

Field Innovations to Policy for Sustainable Agriculture, Biodiversity, Livelihoods and Ecological Resilience in

Kerala



Harnessing Local Resources | Strengthening Livelihoods
Building Climate Resilience



भारत अनुप कृषि प्रौद्योगिकी अनुप्रयोग अनुसंधान संस्थान

ICAR-Agricultural Technology Application Research Institute

Zone-XI, Hebbal, Bengaluru - 560 024



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FORWORD

Indian agriculture is undergoing a period of profound transformation, shaped by the interacting pressures of climate change, biodiversity loss, livelihood vulnerability, and evolving socio-economic aspirations. In this context, states such as Kerala present both unique challenges and powerful opportunities. Characterised by ecologically fragile landscapes, high population density, rich agro-biodiversity, and deeply embedded cultural farming traditions, Kerala's agricultural systems demand policy responses that are integrated, locally grounded, and forward-looking.

The present compilation on ***“Field Innovations to Policy for Sustainable Agriculture, Biodiversity, Livelihoods and Ecological Resilience in Kerala”*** developed through the concerted efforts of ICAR–Krishi Vigyan Kendras and partner institutions across Kerala, is a commendable attempt to translate rigorous field-level evidence into actionable policy insights. The publication addresses a wide spectrum of contemporary concerns, including human–wildlife conflict mitigation, conservation of indigenous crop diversity, farmer-led agroecological models, women's agripreneurship, wetland ecosystem sustainability, high-value crop diversification, protection of GI-tagged products, and revival of traditional agro-processing systems. Together, these themes reflect the multidimensional nature of agricultural sustainability in the state.

A major strength of this volume is its strong field-based evidence, drawn from sustained on-farm engagement, institutional innovation, and community participation under key national programmes, and translated into scalable, replicable models for policy action. The publication also highlights the pivotal role of Krishi Vigyan Kendras as district-level knowledge hubs that bridge research, extension, and policy by integrating scientific insights with local wisdom and programme convergence to build climate-resilient, inclusive, and market-oriented agricultural systems.

I am confident that this volume will be of significant value to policymakers, administrators, researchers, extension professionals, and development practitioners. The insights and recommendations presented herein can meaningfully contribute to evidence-based decision-making, improved programme design, and more responsive governance frameworks aligned with national priorities such as climate resilience, farmers' income enhancement, women's empowerment, and the Sustainable Development Goals.

I congratulate the Director, ICAR–ATARI, Bengaluru, the contributing KVK teams, and all associated stakeholders for this timely and impactful initiative. It is my earnest hope that this compilation will inspire informed policy action and strengthen the collective endeavour to build resilient agro-ecosystems and sustainable rural livelihoods in Kerala and across the country.

(Rajbir Singh)

Date : 15 April 2026





ICAR-Agricultural Technology Application Research Institute, Zone XI

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Director

PREFACE

Kerala's agricultural landscape represents a unique convergence of ecological sensitivity, cultural heritage, high population density, and diversified livelihood systems. From the below-sea-level farming systems of Kuttanad to the high-altitude agro-ecosystems of Idukki, and from forest-fringe villages facing human-wildlife conflict to culturally rich farming traditions linked with ritual art forms, agriculture in Kerala extends far beyond food production. It is intrinsically linked to biodiversity conservation, disaster risk reduction, rural livelihoods, nutrition, gender equity, and cultural continuity.

This compilation on “**Field Innovations to Policy for Sustainable Agriculture, Biodiversity, Livelihoods and Ecological Resilience in Kerala**” brings together experiences based on field-tested evidence, farmer-led innovations, and institutional experiences generated through the extensive network of ICAR-Krishi Vigyan Kendras (KVKs) and partner institutions across Kerala. Each policy brief addresses a critical challenge or opportunity, ranging from human-wildlife conflict mitigation and agro-biodiversity conservation to women's agripreneurship, climate-resilient wetland agriculture, high-value crop diversification, GI-tagged product protection, and sustainable allied enterprises.

A defining strength of these briefs is their grounding in real-implementation, supported by programmes such as NICRA, ARYA, PMFME, NMSA, MIDH, PKVY, and Tribal Sub-Plan initiatives. Rather than isolated success stories, the documents highlight scalable, replicable, and policy-relevant models that demonstrate how science-led extension, community participation, and institutional convergence can translate into tangible livelihood and ecological outcomes.

Collectively, the policy briefs advocate a shift from sectoral and reactive interventions toward integrated, preventive and ecosystem-based policy frameworks, aligned with national priorities such as *climate resilience*, *Atmanirbhar Bharat*, *Doubling Farmers' Income*, *women's empowerment*, and *sustainable development goals*. They underscore the pivotal role of KVKs as district-level knowledge hubs capable of bridging research, policy, and grassroots action.

This compilation is intended for policymakers, planners, administrators, development practitioners, researchers, and extension professionals, offering actionable insights and recommendations that can inform programme design, resource allocation, and governance reforms at state and national levels. By anchoring policy discourse in field realities, this compilation aspires to contribute meaningfully to building resilient agro-ecosystems, secure livelihoods, and inclusive rural futures in Kerala and beyond.

(V. Venkatasubramanian)

Date : 15 April 2026



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Foremost, We express our gratitude with thanks to Dr. M. L. Jat, Hon’ble Director General, ICAR, and Secretary, DARE, Government of India, whose visionary leadership and commitment to sustainable, resilient, and innovative agriculture have provided the guiding framework for this compendium. His emphasis on integrating science, policy, and extension has inspired a holistic, evidence-based approach to addressing the climate, resource, and livelihood challenges of Kerala’s ecosystems.

We gratefully acknowledging Dr. Rajbir Singh, Deputy Director General (Agricultural Extension), ICAR, for his encouragement, guidance and strategic guidance. His expertise in extension reforms and farmer-centric, pluralistic knowledge systems has shaped the policy briefs, ensuring alignment with national priorities while addressing the specific needs of Kerala’s farming community.

We sincere thanks is extended to Dr. R. R. Burman and Dr. Ranjay Kumar Singh, Assistant Directors General (Agricultural Extension), ICAR, whose insights and guidance enhanced the conceptual clarity and analytical rigor of this work. Their emphasis on social inclusion, institutional strengthening, and innovation diffusion has ensured that the policy recommendations are both scientifically sound and socially relevant.

We also place on record our sincere appreciation for the contributions of Directors of ICAR-CMFRI, ICAR-CPCRI, ICAR-IISR and National Partners, whose technical expertise, research experience, and advisory support enriched this compendium. Their multidisciplinary inputs strengthened the scientific foundation of the policy briefs and exemplified the spirit of collaborative research and extension that underpins the ICAR system. The collective knowledge shared by these institutions has been instrumental in shaping integrated and future-ready policy perspectives.

Special recognition is accorded to ICAR–ATARI, Bengaluru and Krishi Vigyan Kendra teams of Kerala state, whose continuous handholding support, field-based insights, and close engagement with the stakeholders greatly enriched the content and orientation of the compendium. Their dedication ensured that grassroots experiences, challenges, and innovations were meaningfully reflected in the policy discourse.

This compendium represents a collective commitment to advancing sustainable agriculture, and diversified livelihood innovations in the state of Kerala. It is our earnest hope that this work will serve as a valuable policy resource, foster informed decision-making, and contribute to inclusive and environmentally responsible development of the state of Kerala.

With sincere gratitude and respect, We acknowledge all the contributors who are associated with this publication.

Editors



Integrated Human–Wildlife Conflict Mitigation Policy for Malappuram District, Kerala

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Executive Summary

Human–Wildlife Conflict (HWC) emerged as one of the most pressing socio-ecological challenges in Kerala, with Malappuram district reporting a disproportionately high incidence of human fatalities, crop loss, livestock depredation, and property damage. The district's proximity to ecologically sensitive forest landscapes—particularly the Nilambur forest division and the Karimpuzha Wildlife Sanctuary—has intensified interactions between people and wildlife, notably elephants, wild boar, bonnet macaques, porcupines, leopards, and tigers.

This policy brief on wildlife conservation, disaster risk reduction, livelihood security, and digital governance, proposes an integrated, preventive, and technology-enabled approach to mitigate HWC in Malappuram district. It emphasizes community participation, farmer-centric innovations, real-time monitoring, and efficient compensation mechanisms while ensuring ecological integrity and wildlife conservation.

Policy Context

The proposed policy aligns with the following national priorities and frameworks:

- **National Wildlife Action Plan (2017–2031):** Emphasis on landscape-level planning, corridor protection, and conflict mitigation.
- **Forest Conservation and Wildlife Protection Acts:** Strengthening coexistence mechanisms while ensuring legal compliance.
- **National Disaster Management Framework:** Treating HWC as a localized, recurring disaster requiring preparedness and rapid response.
- **Doubling Farmers' Income & Rural Livelihood Mission:** Protecting agricultural income and reducing risk exposure in forest-fringe areas.
- **Digital India & e-Governance Initiatives:** Leveraging geo-tagging, digital assessments, and technology-driven service delivery.
- **Atmanirbhar Bharat & Innovation Ecosystem:** Promoting locally developed, farmer-led technological solutions.

Background and Situation Analysis

Kerala has a total geographical area of 38,852 km², of which 22,059 km² (56.78%) is under forest cover, comprising very dense, moderately dense, and open forests. Malappuram district spans approximately 3,554 km², with nearly 29% of its area under forest cover. The Nilambur region alone accounts for about 759 km² of forest, forming part of the Western Ghats–Nilgiris landscape and hosting critical wildlife corridors such as the Karimpuzha Wildlife Sanctuary, which links Silent Valley and Mukurthi National Parks.

Several gram panchayats in Nilambur and Kalikavu blocks include reserve forests and buffer areas. This spatial overlap between human habitation, agriculture, and wildlife habitats resulted in persistent conflict. Statewide data for 2022–23 indicate 8,873 HWC incidents in Kerala, including 98 human deaths and significant crop and livestock losses, with compensation exceeding ₹1,048 lakh. Between 2020 and 2024, Malappuram alone recorded 45 human fatalities, the third highest in the state, with elephant attacks being the primary cause. Sporadic tiger attacks and illegal live-wire trapping incidents have further heightened safety and regulatory concerns.

Agricultural losses are substantial due to wild animal tress pass and consumption of crops. Elephants cause crop damage estimated at ₹22 lakh annually, predominantly affecting plantain (accounting for nearly 89% of elephant damage). Wild boar, porcupines, and bonnet macaques inflict recurring losses on tapioca, coconut, arecanut, rubber, nutmeg, and teak plantations. Importantly, these impacts extend beyond forest fringes into plantations and cash-crop systems, underscoring the district-wide nature of the problem.

Problem Statement and Rationale

Human–wildlife conflict in Malappuram district is characterized by:

- Recurrent crop raiding by elephants and wild boar in forest-fringe and plantation landscapes.
- Livestock depredation and human safety risks due to leopard and tiger movement.
- High vulnerability of perennial and cash crops such as banana, coconut, arecanut, tapioca, and vegetables.
- Predominance of reactive measures (post-incident drives, ad hoc fencing) rather than proactive planning.
- Delays in damage assessment and compensation, leading to under-reporting and erosion of trust.
- Climate variability altering wildlife movement and forage availability.
- Disproportionate impacts on women, elderly persons, tribal communities, and smallholders.

These factors necessitate a comprehensive, district-specific policy that integrates prevention, preparedness, response, and recovery within a single framework.

Policy Objectives

- To reduce human casualties, crop losses, livestock depredation, and property damage arising from HWC in Malappuram district.
- To establish real-time monitoring, early warning, and rapid response mechanisms in identified hotspots.
- To promote adoption of innovative, cost-effective, and sustainable animal-repelling technologies among farmers.
- To ensure timely, transparent, and farmer-friendly compensation and insurance coverage.
- To balance wildlife conservation goals with livelihood security and social well-being of rural households.

Strategic Interventions

a. Preventive and Mitigation Measures

- Identification and mapping of high-conflict zones at panchayat level.
- Deployment of sensor-based animal detection and alert systems in vulnerable locations.
- Establishment of Panchayat-level Wildlife Conflict Mitigation Groups involving farmers, local youth, forest officials, and KVKs.
- Promotion of crop diversification and buffer crops less attractive to wildlife in hotspot areas.
- Encouragement of organic, herbal animal-repellent formulations with strong odor and bitter taste as eco-friendly deterrents.

b. Technology Integration and Local Innovation

A key component of this policy is the promotion of farmer-led technological solutions, particularly the Automatically Controlled Animal-Repelling Electronic Device developed by a local innovator from Tavanur,

Key features include:

- Portability and lightweight design suitable for small and marginal farmers.
- Thermal sensor-based activation for animal detection.
- Variable flashing light and sound patterns to prevent animal habituation.
- Hybrid power operation using solar energy and DC supply, ensuring energy efficiency.

The policy proposes the implementation of pilot demonstration initiatives in the Nilambur, Vazhikkadavu, and Edavanna blocks, supported by targeted subsidy mechanisms and effective convergence with existing agricultural and rural development schemes. It further emphasizes technical validation, refinement, and scaling of interventions through close collaboration between Krishi Vigyan Kendras (KVKs) and the Forest Department, ensuring scientific rigor, institutional coordination, and field-level adaptability.

c. Compensation and Insurance Reforms

- Introduction of digitized crop and livestock loss assessment using geo-tagged photographs and mobile applications.
- Time-bound compensation disbursement with defined service standards.
- Development of wildlife damage insurance products for crops and livestock through public–private partnerships.

d. Community Participation and Capacity Building

- Training programs on safe behavior, conflict avoidance, and emergency response.
- Awareness campaigns on coexistence principles through schools, farmer producer organizations, self-help groups, and youth clubs.
- Recognition and support for farmer innovations addressing HWC.

e. Research, Monitoring, and Institutional Support

- Applied research collaborations among agricultural universities, ICAR institutes, Forest Department, and KVKs.
- Gradual integration of advanced tools such as AI-based tracking, drones, and thermal imaging for large-animal monitoring.
- Systematic documentation and scaling up of successful local practices and innovations.



Expected Outcomes

- Measurable reduction in crop and livestock losses in identified conflict hotspots.
- Improved human safety and psychological well-being of farming and forest-fringe communities.
- Adoption of low-cost, farmer-friendly deterrent technologies in at least 50% of high-risk locations.
- Faster, transparent compensation and expanded insurance coverage.
- Strengthened coexistence framework supporting both biodiversity conservation and rural livelihoods

Conclusion

Human–wildlife conflict in Malappuram district represents a complex interaction of ecological, economic, and social factors. Addressing it requires moving beyond isolated, reactive measures toward an integrated, preventive, and participatory policy framework. Anchored in national priorities and GoI policy directions, this proposed strategy emphasizes technology adoption, community engagement, institutional convergence, and recognition of local innovation. By doing so, it offers a scalable and sustainable pathway to safeguard lives and livelihoods while conserving Kerala's rich wildlife heritage.

Policy Brief 2

Enhancing Biodiversity Conservation through Farmer-Led Agroecological Models

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Executive Summary

Biodiversity forms the backbone of India's food security, ecological resilience, and sustainable agricultural systems. However, increasing monocropping, chemical-intensive farming, habitat degradation, and climate variability have accelerated the erosion of agro-biodiversity across regions. Farmers, as primary land managers, play a critical role in conserving biodiversity, yet they face economic, institutional, and knowledge constraints.

This policy brief presents a farmer-led biodiversity conservation model facilitated by Krishi Vigyan Kendra (KVK) Kannur, Kerala, under the Indian Council of Agricultural Research (ICAR). The case of Sri. Shimjith N., a biodiversity steward from Thillankeri, Kannur, demonstrates how grassroots conservation, when supported by extension systems, can safeguard agro-biodiversity while strengthening livelihoods, youth engagement, and community resilience.

Drawing lessons from this model, the brief outlines policy challenges, strategic recommendations, and actionable interventions, aligned with national priorities such as sustainable agriculture, climate resilience, youth empowerment, and ecosystem restoration.

Policy Context

Krishi Vigyan Kendra (KVK) Kannur serves as a frontline agricultural extension institution implementing technology dissemination, capacity building, and farmer-centric innovation. Kannur District, located between 11°40'–12°48' N latitude and 74°52'–76°56' E longitude, covers 2,971.2 sq. km, accounting for 7.6% of Kerala's total geographical area. The district is bordered by the Western Ghats to the east, the Lakshadweep Sea to the west, and Karnataka and northern Kerala districts on other sides. It comprises four taluks, 11 blocks, 87 panchayats, and 147 villages, and is agro-ecologically classified into highlands, midlands, and lowlands. Agriculture and allied sectors including fisheries form the livelihood base for a significant proportion of the population. Major crops include paddy, coconut, pepper, cashew, arecanut, banana, tapioca, vegetables, and rubber. Coconut, cultivated in nearly all homesteads, holds cultural and economic significance as the *kalpavriksha*.

Problem Statement

Despite high natural biodiversity and fertile soils, Kannur faces several structural and ecological challenges:

- Soil acidity and water stress in certain regions
- Increasing human–wildlife conflict in productive agricultural areas
- Dominance of monocropping systems, particularly rubber and cashew
- Vulnerability of farm incomes to climate variability
- Nutritional insecurity due to reduced crop diversity
- Declining youth participation in agriculture

These challenges necessitate integrated, biodiversity-centric farming approaches supported by robust policy mechanisms

Farmer-Led Innovation: The Shimjith Model

Under ICAR-KVK Kannur's ARYA (Attracting and Retaining Youth in Agriculture) programme, Sri. Shimjith N. emerged as a trainee-turned-master farmer, exemplifying youth-led agroecological transformation.

Over two decades, he has conserved:

- 200+ traditional rice varieties
- 130 turmeric varieties
- 40 Tulsi ecotypes
- 1,000+ medicinal plant species
- Numerous indigenous vegetables, fruits, tubers, and aromatic plants



Receiving Kerala State Biodiversity Award

In parallel, he developed low-cost, scalable innovations, including:

- Eco-friendly wild animal repellent and irrigation systems
- Stingless bee rearing units using coconut shells
- Multi-species cropping models to enhance pollination and ecosystem services

The Model Biodiversity Study Centre – “Jaivakam”, established by him, functions as a living laboratory and community knowledge hub. It supports farmer trainings, student education, organic farming adoption, seed conservation, and eco-restoration. His outreach has benefitted farmers, students, women SHGs (Kudumbashree), tribal communities, and policymakers, with special emphasis on women's empowerment through medicinal plant-based micro-enterprises.

Notably, these efforts are driven by environmental stewardship rather than financial incentives, highlighting the latent potential among farmers that can be amplified through supportive policies.



Key Challenges to Biodiversity Conservation

1. Habitat Loss due to expansion of monocultures
2. Indiscriminate Pesticide Use, harming non-target organisms
3. Soil Degradation and decline in microbial diversity
4. Economic Pressures favouring short-term productivity
5. Limited Awareness and Incentives for biodiversity-friendly practices

Policy Recommendations

a. Promote Agroecological Farming Systems

- Encourage crop diversification, intercropping, agroforestry, and mixed farming under schemes such as National Mission on Sustainable Agriculture (NMSA).
- Scale up organic farming and Integrated Pest Management (IPM) through PKVY and BPKP.
- Strengthen farmer training on judicious pesticide use, emphasizing correct molecule, dosage, timing, and method.

b. Introduce Financial Incentives for Ecosystem Services

- Operationalize Payments for Ecosystem Services (PES) models for farmers maintaining biodiversity-rich landscapes.
- Provide incentives for hedgerows, cover crops, buffer strips, and ecological engineering under centrally sponsored schemes.
- Offset economic risks associated with transitioning away from monocropping systems.

c. Strengthen Agri-Environmental Schemes

- Design India-specific agri-environmental stewardship programmes, learning from global best practices.
- Ensure smallholder inclusivity and simplified access mechanisms.

d. Farmer Education and Capacity Building

- Utilize KVKs, ATMA, and State Agricultural Departments to deliver biodiversity-focused extension.
- Promote farmer-led conservation networks and document national best practices.
- Integrate successful models like Jaivakam into national knowledge platforms.

e. Protection and Restoration of Natural Habitats

- Incentivize conservation of wetlands, sacred groves, mini forests, and on-farm biodiversity hotspots.
- Promote land sharing and land sparing approaches to integrate conservation with production landscapes.

f. Research, Documentation, and Monitoring

- Support participatory research on agro-biodiversity conservation through ICAR and SAUs.
- Develop farmer-friendly biodiversity assessment tools and indicators aligned with national sustainability goals.



Suggested Actions for Policymakers

Policymakers shall prioritize the formulation of targeted subsidy mechanisms that incentivize the adoption of biodiversity-enhancing agricultural practices, while systematically integrating measurable biodiversity indicators into existing agricultural, environmental, and climate policy frameworks. Strategic public investment is required to strengthen participatory, community-led conservation programmes that place farmers at the center of biodiversity

stewardship. In parallel, enabling institutional platforms should be created to foster effective partnerships among farmers, research institutions, non-governmental organizations, and private sector stakeholders, thereby promoting knowledge exchange, innovation, and scalable models for sustainable and biodiversity-inclusive agricultural development.

Conclusion

Biodiversity conservation is integral to the sustainability, resilience, and long-term productivity of India's agricultural systems. Farmers, as primary managers of agro-ecosystems, possess invaluable traditional knowledge and practical capacity to conserve biological diversity when supported by enabling policies and institutional mechanisms. The experience of KVK Kannur and the exemplary farmer-led initiative of Sri. Shimjith N. clearly demonstrate that agro-biodiversity conservation can be effectively integrated with livelihood enhancement, youth engagement, and community empowerment.

However, scaling-up such models requires a deliberate policy shift that moves beyond production-centric approaches towards ecosystem-based agricultural planning. By providing appropriate financial incentives, strengthening extension and capacity-building systems, promoting participatory research, and fostering multi-stakeholder partnerships, the Government of India can create a conducive environment for biodiversity-friendly farming. Integrating biodiversity conservation into mainstream agricultural and climate policies will not only ensure food and nutritional security but also safeguard ecological integrity and rural livelihoods, thereby contributing to resilient and sustainable development for future generations.

Policy Brief 3

Sustaining Kuttanad: Integrated Strategies for Conservation and Livelihood Security in a Unique Ramsar Wetland Agro-Ecosystem

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Executive Summary

Kuttanad, a globally unique below-sea-level farming system in Kerala, represents a critical convergence of food security, biodiversity conservation, and rural livelihoods. Recognised as a Globally Important Agricultural Heritage System (GIAHS) by FAO and forming part of the Vembanad Ramsar Wetland, the region faces mounting pressures from climate change, salinity ingress, infrastructure degradation, and declining farm profitability. This policy brief outlines integrated, climate-resilient, and livelihood-centric strategies to sustain Kuttanad's agro-ecosystem, drawing on field experiences of ICAR–KVKs under the National Innovations in Climate Resilient Agriculture (NICRA) programme. Coordinated policy action, institutional convergence, and community participation are critical to ensuring ecological restoration and long-term sustainability.

Context and Importance of the Issue

Kuttanad spans Alappuzha, Kottayam, and Pathanamthitta districts of Kerala and is often described as the “Rice Bowl of Kerala.” The region is among the few places in the world where agriculture is practiced below mean sea level, in reclaimed paddy fields known as *padasekharams*.

Hydrologically, Kuttanad is shaped by four major rivers—Pamba, Meenachil, Achankovil, and Manimala—which drain into Vembanad Lake. A network of bunds, dykes, canals, and sluice gates, including the Thanneermukkom Barrage, regulates freshwater–salinity dynamics and enables rice cultivation.

Beyond agriculture, the ecosystem delivers vital ecosystem services, including flood buffering, biodiversity conservation, carbon sequestration, and livelihood support for millions of people. However, increasing anthropogenic pressure and climate variability threaten the ecological and economic foundations of the region.

Problem Statement

Despite its ecological and cultural significance, Kuttanad is experiencing acute agricultural distress due to multiple, interlinked challenges:

- Frequent flooding and prolonged waterlogging
- Salinity intrusion affecting soil health and crop productivity
- Deteriorating water management infrastructure
- Climate change–induced weather variability
- Rising input costs and declining profitability of paddy cultivation
- Acute labour shortages and ageing farmer population
- Increased pest and disease incidence
- Limited access to institutional credit, insurance, and markets
- Gradual erosion of traditional ecological knowledge

These challenges undermine both food security and livelihood resilience, necessitating urgent, coordinated policy responses.

Evidence and Ground-Level Insights

Field-level interventions and technology demonstrations carried out by KVK–Kottayam and KVK–Alappuzha under the ICAR-led National Innovations in Climate Resilient Agriculture (NICRA) programme have generated strong empirical evidence on effective adaptation strategies for the Kuttanad agro-ecosystem. Improved water regulation measures, including timely drainage, regulated pumping, and strengthened field bunds, were found to substantially reduce crop losses during extreme rainfall events and prolonged flooding, thereby stabilizing rice productivity in below-sea-level fields. Demonstrations of integrated farming systems such as rice–fish and rice–duck highlighted their potential to diversify farm income, improve nutrient recycling, and reduce pest pressure, resulting in greater income stability and resilience against climate-induced shocks. The



introduction of climate-resilient and short-duration rice varieties, combined with integrated pest management (IPM) practices, significantly lowered production risks by minimizing yield losses from salinity stress, pests, and diseases while reducing dependence on chemical inputs. Importantly, the adoption rates and long-term sustainability of these interventions were markedly higher when implemented through community-based and participatory approaches, such as farmer groups and collective decision-making at the padasekharam level. Collectively, these ground-level experiences underscore the effectiveness of scalable, location-specific, and farmer-centric solutions that integrate scientific innovations with local knowledge to enhance climate resilience and livelihood security in the Kuttanad region.

Policy Objectives

1. Enhance climate resilience of below-sea-level farming systems
2. Restore ecological integrity of the Kuttanad–Vembanad wetland complex
3. Improve farm profitability and livelihood diversification
4. Strengthen institutional coordination and governance mechanisms
5. Integrate scientific innovations with traditional knowledge systems

Policy Options and Strategic Interventions

a) Strengthening Water Management Infrastructure

- Reconstruction and reinforcement of bunds using durable materials such as geotextiles
- Modernisation and regular maintenance of sluice gates and canal networks
- Deployment of decentralised, solar-powered pumping systems for flood control

b) Salinity Management and Soil Health Restoration

- Scientific regulation of Thanneermukkom Barrage operations
- Promotion of organic manuring, green manuring, and SSNM
- Adoption of salt-tolerant and short-duration paddy varieties

c) Climate-Resilient and Diversified Farming Systems

- Promotion of integrated rice–fish and rice–duck systems
- Crop diversification and multiple cropping to reduce mono-crop risk
- Agroforestry along bunds for soil stabilisation and biodiversity enhancement
- Climate-resilient livestock and poultry enterprises

d) Labour-Saving Technologies and Mechanisation

- Introduction of location-specific small farm machinery
- Expansion of custom hiring centres through cooperatives and FPOs
- Targeted subsidies for mechanisation in below-sea-level farms

e) Financial Inclusion and Risk Mitigation

- Simplified access to institutional credit through SHGs and FPOs
- Timely crop insurance settlement and disaster compensation

f) Capacity Building and Knowledge Dissemination

- Regular training programmes on climate-resilient agriculture
- Farmer Field Schools and participatory seasonal planning

g) Revival of Traditional Knowledge

- Documentation and revival of indigenous bund-building and water-sharing practices
- Inclusive participatory planning involving women and elder farmers

h) Enhancing Profitability and Reducing Pest & Disease Incidence

- Promotion of IPM, resistant varieties, and surveillance-based advisories
- Integrated nutrient management to reduce input costs

i) Promotion of Farm Tourism

The promotion of farm tourism in Kuttanad offers a viable pathway to supplement farm incomes while reinforcing ecological conservation and cultural preservation. By capitalising on the region's distinctive below-sea-level paddy landscapes, traditional water management systems, and rich agrarian heritage, farm tourism can provide farmers with diversified and resilient livelihood opportunities beyond conventional rice cultivation. Structured initiatives such as guided tours of padasekharams, participatory paddy transplanting and harvesting experiences, demonstrations of traditional farming tools and practices, and farm-to-table culinary experiences featuring local rice and wetland produce can attract visitors interested in rural, educational, and eco-friendly tourism.

Such activities generate additional revenue streams, reduce dependence on fluctuating agricultural returns, and create employment opportunities within farming households. Importantly, agri-eco tourism can foster youth engagement by creating entrepreneurial roles in guiding, hospitality, value-added processing, and digital promotion, thereby addressing rural outmigration. At the same time, it contributes to the preservation of cultural heritage and traditional knowledge, promotes public appreciation of wetland farming systems, and supports environmentally responsible tourism models that align with the conservation goals of the Kuttanad-Vembanad Ramsar wetland ecosystem.

Implementation and Institutional Coordination

Effective implementation requires convergence among:

- Local Self-Government Institutions (LSGIs)
- Line departments of Government of Kerala
- ICAR institutes, KVKs, and research organisations
- Farmer Producer Organisations and community institutions

Establishing a Multi-Stakeholder Kuttanad Development Authority with transparent monitoring mechanisms is recommended to ensure coordinated action and efficient resource utilisation.

Expected Outcomes

- Improved resilience of farming systems to floods and salinity
- Enhanced farm incomes and livelihood diversification
- Reduced ecological degradation of the Ramsar wetland
- Strengthened community stewardship and governance
- Long-term sustainability of a globally unique agro-ecosystem

Conclusion

The Kuttanad agro-ecosystem represents a globally significant landscape where below-sea-level farming, intricate water management, and rich cultural heritage converge. However, the region faces multiple stressors, including frequent flooding, salinity intrusion, climate variability, ageing infrastructure, declining profitability, labour shortages, and erosion of traditional knowledge. Field-level evidence from KVK-Kottayam and KVK-Alappuzha under the NICRA programme demonstrates that integrated, climate-resilient, and community-driven interventions—such as improved water regulation, adoption of short-duration and salt-tolerant rice varieties, integrated pest management, and diversified farming systems like rice-fish and rice-duck—can effectively enhance productivity, resilience, and farmer incomes.

Complementary strategies, including the promotion of farm tourism, revival of traditional knowledge, targeted mechanisation, financial inclusion, and participatory capacity building, offer additional pathways for livelihood diversification, youth engagement, and cultural preservation. These interventions, when implemented through coordinated, multi-stakeholder approaches involving local self-government institutions, line departments, research organisations, and farmer collectives, can ensure the long-term ecological restoration, sustainable productivity, and socio-economic viability of Kuttanad.

Ultimately, sustaining Kuttanad requires a synergistic integration of scientific innovations with traditional wisdom, policy support, and community participation to safeguard one of India's most unique and fragile wetland-agricultural landscapes for future generations.

Policy Brief 4

Conservation of Indigenous Arecanut Varieties to Nurture Cultural Heritage and Sustainable Livelihoods in Kerala

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Executive Summary

Kerala's indigenous ritualistic art forms such as Padayani, Theyyam, and Perumakaliyattam represent a living interface between agriculture, ecology, and cultural identity. Arecanut (*Areca catechu*), particularly its leaf sheath, spathe, and inflorescence, plays a critical role in these ritual practices. However, the widespread replacement of traditional arecanut cultivars with high-yielding varieties has resulted in the loss of raw material essential for folk and ritual art forms.

This policy brief highlights the successful initiative led by Kerala Agricultural University (KAU) and ICAR–ATARI, Bengaluru, in collaboration with KVKs and the Kerala State Folklore Academy, to revive indigenous arecanut cultivars such as *Kasaragod local* for cultural conservation, ecological resilience, and livelihood security. The brief recommends targeted policy support for conserving traditional crop biodiversity linked to cultural heritage.

Background and Context

The history of Kerala's art and culture is deeply interwoven with agriculture. Tribal, folk, and ritualistic art forms evolved as socio-cultural expressions of agrarian communities, often synchronized with agricultural seasons, farm operations, and ecological cycles. These traditions not only reflect religious beliefs but also encode indigenous knowledge systems related to environmental conservation, biodiversity, and sustainable agriculture.

Ritualistic art forms like Padayani and Theyyam symbolically represent fertility, protection of nature, and agricultural prosperity. They are traditionally performed between February and May, coinciding with key agricultural transitions. Visual documentation by KAU–ATIC, Mannuthy has established the strong interlinkages between these rituals, farming practices, and crop resources.



Problem Statement

Despite their cultural significance, traditional ritual art forms are witnessing a steady decline due to:

- Replacement of indigenous arecanut varieties with high-yielding cultivars (e.g., Mangala, Mohitnagar) bred solely for nut production.
- Unsuitability of modern varieties for ritual use due to smaller, weaker leaf sheaths and spathes.
- Non-availability of traditional cultivars such as *Kasaragod local*, *Ratnagiri local*, and other South Canara types, which are stress-tolerant and culturally preferred.
- Lack of organized planting material production and farmer incentives for cultivating traditional varieties.

The erosion of these varieties threatens both intangible cultural heritage and on-farm agrobiodiversity.

Evidence and Intervention

Recognizing this critical gap, Kerala Agricultural University, in collaboration with ICAR institutions, implemented a phased and region-specific intervention aimed at conserving indigenous arecanut varieties closely associated with ritualistic art forms. The approach strategically integrated cultural preservation with agricultural biodiversity conservation, ensuring active participation of both farming and cultural communities.

Phase I, which focused on Padayani-centric conservation in Pathanamthitta district, involved the large-scale distribution of planting material of the indigenous *Kasaragod local* arecanut variety. By June 2024, 5,000 seedlings were supplied to more than 40 Padayani Sanghams, addressing the acute shortage of culturally suitable arecanut resources required for ritual performances. This phase was implemented through a coordinated effort of KVKs Kottayam and Kannur, ATIC Mannuthy and ICAR-ATARI Bengaluru in close collaboration with the Kerala State Folklore Academy, thereby ensuring institutional convergence between agricultural extension and cultural preservation agencies.

Building on the success of Phase I, Phase II expanded the intervention to Theyyam-dominated regions of Kannur and Kasaragod districts, with a dual focus on documentation and material support. Detailed documentation of agriculture-linked Theyyam forms was undertaken with support from ICAR-ATARI, Bengaluru, highlighting the deep-rooted connections between farming systems, ecological beliefs, and ritual practices. As part of this phase, 5,000 seedlings of Kasaragod local arecanut were distributed to 100 Theyyakkavus and Mundyas in Kannur district by March 2025. In addition, 1,000 seedlings were supplied to ritual centers in Trikkaripur village of Kasaragod district, further strengthening the availability of culturally appropriate planting material. Both programmes under this phase were sponsored by ICAR-ATARI, Bengaluru.

Collectively, these phased interventions not only revived farmer interest in cultivating indigenous arecanut cultivars but also reinforced the sustainability of ritualistic art institutions that depend on agriculture-derived resources. The initiative demonstrated a viable model for integrating agrobiodiversity conservation with cultural heritage preservation, contributing to long-term ecological resilience and socio-cultural continuity.



Objectives of the Initiative

- Conservation of traditional ritual art forms linked to agriculture for cultural continuity.
- Visual documentation of the interlinkages between farming systems, rituals, and folk arts such as Padayani, Theyyam, and Perumakaliyattam.
- Promotion and cultivation of indigenous arecanut cultivars in ritual-performing districts.
- Socio-economic upliftment of farming and artisan communities through culturally relevant agriculture.



Outcomes and Significance

The initiative yielded significant outcomes by restoring reliable access to culturally appropriate indigenous arecanut planting material required for ritualistic art forms such as Padayani and Theyyam, thereby addressing a long-standing constraint faced by cultural institutions. It contributed substantially to the on-farm conservation of indigenous arecanut germplasm, promoting the continued cultivation of traditional, stress-tolerant local cultivars that had been gradually displaced by high-yielding varieties. The programme also fostered strong institutional linkages among farmers, ritual committees, cultural organizations, and agricultural research and extension agencies, creating a collaborative framework for integrating cultural heritage with agricultural development. Importantly, the initiative enhanced public and stakeholder awareness of the critical role of agriculture in sustaining intangible cultural heritage, reinforcing the idea that traditional farming systems are central to cultural continuity. Additionally, by encouraging the adoption of locally adapted cultivars requiring fewer external inputs, the intervention supported environmentally sustainable, low-input farming systems, contributing to long-term ecological resilience and livelihood security.

Policy Gaps Identified

- Absence of dedicated schemes linking agrobiodiversity conservation with cultural heritage.
- Limited institutional mechanisms for multiplication and distribution of indigenous planting materials.
- Lack of targeted subsidies or incentives for farmers cultivating traditional varieties for non-commercial ecosystem and cultural services.

Policy Recommendations / Action Points

(a) State-Level Promotion

- Government of Kerala to recognize indigenous arecanut varieties as heritage-linked crops.
- Promote their cultivation in ritual-performing regions through special missions.

(b) Planting Material Production

- Strengthen KVKs, state nurseries, and departmental farms for decentralized production of traditional arecanut seedlings.
- Include indigenous cultivars under ongoing horticulture and biodiversity schemes.

(c) Farmer Incentives

- Provide subsidies for planting materials and inputs to farmers cultivating traditional arecanut varieties.
- Encourage farmer groups, ritual committees, and cultural institutions to jointly maintain plantations.

(d) Documentation and Awareness

- Supporting of continuous visual and ethnographic documentation of agriculture-linked ritual practices.
- Integrating the findings in agricultural extension, education, and cultural promotion programmes.

Conclusion

The conservation of indigenous arecanut varieties is not merely an agricultural intervention but a strategic cultural policy imperative. By aligning agrobiodiversity conservation with ritual art preservation, Kerala demonstrated a scalable model where culture, ecology, and livelihoods converge. Institutionalizing such approaches through policy support will ensure that traditional knowledge systems and cultural identities remain vibrant for future generations.

Policy Brief 5

Conservation, Value Addition and Market Protection of GI-Tagged Marayoor Jaggery (Marayoor Sarkara), Idukki District, Kerala

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Executive Summary

Marayoor Jaggery (Marayoor Sarkara), a Geographical Indication (GI)-tagged product from Idukki district, Kerala, represents a unique agro-ecological, cultural, and livelihood system practiced predominantly by tribal and marginal farmers. Despite its GI recognition in 2019, the sector faces declining cultivation, climate stress, counterfeit marketing, wildlife damage, and weak value-chain integration.

This policy brief proposes a convergent, mission-mode intervention aligned with Government of India schemes such as PMFME, ODOP, National Mission on Sustainable Agriculture (NMSA), Tribal Sub-Plan (TSP), and GI Protection Framework, to ensure conservation, livelihood security, and national branding of Marayoor Jaggery as a premium natural sweetener.

Context and Rationale

Sugarcane is an important commercial crop supporting the traditional sweetener industry in India. In Kerala, sugarcane cultivation is concentrated in select agro-climatic pockets, of which Marayoor and Kanthallur regions of Idukki district are unique due to:

- Location in a rain-shadow zone with low night temperatures
- Terraced cultivation using traditional irrigation sources
- Absence of chemical clarificants in jaggery processing
- Indigenous processing knowledge passed through generations

Marayoor Jaggery is renowned for its distinct aroma, golden colour, hardness, purity, and high mineral content, attributed to soil characteristics, water quality, varieties used, and traditional production practices. GI recognition has enhanced its identity, but not yet translated into sustained income or market protection.

Objectives of the Policy Intervention

The proposed policy framework aims to:

1. Preserve and institutionalize traditional jaggery production systems
2. Protect GI integrity and prevent market dilution through counterfeits
3. Enhance farmer incomes through value addition and assured markets
4. Promote climate-resilient and organic sugarcane cultivation
5. Strengthen tribal institutions, FPOs, and youth participation

Current Status and Key Challenges

Despite high demand and GI recognition, the Marayoor Jaggery sector faces the following structural and operational challenges:

a. Production Constraints

- Sharp decline in sugarcane area and productivity due to monocropping and soil degradation
- Limited access to climate-resilient and location-specific varieties
- Increasing climate variability, drought spells, and temperature anomalies

b. Ecological and Wildlife Challenges

- Frequent crop losses due to wild boars and elephants, given proximity to Chinnar Wildlife Sanctuary
- Inadequate compensation and preventive infrastructure

c. Processing and Labour Issues

- Labour scarcity and rising wage costs
- Limited modernization of traditional processing units
- Inadequate hygiene, water access, and storage infrastructure



d. Market and Institutional Challenges

- Rampant counterfeit jaggery sold under the Marayoor brand
- Weak branding, traceability, and consumer awareness
- Limited youth interest due to uncertain and seasonal incomes

Strategic Importance of Marayoor Jaggery

1. Economic Significance

- Primary livelihood for 600+ tribal and marginal farming families
- High value-to-volume ratio suitable for niche and premium markets

2. Cultural and Tribal Heritage

- Traditional artisanal product integral to tribal identity and knowledge systems

3. Ecological Sustainability

- Chemical-free cultivation in an ecologically sensitive buffer zone
- Compatible with organic and low-carbon agriculture goals

4. Tourism and Nutrition

- Strong linkage with eco-tourism, agro-tourism, and GI tourism
- Rich source of iron, magnesium, antioxidants, and natural sugars



Policy Recommendations

A. Production and Resource Support

- Subsidized supply of recommended sugarcane varieties (e.g., Co 86032) and promotion of new climate-resilient varieties
- Establishment of model nurseries and SSI-based demonstration farms
- Soil rejuvenation through organic amendments and crop diversification
- Compensation and insurance mechanisms for climate and wildlife damage

B. Processing and Infrastructure Development

- Upgradation of traditional jaggery units using eco-friendly and energy-efficient technologies
- Support for solar dryers, clean water supply, hygienic moulding and packaging units
- Creation of community-owned processing clusters managed by FPOs

C. Marketing, Branding and GI Protection

- Promotion of certified brands such as “Marayur Madhuram” through state and national marketing agencies
- Introduction of digital traceability systems (QR code-based GI verification)
- Awareness campaigns involving local bodies, traders, and consumers to curb counterfeit products

D. Farmer and Tribal Empowerment

- Strengthening of Marayur and Kanthallur Tribal Farmers Producer Company Ltd. through:
 - Capacity building
 - Working capital support
 - Market linkages with institutional buyers
 - Promotion of direct-to-consumer and e-commerce platforms

E. Policy Convergence and Institutional Integration

- Inclusion of Marayoor Jaggery under ODOP (One District One Product)
- Convergence with PMFME, NMSA, TSP, and Tourism Development Schemes
- Inclusion in mid-day meal programmes, tribal hostels, and Ayurveda institutions

Implementation and Monitoring Framework

A Marayoor Jaggery Task Force is proposed, comprising representatives from:

- Department of Agriculture
- Local Self Government Institutions
- Tribal Welfare Department
- ICAR-KVK
- Farmer Producer Organizations
- Industry and Marketing Departments

Quarterly reviews, outcome-based indicators, and third-party assessments will ensure transparency and effectiveness.

Expected Outcomes

- Stabilization and revival of sugarcane cultivation in Marayoor
- Enhanced incomes and livelihood security for tribal farmers
- Protection of GI authenticity and elimination of counterfeit trade
- Emergence of Marayoor Jaggery as a nationally recognized premium natural sweetener
- Strengthened linkage between agriculture, nutrition, tourism, and rural entrepreneurship

Conclusion

Marayoor Jaggery (Marayoor Sarkara) represents a rare convergence of geographical uniqueness, traditional knowledge, tribal livelihoods, and ecological sustainability. Despite its recognition as a GI-tagged product, the sector remains vulnerable due to declining cultivation, climate stress, wildlife conflict, weak institutional support, and market distortions arising from counterfeit products. Without timely and coordinated policy intervention, this heritage value chain risks gradual erosion.

This policy brief underscores the need for a holistic, mission-mode approach anchored in the Government of India framework, emphasizing production sustainability, processing modernization, GI protection, market integration, and tribal empowerment. Converging national flagship schemes such as PMFME, ODOP, NMSA, Tribal Sub-Plan, and GI protection mechanisms will enable scale, efficiency, and long-term resilience of the Marayoor Jaggery ecosystem.

By strengthening Farmer Producer Organizations, promoting climate-resilient sugarcane cultivation, upgrading traditional processing units, and instituting robust branding and traceability systems, Marayoor Jaggery can evolve into a nationally recognized premium natural sweetener. Such an approach will not only enhance farmer incomes and attract youth participation but also reinforce food authenticity, nutritional security, and sustainable land-use practices in ecologically sensitive regions.

In conclusion, safeguarding and promoting Marayoor Jaggery is not merely an agricultural intervention but a strategic investment in cultural heritage, tribal welfare, rural entrepreneurship, and sustainable development. With coordinated policy support and community-led implementation, Marayoor Jaggery can emerge as a

Policy Brief 6

Revival of Sugarcane Farming and Promotion of Traditional Jaggery Production in Kerala-A Replicable Model Based on the Alangadan Sharkara

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Executive Summary

Traditional jaggery (Sharkara) production in Kerala has witnessed a steep decline over the last several decades due to contraction of sugarcane cultivation, labour shortages, rising production costs, loss of processing infrastructure, and competition from cheaper interstate imports. This decline has adversely affected rural livelihoods, food heritage, and access to chemical-free traditional sweeteners.

The successful revival of Alangadan Sharkara in Ernakulam district by ICAR–KVK Ernakulam, in partnership with local self-government institutions and cooperatives, demonstrates that scientifically supported sugarcane cultivation, modernised traditional processing, institutional convergence, and branding can make jaggery production economically viable and culturally sustainable.

This policy brief proposes a statewide programme for Kerala to revive sugarcane farming and traditional jaggery production, with potential scalability to other states possessing similar agro-cultural contexts. The approach aligns with national priorities on doubling farmers' income, value addition, agro-processing, nutrition security, and heritage conservation.

Context and Importance of the Issue

Jaggery production, traditionally rooted in locally cultivated sugarcane, was once a thriving cottage industry in Kerala. Districts such as Ernakulam, Kottayam, Idukki, Thrissur, and Palakkad were characterised by numerous *sharkara alas* small, seasonal jaggery-making units that operated intensively during the sugarcane harvest period. Beyond its role as a sweetener, jaggery (*sharkara*) occupied a central place in Kerala's culinary traditions, religious rituals, and Ayurvedic formulations.

Over time, rapid urbanisation and a gradual shift towards alternative cash crops led to a steady decline in sugarcane cultivation. Acute labour shortages, escalating production costs, and limited technological modernisation further undermined the viability of traditional jaggery-making. The increasing availability of low-cost jaggery from other states significantly eroded the market competitiveness of local producers, rendering many units economically unviable. Traditional processing methods such as animal-driven crushers and prolonged boiling over wood-fired chulhas were highly labour-intensive, energy inefficient, and posed occupational health risks due to heat and smoke exposure. In the absence of mechanisation, organised marketing systems, and assured price realisation, the sector progressively lost its economic appeal.

Consequently, younger generations increasingly opted for less arduous and more remunerative livelihood options, leading to the erosion of traditional skills and the abandonment of jaggery-processing infrastructure. In the Alangadan region of Ernakulam district, field evidence suggests that the last operational jaggery unit ceased functioning nearly six to seven decades ago, marking the disappearance of a once-flourishing local agro-based tradition.

Rationale for Revival

a. Rural Livelihood Enhancement

Revival of traditional jaggery-making offers significant potential to strengthen rural livelihoods by creating a locally integrated value chain encompassing sugarcane cultivation, processing, packaging, and marketing. Employment opportunities can be generated for farmers, agricultural labourers, artisans, and micro-entrepreneurs, while also stimulating allied sectors such as transport, equipment fabrication and maintenance, fuel supply, and input services.

Localized processing reduces post-harvest losses, minimizes transport costs, and improves traceability, thereby enabling better price realization for producers. With rising consumer demand for traditional, chemical-free sweeteners, Kerala's indigenous jaggery varieties can effectively access niche markets including health-conscious urban consumers, Ayurveda-based industries, and premium food segments. Collective marketing through Farmer Producer Organisations (FPOs), Self-Help Groups (SHGs), and cooperatives can further enhance bargaining power, ensure fair returns, encourage youth participation, and reduce rural outmigration.

b. Cultural Preservation

Jaggery has historically occupied a central place in Kerala's cultural, culinary, and spiritual traditions. It is an essential ingredient in festive foods, temple offerings, and ceremonial feasts across communities, where purity and authenticity of ingredients carry deep symbolic significance. In religious and social rituals, the trust placed in traditional food items reflects the sanctity of the occasion.

In this context, *Alangadan Sharkara*—produced using time-honoured methods and free from synthetic additives—represents not merely a sweetener but a symbol of faith, purity, and continuity. Its revival ensures that cultural practices and rituals can be preserved in their authentic form, aligned with ancestral values and traditions.

c. Health and Nutrition

Traditional jaggery is a nutritionally superior alternative to refined sugar, containing essential minerals such as iron, calcium, magnesium, and potassium. It supports digestion, strengthens immunity, and functions as a natural detoxifying agent. Compared to refined sugar, jaggery has a relatively lower glycaemic index and provides slow-release energy, reducing sudden spikes in blood glucose when consumed in moderation.

At a time of growing public awareness regarding the adverse health impacts of refined sugar and chemical additives, locally produced, chemical-free jaggery responds directly to consumer demand for safe, wholesome, and unadulterated natural sweeteners.

d. Crop Diversification and Farm Resilience

Reintroducing sugarcane within diversified and mixed farming systems provides farmers with a viable alternative to monoculture crops such as paddy, banana, or vegetables. Crop diversification through

- Reduces dependence on a single crop and income source;
- Enhances resilience against market volatility, pest and disease outbreaks, and climate variability;
- Improves soil health through varied cropping patterns and organic residue recycling.

By integrating sugarcane into existing farming systems, farmers can enhance overall productivity, stabilize incomes, and revive a crop of both cultural and economic significance to Kerala.

e. Branding and Geographical Indication (GI) Potential

Kerala's distinctive jaggery varieties—such as *Alangadan Sharkara*, Central Travancore jaggery, and *Marayoor Sharkara*—possess strong identity-based market appeal rooted in geography, traditional knowledge, and production practices. Securing Geographical Indication (GI) status can safeguard these products from imitation, enhance their market value, and reinforce regional pride.

GI recognition can facilitate entry into premium retail outlets, health food chains, Ayurveda-based industries, and export markets, positioning Kerala's traditional jaggery as a high-value heritage product with global relevance.

f. Agro-Tourism and Experiential Economy

The artisanal jaggery-making process—encompassing traditional juice extraction, slow boiling over wood fires, and hand-moulding into golden forms—is visually engaging and culturally rich. Integrating jaggery production into agro-tourism initiatives can:

- Attract tourists, students, researchers, and culinary enthusiasts;
- Offer live demonstrations, hands-on learning experiences, and direct-from-source purchases;
- Evolve into heritage trails, jaggery festivals, and seasonal cultural tourism events.

Such initiatives diversify rural income sources, strengthen local economies, and foster wider public appreciation of Kerala's traditional food systems and agrarian heritage.

Problem Statement

- Shrinking area under sugarcane cultivation in Kerala
- Absence of functional village-level jaggery processing units
- High labour intensity and health risks in traditional processing
- Lack of organised branding, quality assurance, and market access
- Influx of low-cost, often chemically adulterated jaggery from outside the state
- Loss of traditional knowledge and intergenerational skill transfer

Evidence from Field Practice: Alangadan Jaggery Revival

Recognising both the heritage value and the emerging market potential of *Alangadan Sharkara*, ICAR–Krishi Vigyan Kendra (KVK), Ernakulam, in collaboration with the Alangad Grama Panchayat and the Alangad Service Co-operative Society, initiated a revival programme to restore sugarcane cultivation and traditional jaggery production in the Periyar river basin. The initiative aimed to reintroduce climate-appropriate sugarcane varieties, revive artisanal processing practices, and establish a viable institutional framework for sustainable production and marketing.

Implementation Steps

a. Varietal Introduction



A high-yielding, disease-resistant sugarcane variety, CO 86032, developed by the ICAR–Sugarcane Breeding Institute, Coimbatore, was selected for its suitability for traditional jaggery making. In 2022, under a frontline demonstration programme, ten progressive farmers from Alangad Panchayat cultivated the variety over one hectare, with continuous technical backstopping from KVK.

Seventy Years Later: First Sugarcane Saplings Mark a New Beginning in Alangad, Ernakulam

b. Farmer Mobilisation



Initial hesitation among farmers—stemming from uncertainties related to processing facilities and market access—was addressed through focused awareness programmes, village-level meetings, and exposure visits. KVK provided assurance that a functional jaggery processing unit would be established well before harvest, thereby reducing the perceived risk of unsold sugarcane and encouraging

A Sweet Comeback: Traditional Jaggery Making after Seven Decades in Alangad, Ernakulam

c. Processing Revival

KVK facilitated the establishment of a modernised yet traditional jaggery processing unit through a tripartite partnership involving the Grama Panchayat and the Service Co-operative Society. Infrastructure support included a 500 kg/hr electrically operated sugarcane crusher, wood-fired smokeless chulhas, and a hand-crafted wooden cooling pan to retain traditional quality attributes. Financial support for processing equipment was mobilised through ICAR–Agricultural Technology Application Research Institute (ATARI), while the processing shed was constructed under the Agriculture Infrastructure Fund (AIF) with NABARD support.



In the Spotlight: Newspapers Celebrate the Return of Traditional Jaggery

d. Chemical-Free Production

Processing protocols were standardised in consultation with the ICAR-Indian Institute of Sugarcane Research (IISR), Lucknow. These protocols ensured the production of jaggery free from sodium bicarbonate, synthetic colouring agents, and chemical preservatives, reinforcing the product's natural and health-friendly



Eco-Friendly Smokeless Chulhas Supporting Sugarcane Juice Pre-Heating and Concentration, Extracting Juice with electric crusher and Releasing Bagasse

e. Branding and Marketing

The jaggery was moulded into traditional round forms, packaged in food-grade polyethylene, and marketed under the brand “Alangadan Sharkara.” Branding emphasised purity, traditional processing, and local heritage. Promotional and awareness activities were undertaken in collaboration with the Agriculture Technology Management Agency (ATMA) and local farmer collectives, including exhibitions and public events.



Promoting Alangadan Jaggery: Exhibition Stall for Popularisation and branding



Outcomes

- a. **Reintroduction of Sugarcane Cultivation:** Sugarcane cultivation was revived across more than 10 acres within two years, with average yields of 71 MT/ha.
- b. **Resumption of Jaggery Production:** Commercial jaggery production restarted in Alangad after several decades, achieving a daily processing capacity of 80 kg.
- c. **Enhanced Farmer Incomes:** Farmers benefited from assured cane procurement by a locally managed processing unit, operated through community institutions, along with strong local demand for traditional jaggery.
- d. **Cultural and Community Revival:** The initiative successfully restored a heritage food product, strengthening community pride, cultural identity, and collective ownership.

Policy Objectives

- a. