nelson A. The global burden of pathogens and pests on major food crops. *Nat Ecol Evol.* 2019;3(3):430-439.
- Shankar M, Khan MA, Bharath T, Pallavi S, Himabindu T, Naaik RB, *et al.* Popularization of improved short duration rice variety Telangana Sona (RNR 15048) through frontline demonstrations in Nalgonda District, Telangana. *J Crop Weed.* 2022;18(3):206-212.
- Sujono J, Matsuo N, Hiramatsu K, Mochizuki T. Improving the water productivity of paddy rice (*Oryza sativa* L.) cultivation through water saving irrigation treatments. *Agric Sci.* 2011;2(4):511-517.
- Sundararaj N, Nagaraju S, Venkataramu MN, Jaganath MK. *Designs and Analysis of Field Experiments.* Bangalore (Karnataka): University of Agricultural Sciences; 1972.
- Takeshima H, Adhikari RP, Poudel MN, Kumar A. Farm household typologies and mechanization patterns in Nepal Terai. IFPRI Discuss Pap. 2015;1-56.
- USDA FAS. *Grain and Feed Update: India.* GAIN Report Number IN2024-0055. Washington (DC): USDA Foreign Agricultural Service; 2024.
- Weerakoon WMW, Mutunayake MMP, Bandara C, Rao AN, Bhandari DC, Ladha JK. Direct-seeded rice culture in Sri Lanka: Lessons from farmers. *Field Crops Res.* 2011;121(1):53-63.