

A Survey of Sustainable Agricultural Practices Among Farmers in Ranjole Village, Zaheerabad Mandal, Telangana

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ABSTRACT

This study investigates the adoption and efficacy of sustainable agricultural practices among farmers in Ranjole village, Zaheerabad Mandal, Sangareddy District, Telangana. Using an in-depth, semi-structured interview approach, twenty farmers cultivating a wide range of crops — including dragon fruit, sugarcane, ginger, oil palm, banana, soybean, green gram, sweet corn and jowar, among others — were surveyed to document existing sustainable practices, assess their economic and ecological outcomes, and identify the factors that support or constrain their adoption. Farmer accounts were triangulated with secondary records obtained from the Agricultural Department, including crop yield statistics, land-use data and details of government scheme participation. The findings reveal a moderate but growing integration of traditional ecological knowledge with modern sustainable techniques, reflected in the use of organic and farmyard manure, crop rotation, intercropping, mulching, and, among a smaller number of farmers, drip irrigation and rainwater harvesting. Cropping choices and management strategies differed markedly by landholding size: farmers with smaller holdings (1–3 acres) prioritised staple grains and low-input, risk-diversifying strategies, while farmers with larger holdings (5 acres and above) invested in high-value commercial crops, modern inputs, and infrastructure such as drip irrigation and cold storage. Economic outcomes were generally stable to improving among adopters of diversified and input-efficient practices, though most farmers remained dependent on local markets and intermediaries, limiting profit margins. Government support programmes, while present in the form of subsidies, crop insurance and input assistance, showed inconsistent reach and delivery. The study concludes that the blend of indigenous wisdom and contemporary sustainable methods is central to ecological balance and economic viability in this rainfed, semi-arid agricultural system, and that policy and extension interventions are likely to be most effective when tailored separately to the needs of small and large farmers.

Keywords: Rural farming, Sustainable agriculture, Traditional ecological knowledge, Crop diversification, Smallholder farmers, Telangana

1. INTRODUCTION

India's agricultural sector continues to confront significant challenges, including climate variability, resource scarcity and volatile input and output prices, all of which necessitate a shift toward sustainable practices to safeguard food security and farmer resilience. Telangana,

much of which is rainfed and semi-arid, exemplifies these pressures, with Zaheerabad Mandal in Sangareddy District a representative case. While broader regional and national research has examined sustainable agriculture and climate adaptation, understanding of adoption at the micro, village level remains comparatively limited.

This study addresses that gap by focusing on Ranjole village. Its objectives are to document the sustainable agricultural practices currently in use, assess their economic and ecological outcomes, and identify the factors that support or constrain their adoption. Twenty farmers cultivating a diverse range of crops were interviewed in depth, and their accounts were supplemented with official data from the Agricultural Department to provide both a farmer-level and a village-level view of current practice. The findings are intended to offer localised, empirical evidence that can inform policy and agricultural extension programmes aimed at enhancing farmer livelihoods in Ranjole and in similar semi-arid villages of the Telangana plateau.

1.1 Importance of the Study

- Provides a village-level, farmer-verified account of sustainable agricultural practices in a semi-arid rainfed region.
- Generates data to inform effective policy decisions that promote eco-friendly, low-input farming methods.
- Identifies beneficial strategies and persistent challenges that directly affect farmer livelihoods.
- Contributes localised insight into crop diversity, climate resilience and indigenous knowledge in a micro-region that is under-represented in the wider literature.
- Documents farmer adaptation and mitigation techniques relevant to ongoing climate variability.
- Provides an evidence base to guide targeted, impactful agricultural extension programmes.

1.2 Objectives

- Document the sustainable agricultural practices currently used by farmers in Ranjole village.
- Assess the economic outcomes associated with these practices.
- Identify the factors that support or constrain their adoption.
- Understand local crop diversity and its contribution to resilience.
- Inform targeted, landholding-sensitive policy recommendations.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in Ranjole village, Zaheerabad Mandal, Sangareddy District, Telangana — a rainfed, semi-arid region where agriculture remains the dominant livelihood

activity. Farmers in the village cultivate a wide range of crops, from staple grains such as jowar and pulses to horticultural and commercial crops including dragon fruit, sugarcane, ginger, oil palm, banana and sweet corn, reflecting a transition in progress from traditional subsistence cropping toward diversified and, in some cases, high-value commercial cultivation.

2.2 Research Design and Participants

The study adopted a qualitative research design to explore agricultural practices and their outcomes. Data were collected from a purposive sample of 20 farmers in Ranjole village, selected to represent a broad spread of crops and landholding sizes rather than a single cropping system.

2.3 Data Collection and Tool

Primary data were gathered through in-depth, semi-structured interviews conducted in person with each farmer at their farm. The interview guide covered farmer and farm profile, land preparation and soil management, fertilisation practices, irrigation and water conservation, pest and disease management, government scheme participation, harvesting and post-harvest handling, and marketing and profitability, allowing crop-specific detail to be captured alongside comparable, village-wide themes.

2.4 Secondary Data Sources

Data from the Agricultural Department were used to complement and validate the farmer interviews and to provide macro-level context. Official documents accessed included annual reports, statistical abstracts, and policy and administrative records, together with Ranjole-specific records on historical crop yields, cropping patterns, land utilisation and soil health, and documentation of government schemes, subsidies, credit and training programmes available to farmers. This departmental data provided an essential baseline against which farmer-reported information on landholding, crop choice and scheme participation could be cross-checked, strengthening the reliability of the qualitative findings.

2.5 Data Analysis

Interview transcripts were subjected to qualitative thematic analysis to identify recurring themes and patterns across farmers and crops. Themes were organised around crop diversity, sustainable practice adoption, economic outcomes, government support effectiveness, pest management strategies, water conservation, integration of traditional and modern knowledge, market strategies, and the challenges reported by farmers.

3. RESULTS

3.1 Farmer and Farm Profile

Twenty farmers were interviewed, cultivating a diverse range of crops including dragon fruit, soybean, green gram, sweet corn, jowar, cotton, ginger, red gram, papaya, black gram, oil palm, tomato, sugarcane, banana and other crops, all within Ranjole village (Table 1).

Table 1. Respondent profile — farmers interviewed in Ranjole village

No.	Farmer	Primary crop	Survey No.
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1	B. Manjula	Dragon fruit	71/01
2	Gousoddin	Soybean	138/Aa
3	Bandla Lalamma	Green gram	136
4	Nageswar Reddy	Sweet corn	112/Aa
5	Naikini Mogulamma	Jowar	204/U2
6	Anitha	Cotton	131/Aa
7	Raji Reddy	Ginger	204/5/1
8	G. Mohan	Red gram	119/1
9	Srinivas Reddy	Papaya	112/2/Aa
10	Boini Yaddamma	Black gram	32/1/Aa
11	T. Mohan Reddy	Oil palm	67/A/2
12	Bobbiligama Bhagnna	Tomato	78/2/Uu
13	Kyatham Ravender	Sugarcane	26/Y/A
14	Pattlolla Sangameswer	Banana	17/1/A
15	Yellampally Navadeep	—	13/2/A
16	Bandi Ravi	—	185/1/A
17	Suryapet Sathish Kumar	—	97/U
18	Machkuri Laxamma	—	434/U
19	Mithilesh Reddy	—	04/2/3
20	Chakali Srinivas	—	365/9

All farmers are residents of Ranjole village, Zaheerabad Mandal. Crops not specified in the source interview record are marked "—".

3.2 Crop Diversity and Cropping Patterns

Farmers in Ranjole village cultivate a moderate-to-wide range of crops spanning staple grains, pulses, and both established and emerging commercial and horticultural crops. This diversification, evident even within a single village, reflects a degree of risk-spreading against climate variability and market fluctuation, though several farmers noted scope for further expansion into higher-value crops where water and capital allow.

3.3 Land Preparation, Soil Management and Fertilisation

Deep ploughing to break the hard soil layer and improve root development was reported as standard practice across crops, typically repeated two to four times before sowing. Farmyard manure (FYM) and other organic amendments — including press mud in dragon fruit cultivation and neem cake in banana and oil palm cultivation — were widely used to build soil fertility ahead of planting, generally applied at rates of roughly 8–25 tonnes per acre depending on the crop. Chemical fertilisers, principally urea, DAP and NPK combinations, were applied in split doses timed to key growth stages (for example, at planting and again at pod formation in soybean, or in three to six splits across the growing season in sugarcane and banana), indicating a general pattern of combining organic and inorganic nutrient sources rather than relying on either exclusively.

