



Adoption of organic rice cultivation practices among BPT-5204 Paddy farmers in Srikakulam District, Andhra Pradesh: Patterns, drivers, and constraints

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Abstract

The transition from chemical-intensive to organic rice cultivation requires not only agronomic readiness but also an accurate understanding of which organic practices farmers already adopt, which they partially adopt, and which remain entirely unadopted. This study examines the paddy crop profile, varietal preferences, input use patterns, yield performance and most centrally the extent of adoption of 15 organic rice cultivation practices among 500 BPT-5204 (Samba Mahsuri) paddy farmers across 15 villages in Srikakulam district, Andhra Pradesh. Farmers were organised into two spatial clusters: Cluster-1 (261 farmers, 7 villages) and Cluster-2 (239 farmers, 8 villages). Results show that BPT-5204 and MTU-7209 (Swarna) are the most widely grown varieties, though farmers are increasingly apprehensive about the former due to withdrawal of government subsidies and price support. Average paddy yield ranges from 25 to 30 bags per acre (2,000–2,400 kg/acre), with two chemical sprays the norm for pest control. Deep summer ploughing is universally and fully adopted across both clusters. Farmyard manure application, green manure incorporation, row transplanting, and alleyway making are substantially better adopted in Cluster-2, driven by higher cattle ownership. In contrast, organic bio-input practices seed treatment with beejamrutha, and application of jeevamrutha, nemastram, and sour buttermilk are considerably better adopted in Cluster-1, directly attributable to the presence of Zero Budget Natural Farming (ZBNF) extension activities in four of its seven villages. Practices including azolla application, pheromone trap installation, and leaf clipping remain entirely unadopted across both clusters due to a combination of input unavailability and lack of awareness. The study identifies cluster-specific adoption gaps and derives targeted recommendations for extension strategy.

Keywords: BPT-5204, Samba Mahsuri, organic rice, technology adoption, ZBNF, jeevamrutha, Srikakulam, Andhra Pradesh, bio-inputs, ICS

Introduction

Rice cultivation in India is increasingly confronted with twin pressures: stagnating productivity under chemical-intensive management, and growing consumer and regulatory demand for organically produced rice. The continuous application of synthetic nitrogen fertilisers, pesticides, and growth regulators over several decades has contributed to soil health degradation, pest resistance, declining factor productivity, and mounting debt burdens among smallholder farmers, particularly in states such as Andhra Pradesh where paddy is the dominant kharif crop (Nayak *et al.*, 2021) [13]. Nationally, the cultivated area under organic farming has grown from 11.83 lakh hectares in 2014 to 29.17 lakh hectares in 2020, driven by both government policy and market incentives (Ministry of Agriculture and Farmers' Welfare, 2021) [21].

The paddy variety BPT-5204 (Samba Mahsuri) occupies an estimated 4 million hectares across India — one of the largest area coverages for any single rice variety in the world (NRI Agritech, 2012) [14]. In north coastal Andhra Pradesh and specifically in Srikakulam district, BPT-5204 is the predominant fine-grain variety, prized for its medium-slender grain, excellent cooking quality, and consumer acceptance. However, it is notoriously susceptible to brown plant hopper (BPH), bacterial leaf blight (BLB), and blast disease, requiring a disproportionately high number of chemical pesticide applications relative to other varieties (Pusa Samba 1850 technology note, ICAR-IARI, 2021) [8]. This susceptibility makes the organic transition of BPT-

5204 cultivation agronomically challenging, yet simultaneously all the more important from sustainability and farmer welfare perspectives.

Andhra Pradesh has been at the forefront of large-scale organic and natural farming transitions in India. The Andhra Pradesh Community Natural Farming (APCNF) programme, implemented by the Rythu Sadhikara Samstha (RySS) through the Zero Budget Natural Farming (ZBNF) methodology, is considered one of the world's largest agroecological programmes, targeting 6 million farmer households (Pant *et al.*, 2019) [16]. Field evaluations in Andhra Pradesh have shown that ZBNF paddy plots achieve comparable or higher yields relative to conventional plots, while significantly reducing input costs (LaCanne & Lundgren, 2022; Daystar *et al.*, 2025) [3, 10]. Key ZBNF practices jeevamrutha (a microbial inoculant prepared from cow dung, cow urine, water, jaggery, and pulse flour), beejamrutha (seed treatment culture) and mulching are directly relevant to the organic paddy cultivation practices examined in this study.

Yet, despite the policy salience of organic paddy farming in Andhra Pradesh, very few field studies have systematically examined what organic practices farmers already adopt, what determines inter-cluster and inter-farmer variation in adoption, and what the principal barriers are at the level of specific practices rather than farming systems in general. Understanding practice-level adoption is essential for designing targeted, resource-efficient extension programmes. A practitioner who knows, for instance, that deep summer ploughing is universally adopted while azolla

application and pheromone trap use are entirely absent can prioritise interventions very differently from one operating on aggregate adoption indices.

This paper addresses that gap. It reports findings from a field survey of 500 BPT-5204 paddy farmers in 15 villages across Srikakulam district, examining: (i) paddy varietal preferences and reasons for shifting away from BPT-5204; (ii) current fertiliser use and chemical pest management practices; (iii) yield levels and marketing channels; and (iv) the extent of adoption of 15 specific organic rice cultivation practices, with analysis of the structural and programmatic drivers behind inter-cluster variation.

Literature Review

The agronomic literature on organic rice identifies nitrogen management, weed suppression, and pest control as the three most critical challenges in the transition from conventional to organic cultivation (Hazra *et al.*, 2018). Hazra *et al.* (2018) [7] demonstrated that diverse organic nutrient sources particularly split application of vermicompost, green manures, and biofertilisers can adequately meet crop nutrient demand in organic rice systems, while integrated weed management and the use of disease/insect-resistant varieties remain important yield stabilisers. The yield gap between conventional and organic rice has been estimated at 5-25% depending on management intensity and agro-climatic context, though well-managed organic systems can narrow this gap significantly (Hazra *et al.*, 2018; LaCanne & Lundgren, 2022) [7, 10].

On the adoption of organic and sustainable agricultural practices, a consistent body of literature points to the multi-dimensional nature of adoption decisions. Sharma and Kaur (2015) [19] found that while respondents showed medium-to-high adoption of organic farming practices overall, practices requiring additional inputs or knowledge such as biological pest management remained under-adopted even among self-identified organic farmers. Prasanth (2016) [20], in a study of organic farmers in the Andaman and Nicobar Islands, found that deep summer ploughing and bird perch installation were universally adopted due to their alignment with traditional practices, whereas pheromone trap installation and pseudomonas-based seed treatment were not adopted due to input unavailability a finding directly mirrored in the present study's results.

Singh *et al.* (2016) [20], studying Integrated Pest Management (IPM) adoption among paddy growers, found that the majority of farmers did not apply bio-fertilisers, despite awareness, primarily due to uncertainty about dosages and inadequate extension support. Oinam and Sudhakar (2014) [15] reported that approximately 62.5% of paddy farmers in Manipur applied recommended quantities of organic manures in nurseries, while the remaining 37.5% were non-adopters due to input supply constraints. These findings underscore that adoption is not a binary state but a continuum influenced by input access, knowledge, cost, labour, and peer behaviour.

The role of programmatic extension particularly farmer-to-farmer learning models in driving organic practice adoption is well-established in the Andhra Pradesh context. Pant *et al.* (2019) [16] showed that ZBNF's decentralised Community Resource Person (CRP) network was instrumental in achieving statistically significant differences in yields and income between ZBNF and non-ZBNF farmers across multiple districts. Goswami *et al.* (2022) [5], studying rice farmers in Andhra Pradesh, identified higher labour costs,

lack of agroecological experience, and high pest incidence as the primary constraints to natural farming adoption, with labour being particularly acute in irrigated paddy systems where organic weeding practices are labour-intensive.

On varietal aspects, BPT-5204's susceptibility to BPH and BLB has been documented extensively (Improved Samba Mahsuri, Wikipedia, 2024; NRI Agritech, 2012) [14, 22]. The variety's cultivation is spread across 5 million acres in Andhra Pradesh and Karnataka, making it the most important fine-grain rice variety in peninsular India. Its market preference among consumers and its suitability for canal-irrigated north coastal Andhra Pradesh are well recognised. However, the lack of government MSP support specific to BPT-5204 which has historically constrained its price realisation is a documented policy challenge that affects farmer motivation to continue cultivating this variety (Business Standard, 2011) [1]. The present study contributes empirical evidence on how these market, policy, and agronomic factors are playing out at the farm level in Srikakulam.

Carlo *et al.* (2018) [2], in their review of ecological farming approaches, emphasised that cluster-level analysis of practice adoption taking into account both biophysical and social variables provides more actionable insights than district or state-level averages. Mittal and Mehar (2016) [12] found that socio-economic characteristics including age, education, and farm size were significant predictors of information source use in Indian agriculture, implying that adoption gaps identified at the cluster level require cluster-specific communication strategies. The present study integrates these insights into a cluster-stratified analysis of organic practice adoption.

Materials and Methods

1. Study Area and Sampling

The study was conducted in 15 villages across three mandals (Polaki, Srikakulam, and Narasannapeta) in Srikakulam district, Andhra Pradesh, selected on the basis of their leading position in paddy area and production among all 38 mandals in the district. Villages were grouped into two spatial clusters: Cluster-1 (7 villages; 261 farmers) and Cluster-2 (8 villages; 239 farmers). The sampling unit was a paddy-growing farmer with a minimum land holding of 2 acres who cultivated BPT-5204 in the reference season. Five hundred such farmers were selected using purposive sampling. Data were collected from February to June 2022 through a pre-tested semi-structured interview schedule.

2. Measurement of Adoption

The extent of adoption of organic rice cultivation practices was measured on a three-category ordinal scale: Fully Adopted (practised completely and consistently), Partially Adopted (practised occasionally or incompletely), and Not Adopted (never practised). Fifteen practices spanning seed treatment, land preparation, nutrient management, pest management, and plant protection were assessed. This approach follows the practice-by-practice adoption audit methodology used by Prasanth (2016) and Sharma and Kaur (2015) [17, 19].

3. Data Analysis

Data were coded and tabulated. Adoption levels are reported as frequencies and percentages, stratified by cluster. Differences in adoption patterns between clusters are interpreted in the light of structural variables (cattle

ownership, irrigation access, farming system type) and programmatic variables (ZBNF extension coverage). No inferential statistics were applied given the purposive sampling design; the analysis is descriptive and comparative.

Results and Discussion

1. Paddy Variety Profile

In Cluster-1, the two most widely grown varieties are BPT-

5204 (202 farmers; 77.4%) and MTU-7209 Swarna (197; 75.5%), followed by NP 9558 Nuzuveedu Swarna (63; 24.1%). In Cluster-2, BPT-5204 is grown by 225 farmers (94.1%), MTU-7209 by 125 (52.3%), and RNR 15048 Sugar Free Rice (a rabi specialty variety) by 110 (46.0%). The wider variety portfolio in Cluster-1 suggests greater experimentation and market responsiveness among its farmers. Table 1 summarises variety-wise cultivation across clusters.

Table 1: Paddy Varieties Grown by Sampled Farmers

Variety (Local Name)	Cluster-1 (n)	Cluster-1 (%)	Cluster-2 (n)	Cluster-2 (%)
BPT-5204 (Samba Mahsuri)	202	77.4	225	94.1
MTU-7209 (Swarna)	197	75.5	125	52.3
NP 9558 (Nuzuveedu Swarna)	63	24.1	16	6.7
RNR 15048 (Sugar Free Rice)	53	20.3	110	46.0
MTU-1064 (Amara)	57	21.8	34	14.2
MTU-1061 (Indra)	33	12.6	67	28.0
RGL 2537 (Srikakulam Sannalu)	50	19.2	24	10.0
MTU-1121 (Sridruthi)	15	5.7	21	8.8

Note: Percentages exceed 100 as individual farmers may grow multiple varieties. Source: Field survey data (2022).

2. Farmer Perceptions of BPT-5204

Farmer opinions on BPT-5204 reveal a variety under agronomic and policy stress. All 500 respondents noted the government's discontinuation of BPT-5204 procurement under the Paddy Grade-A Minimum Support Price (MSP) category a policy shift that has substantially reduced price realisation for BPT-5204 growers relative to other varieties. This is consistent with longstanding farmer grievances about the pricing of BPT-5204: its MSP has historically been treated on par with ordinary varieties despite its premium grain quality (Business Standard, 2011) ^[1]. In Srikakulam, the market price for BPT-5204 declined from approximately Rs. 1,900 per quintal in 2019 to Rs. 1,600 in 2021, partly due to competition from the newly prominent rabi variety RNR-15048.

Additionally, 456 of 500 farmers rated the variety's susceptibility to BPH and other sucking pests as a serious concern, as it necessitates 2-3 chemical sprayings per season compared to fewer for varieties like Swarna. The high cost of cultivation resulting from pesticide use, combined with below-MSP price realisation and the withdrawal of seed subsidies (cited by 411 farmers), is driving a shift in farmer preference toward Swarna, Amara, and Nuzuveedu Swarna for forthcoming seasons. Despite these reservations, 475 of 500 farmers acknowledged the variety's suitability to north coastal Andhra Pradesh's agro-climatic conditions, and 421 specifically valued it for household consumption due to its fine grain and superior cooking quality.

3. Fertiliser Use

Inorganic fertiliser use is near-universal in both clusters. In Cluster-1, urea is applied by 253 farmers (97.0%), DAP or SSP by 244 (93.5%), and muriate of potash (MOP) by 215 (82.4%). Complex fertilisers such as 28-28-0 or 14-35-14 are used by 146 (56.0%) farmers. Only 8 farmers (3.1%) use no inorganic fertiliser at all. In Cluster-2, the pattern is similar: urea (233; 97.5%), DAP/SSP (227; 95.0%), MOP (215; 90.0%), with only 6 farmers (2.5%) entirely abstaining from chemical inputs. The application schedules follow standard recommendations: urea in three splits at transplanting, tillering, and panicle initiation; DAP/SSP as a single basal dose; and potash in one or two splits. The near-absence of completely organic farmers among the 500 surveyed underlines that the study area is in a pre-transition stage, with most farmers practising conventional paddy cultivation.

4. Chemical Pest Management

Two chemical sprays per season is the norm across both clusters: adopted by 68.6% of farmers (179 of 261) in Cluster-1 and 74.9% (179 of 239) in Cluster-2. The predominant pests reported are BPH, stem borer, gall midge, and green leafhopper (GLH); common diseases include rice blast and sheath blight. Pesticide recommendations are primarily sourced from local retailers, with occasional guidance from Village Agricultural Assistants (VAAs). The high and relatively uniform rate of chemical spray use across both clusters reflects the pest pressure associated with BPT-5204's susceptibility profile (Pusa Samba 1850 technology note, ICAR-IARI, 2021) ^[8] and the absence of systematic IPM training.

Table 2: Number of Chemical Sprays Used for Pest Control in Paddy

No. of Sprays	Cluster-1 (n)	Cluster-1 (%)	Cluster-2 (n)	Cluster-2 (%)
1 spray	19	7.3	14	5.9
2 sprays	179	68.6	179	74.9
3 sprays	40	15.3	17	7.1
More than 3 sprays	11	4.2	16	6.7
No chemical sprays	12	4.6	13	5.4
Total	261	100.0	239	100.0

Source: Field survey data (2022).

5. Paddy Yield

The majority of farmers in both clusters reported yields of 25–30 bags per acre (equivalent to 2,000–2,400 kg/acre, with one bag weighing 80 kg): 67 per cent of Cluster-1 farmers and 65 per cent of Cluster-2 farmers. Only 2 per cent (Cluster-1) and 4 per cent (Cluster-2) reported yields below 20 bags per acre. 11 per cent of Cluster-1 and 9 per cent of Cluster-2 farmers reported yields above 30 bags per acre. For BPT-5204 specifically, yield under adequate pest

management was reported as 25–30 bags per acre, falling to 20–25 bags when pest control is inadequate. Varieties such as NP 9558 (Nuzuveedu Swarna) can achieve over 30 bags per acre in some areas.

6. Adoption of Organic Rice Cultivation Practices

Table 3 and Table 4 present the extent of adoption of 15 organic rice cultivation practices for Cluster-1 and Cluster-2 respectively.

Table 3: Extent of Adoption of Organic Rice Cultivation Practices in Cluster-1 (n = 261)

Organic Practice	Fully Adopted	Partially Adopted	Not Adopted
Seed treatment with <i>Trichoderma viridae</i> / beejamrutha / <i>Pseudomonas fluorescens</i>	25.3%	36.0%	38.7%
Deep summer ploughing for pest control	100.0%	0.0%	0.0%
Sheep manuring or allowing cattle to graze in the field	19.2%	79.3%	1.5%
Application of FYM @ 5 t/acre	41.4%	50.2%	8.4%
Incorporation of green manure crops (sunhemp or sesbania)	25.7%	69.0%	5.4%
Planting seedlings in rows for hand weeding and pest control	28.4%	66.3%	5.4%
Leaf clipping to eliminate egg masses	0.0%	0.0%	100.0%
Making alleyways (E-W) at 1 per 2 m to control sucking pests	29.9%	64.8%	5.4%
Application of azolla	0.0%	0.0%	100.0%
Installing bird perches @ 6–8 per acre	0.0%	6.9%	93.1%
Installing yellow sticky traps for plant hopper control	0.0%	8.0%	92.0%
Installing pheromone traps @ 6–8 per acre	0.0%	0.0%	100.0%
Application of jeevamrutha / ghanajeevamrutha for nutrient supply	26.4%	34.9%	38.7%
Application of neemastram / neem oil for sucking pest control	29.9%	31.4%	38.7%
Application of sour buttermilk / pedamutrainguvadravanam for fungal leaf spots	15.3%	46.0%	38.7%

Source: Field survey data (2022).

Table 4: Extent of Adoption of Organic Rice Cultivation Practices in Cluster-2 (n = 239)

Organic Practice	Fully Adopted	Partially Adopted	Not Adopted
Seed treatment with <i>Trichoderma viridae</i> / beejamrutha / <i>Pseudomonas fluorescens</i>	3.8%	10.9%	85.4%
Deep summer ploughing for pest control	100.0%	0.0%	0.0%
Sheep manuring or allowing cattle to graze in the field	41.0%	55.2%	3.8%
Application of FYM @ 5 t/acre	55.6%	43.1%	1.3%
Incorporation of green manure crops (sunhemp or sesbania)	49.0%	41.0%	10.4%
Planting seedlings in rows for hand weeding and pest control	46.9%	43.1%	10.0%
Leaf clipping to eliminate egg masses	0.0%	0.0%	100.0%
Making alleyways (E-W) at 1 per 2 m to control sucking pests	49.4%	40.6%	10.4%
Application of azolla	0.0%	0.0%	100.0%
Installing bird perches @ 6–8 per acre	0.0%	6.3%	93.7%
Installing yellow sticky traps for plant hopper control	0.0%	4.2%	95.8%
Installing pheromone traps @ 6–8 per acre	0.0%	0.0%	100.0%
Application of jeevamrutha / ghanajeevamrutha for nutrient supply	2.1%	12.1%	85.8%
Application of neemastram / neem oil for sucking pest control	1.7%	12.1%	86.2%
Application of sour buttermilk / pedamutrainguvadravanam for fungal leaf spots	1.7%	12.1%	86.2%

Source: Field survey data (2022).

7. Analysis of Adoption Patterns

7.1 Universally Adopted Practices

Deep summer ploughing is the single practice fully adopted by 100% of farmers in both clusters. Its universal adoption reflects its historical alignment with traditional agronomic practice rather than its formal status as an organic recommendation. It is an age-old soil management technique that farmers have practised for generations, and its benefits in breaking pest and weed cycles are well understood. This pattern echoes the finding of Prasanth (2016) [17], who reported 100% adoption of deep summer ploughing in the Andaman and Nicobar Islands for precisely the same reason.

7.2 Practices with Better Adoption in Cluster-2

FYM application (@ 5 t/acre) is fully adopted by 55.6% of Cluster-2 farmers compared to 41.4% in Cluster-1.

Incorporation of green manure crops is fully adopted by 49.0% in Cluster-2 against 25.7% in Cluster-1. Similarly, row transplanting (46.9% vs. 28.4%) and alleyway making (49.4% vs. 29.9%) are more fully adopted in Cluster-2. This consistent pattern is explained by two structural features of Cluster-2. First, cattle ownership is substantially higher in Cluster-2 (78%) than in Cluster-1 (60%), providing a greater supply of dung for FYM production a resource-based determinant of organic input availability consistent with findings by Goswami *et al.* (2022) [5]. Second, a larger proportion of Cluster-2 farmers practice transplanting in puddled fields, which naturally enables green manure incorporation through the puddling operation itself. Cluster-1 farmers facing acute labour scarcity during the kharif peak season more frequently opt for broadcast sowing, which does not lend itself to row-based management or green manure incorporation prior to transplanting.

7.3 Practices with Better Adoption in Cluster-1

The pattern is reversed for bio-input practices. Seed treatment with beejamrutha or *Trichoderma* is fully adopted by 25.3% of Cluster-1 farmers against just 3.8% in Cluster-2. Application of jeevamrutha is fully adopted by 26.4% in Cluster-1 versus 2.1% in Cluster-2. Neemastram application is fully adopted by 29.9% versus 1.7%. Sour buttermilk or pedamutrainguvadravanam use is fully adopted by 15.3% versus 1.7%. This clear gradient is directly attributable to programmatic extension: ZBNF activities were active in four of the seven Cluster-1 villages (Bhyri, Karajada, Makivalasa, and Devadi) at the time of the survey, compared to only one village (Gollalavalasa) in Cluster-2. ZBNF training, delivered through Community Resource Persons (CRPs) as described by Pant *et al.* (2019) ^[16], equips farmers with the knowledge and skill to prepare and apply these bio-inputs on-farm using locally available cow dung and cow urine. In the absence of such programmatic support, awareness of these practices and therefore their adoption drops sharply. This finding directly supports the conclusions of Singh *et al.* (2016) and Prasanth (2016) ^[20] that knowledge transfer through structured extension is a critical determinant of organic input adoption.

7.4 Entirely Unadopted Practices

Azolla application, pheromone trap installation (6-8 per acre), and leaf clipping to eliminate egg masses are entirely unadopted (0% full adoption; 0% partial adoption) in both clusters. Bird perch installation (6-8 per acre) is also fully unadopted, though a small minority (6.9% in Cluster-1; 6.3% in Cluster-2) have partially adopted it. Yellow sticky traps are partially adopted by 8.0% and 4.2% respectively. Farmer explanations for non-adoption differ by practice. For leaf clipping and azolla, the reason is a complete absence of awareness of their agronomic benefits an extension gap. For pheromone traps and yellow sticky traps, the reason is non-availability in local input markets a supply chain gap. These two categories of constraint require different interventions: awareness campaigns and demonstrations for the former; supply chain development and input linkages for the latter. These findings replicate those of Prasanth (2016) ^[17], who identified the same categories of constraint in a geographically distant but structurally comparable context.

Conclusions

This study provides a systematic, practice-level analysis of organic rice cultivation adoption among 500 BPT-5204 paddy farmers in Srikakulam district, Andhra Pradesh. The findings reveal a complex, spatially differentiated adoption landscape that cannot be captured by aggregate adoption indices. Deep summer ploughing is the sole practice universally adopted, reflecting its roots in traditional agronomic practice. FYM application, green manure incorporation, row transplanting, and alleyway making are substantially better adopted in Cluster-2, driven by higher cattle ownership and the prevalence of puddle transplanting. Conversely, organic bio-input practices jeevamrutha, beejamrutha, neemastram, and sour buttermilk are significantly better adopted in Cluster-1, attributable to active ZBNF extension coverage in four of its seven villages. Azolla application, pheromone traps, and leaf clipping are entirely unadopted across both clusters, due to input unavailability and lack of awareness respectively.

These findings carry clear implications for extension design. Extension programmes in Cluster-1 should prioritise increasing cattle ownership (or facilitating shared-cattle models) to expand FYM and bio-input preparation capacity, and should encourage puddle transplanting to enable green manure incorporation. In Cluster-2, ZBNF CRP coverage should be expanded to all eight villages to build bio-input preparation capacity, particularly for beejamrutha and jeevamrutha. Across both clusters, supply chain development for pheromone traps and yellow sticky traps, combined with field demonstrations of azolla and leaf clipping, would address the entirely unadopted category of practices. On the variety front, the declining attractiveness of BPT-5204 under current market and policy conditions argues for varietal transition support such as promotion of blast-resistant near-isogenic lines like Pusa Samba 1850, or fine-grain alternatives such as MTU-1224 (Marteru Samba) as part of a comprehensive organic rice farming development programme.

This study's cluster-stratified methodology disaggregating adoption by village cluster and identifying structural and programmatic drivers provides a replicable approach for other districts and crops undergoing organic farming transitions. Future research should employ inferential methods to statistically test the relative importance of cattle ownership, ZBNF programme exposure, education, and land holding in predicting adoption of individual practices.

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