3.4 Irrigation and Water Conservation

Water management practices varied with crop and farmer investment capacity. Dragon fruit, sugarcane and banana growers used borewell or well irrigation supplemented by drip irrigation

and mulching (including mulching sheets and trash mulching) to conserve soil moisture, while several rainfed crops — including soybean, jowar and green gram — depended primarily on the monsoon with limited supplementary irrigation. Drip irrigation subsidies were reported as available, though on a limited cycle (once every seven years for at least one farmer), constraining how frequently infrastructure could be renewed or expanded.

3.5 Pest and Disease Management

Farmers reported an evolving, blended approach to pest and disease control, combining traditional and cultural practices — sanitation, pruning of infected material, pest-free seed selection, and neem oil or neem cake application — with targeted use of chemical fungicides and insecticides where infestation was severe. Detection methods included pheromone traps and sticky pads for pests such as fall armyworm and stem borer in sweet corn, and visual monitoring for fungal diseases such as stem canker and cactus rust in dragon fruit (Fig 1), red rot and smut in sugarcane, and Panama wilt and Sigatoka leaf spot in banana (Table 2).



Fig 1: Stem canker in Dragon fruit

Table 2. Pests, diseases and management practices reported by crop

Crop	Key pests	Key diseases	Reported management
Dragon fruit	Monkeys, birds (fruit damage)	Stem canker, cactus rust	Sanitation, pruning, carbendazim and mancozeb (2 g/L)
Ginger	Shoot borer, rhizome scale	Soft rot, leaf spot	Pest-free rhizomes, neem oil, improved drainage, fungicide sprays
Oil palm	Bagworms, nettle caterpillars, rhinoceros beetle	Bud rot, Ganoderma basal stem rot	Pheromone traps, neem extracts, drainage, removal of infected palms
Sugarcane	Early shoot borer, internode borer, root grub	Red rot, smut, wilt	Resistant varieties, sett treatment (carbendazim),

			residue destruction, legume rotation
Banana	Banana weevil, nematodes, aphids	Panama wilt, Sigatoka leaf spot, bunchy top virus	Tissue-culture planting material, neem cake, mancozeb/carbendazim sprays
Soybean	Leaf miner, pod borer	—	Careful urea dosing, neem oil, biological pesticides
Green gram	Aphids, whiteflies	Virus transmission via sap-feeding pests	Neem oil / bio-pesticides early, chemical spray if severe
Sweet corn	Stem borer, fall armyworm	—	Pheromone traps, manual removal, emamectin benzoate / carbofuran if severe
Jowar	Birds, wild boar	Downy mildew, smut	Disease-free seed, crop rotation, mancozeb / tebuconazole

3.6 Government Schemes and Institutional Support

Government support was reported across nearly all crops in some form, most commonly through Rythu Bandhu, PM-Kisan, crop insurance, and subsidised inputs such as seed and drip irrigation. Support was most substantial for capital-intensive crops: the dragon fruit farmer, for example, received a subsidy of roughly ₹1.45 lakh against a farm establishment cost of ₹10 lakh, alongside periodic drip irrigation subsidy (Fig 2). For short-duration crops such as soybean, direct scheme applicability was reported as more limited, with subsidised seed and procurement centres the main forms of support. Overall, government support programmes were present but showed mixed effectiveness, with farmers citing challenges in the timely delivery of subsidies and in access to information about available schemes.



Fig 2: Board showing details of Government subsidy in Dragon fruit field

3.7 Harvesting, Storage and Marketing

Harvesting remained predominantly manual across crops, timed to physiological maturity indicators such as pod colour and dryness in pulses, leaf yellowing and drying in ginger, and



fruit colour change in oil palm and banana. Post-harvest handling practices included sun-drying, airtight storage with neem leaves to deter storage pests (green gram), and, for higher-value or perishable crops such as dragon fruit, cold storage to allow farmers to time sales to periods of peak market price rather than selling immediately at harvest (Fig 3). Marketing, however, remained largely dependent on local markets and intermediaries for most farmers, with only a minority — such as the dragon fruit grower, who supplies buyers across Telangana, Maharashtra and Goa — accessing markets beyond the immediate region. This reliance on local intermediaries, combined with limited value-added processing, was identified as a factor constraining farmer profit margins.

Fig 3: Storage of Dragon fruits

3.8 Yield and Economic Outcomes

Reported yields and market returns varied considerably by crop, reflecting differences in input intensity, crop duration and market structure (Table 3).

Table 3. Reported yield and market value by crop

Crop	Reported yield	Reported price / return
Ginger	6–8 t/acre (fresh)	₹3,000–8,000 per quintal (fresh); dried ginger higher
Oil palm	15–25 t FFB/ha/year (mature palms)	₹8–12 per kg FFB (farm-gate)
Sugarcane	35–45 t/acre (irrigated); 20–25 t/acre (rainfed)	FRP ≈ ₹315–350 per quintal (2024–25)
Banana	30–40 t/acre (up to 50+ with tissue culture)	₹8–15 per kg
Soybean	10–12 quintals/acre	Procurement-centre market value
Green gram	8–10 quintals/acre	≈ ₹7,500 per quintal; net profit ≈ ₹50,000 per 10 quintals after ~20–25% costs
Sweet corn	3–4 t/acre	₹6–10 per cob (wholesale); ₹25,000–30,000 profit per acre
Jowar	15–20 quintals/acre	MSP ≈ ₹3,300–3,400 per quintal

Dragon fruit	Not specified (12-acre orchard)	Farm establishment $\approx$ ₹10 lakh; subsidy $\approx$ ₹1.45 lakh received
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3.9 Case Study: Dragon Fruit Cultivation

Dragon fruit cultivation by B. Manjula (18 years of farming experience, 12 acres under dragon fruit) illustrates the more capital-intensive end of diversification observed in the village (Fig 4). Cultivation relies on well-drained red and black soils, FYM and press mud for fertility, and drip irrigation supplemented by mulching sheets for weed and moisture control — appropriate given the crop's low water requirement as a desert-adapted species. Because the crop requires substantial heat, the farmer uses low-wattage LED bulbs (14–20 W) to supplement warmth during critical growth periods, an innovative, low-cost adaptation. Government support included a subsidy of roughly ₹1.45 lakh against an establishment cost of about ₹10 lakh, alongside periodic drip irrigation subsidy, and the farmer benefits from Rythu Bandhu, PM-



Kisan and crop insurance. Key production risks are fungal diseases (stem canker, cactus rust) and fruit losses to monkeys and birds; these are managed through sanitation, pruning and both organic and chemical fungicides (carbendazim and mancozeb). Post-harvest, the farmer uses cold storage — sometimes self-built — to time sales to periods of peak demand across Telangana, Maharashtra and Goa, and additionally shares farming knowledge with agriculture students, illustrating a form of community-level knowledge transfer alongside commercial cultivation.

Fig 4: Dragon fruit cultivation – Student and Farmer

3.10 Challenges Faced

- Climate variability, including erratic rainfall and heavy-rain crop damage.
- Fluctuating market prices and heavy dependence on local intermediaries.
- Limited access to credit and to timely, well-communicated subsidy delivery.

- Inadequate infrastructure for storage and transportation, particularly for perishable and horticultural crops.
- Crop losses to wildlife (monkeys, birds, wild boar) and to pest and disease outbreaks.

3.11 Overall Sustainability Impact

Taken together, the results point to a moderate overall level of sustainability adoption in Ranjole village: positive shifts are evident in environmental awareness, the blending of traditional and modern knowledge, and economic resilience through diversification, but adoption of resource-conserving techniques such as drip irrigation, rainwater harvesting and integrated pest management remains uneven, and continued effort is needed to extend these practices more broadly across the farming community.

4. DISCUSSION

The results of this field study highlight a complex, landholding-dependent picture of sustainable agriculture in Ranjole village, in which the strategies, constraints and opportunities available to farmers differ markedly by farm size.

4.1 Landholding Size and Farming Strategy

Small farmers, here defined as those cultivating 1–3 acres, typically prioritise food security, dedicating a significant share of their land to staple grains for household consumption and relying on traditional methods, diversified planting to spread risk, and minimal use of costly external inputs. Large farmers, defined as those with 5 acres or more, tend to focus on high-value cash crops — dragon fruit, sugarcane, oil palm and banana among them in this study — leveraging their larger acreage for specialisation, economies of scale, and greater investment in modern machinery, irrigation infrastructure and inputs. This distinction is consistent with the case-level evidence gathered here: capital-intensive practices such as drip irrigation, cold storage and LED-based heat supplementation were concentrated among farmers cultivating commercial or horticultural crops on larger holdings, while lower-input, rainfed cultivation of pulses, jowar and soybean characterised smaller and more subsistence-oriented operations.

4.2 Crop Diversification and Traditional–Modern Knowledge Integration

The moderate-to-wide crop diversity documented in the village — spanning millets, pulses, vegetables and increasingly horticultural and plantation crops — supports resilience against both climate variability and market fluctuation, consistent with the broader literature on agroecological diversification (Altieri, 2004; Pretty, 2008). The integration of traditional practices, such as FYM application, neem-based pest control and manual, experience-based fertiliser dosing, alongside modern techniques such as drip irrigation, pheromone traps and targeted agrochemical use, reflects an adaptive, hybrid model of farming rather than a wholesale shift to either traditional or industrial methods. This pattern echoes findings elsewhere in India and South Asia, where traditional ecological knowledge continues to function as a resource for resilience even as farmers adopt selected modern inputs (Berkes et al., 2000; Gadgil et al., 1993).

4.3 Water Management and Input Use

Water conservation techniques such as drip irrigation and mulching were reported mainly among farmers with greater capital and larger holdings, while rainfed cultivation predominated among smaller farmers and lower-value crops. The limited renewal cycle for drip irrigation subsidy (once every seven years, per farmer report) suggests that infrastructure subsidy design may not be well matched to the pace at which farmers would ideally upgrade or repair systems, a gap consistent with the wider observation that extension and subsidy programmes are not always closely matched to farmers' actual constraints (Reshma et al., 2024).

4.4 Government Support and Market Access

While government schemes such as Rythu Bandhu, PM-Kisan, crop insurance and targeted subsidies (for example, for dragon fruit establishment and drip irrigation) were accessed by farmers across crop types, the reported inconsistency in timely delivery and information access indicates room for improvement in how these schemes reach farmers at the village level. Similarly, farmers' continued reliance on local markets and intermediaries, with limited direct market access or value-added processing, constrains the profit margins that diversified and sustainably produced crops might otherwise command — an outcome that aligns with wider evidence on the importance of market linkages for realising the economic benefits of sustainable practice adoption (Bisht et al., 2020).

4.5 Implications for Policy and Extension

The overall sustainability impact in Ranjole village is best understood as the sum of two differentiated sets of contributions. Small farmers sustain low-input, diversified systems that preserve traditional knowledge and biodiversity, while large farmers have the capacity to drive further sustainable change through technology adoption, but also carry a greater risk of resource-intensive practices if not well supported and managed. This suggests that policy and extension interventions are likely to be most effective when tailored separately to each group: for small farmers, strengthening farmer collectives for shared market access and resource use, and providing targeted micro-finance for low-cost sustainable methods; and for large farmers, incentivising resource-efficient technologies such as precision irrigation and sensor-based fertilisation, and fostering partnerships with food processing industries for value addition and stable market linkages.

5. CONCLUSION

This field study of Ranjole village reveals a nuanced picture of farming practice, significantly shaped by landholding size. While a general shift toward sustainable methods is evident across the village, the strategies, challenges and opportunities differ markedly between small farmers (1–3 acres) and large farmers (5 acres and above). Small farmers contribute to sustainability primarily through low-input, diversified systems that preserve traditional knowledge and biodiversity, while large farmers hold greater capacity to drive sustainable change through technology adoption, tempered by a corresponding risk of higher resource consumption if not managed responsibly. The village's moderate overall improvement in sustainability reflects an ongoing transition in which positive shifts from both groups are counterbalanced by persistent challenges around climate variability, market access, credit and infrastructure.

Recommendations for small farmers include strengthening farmer collectives for better market access and shared resource utilisation (for example, community-owned irrigation systems), providing targeted micro-finance and subsidies for low-cost, traditional sustainable methods that can be scaled efficiently, and promoting education on basic business practices and value addition for diversified local produce. For large farmers, recommendations include incentivising the adoption of advanced, resource-efficient technologies (such as precision irrigation and sensor-based fertilisation) through subsidies and technical training, encouraging diversification into high-value, climate-resilient crops under certified sustainable practices, and fostering partnerships with food-processing industries for value addition and stable market linkages. By recognising these distinct needs and tailoring interventions accordingly, Ranjole village can accelerate its transition toward a resilient, sustainable agricultural future, offering a model that may be relevant to other semi-arid villages of the Telangana plateau and beyond.

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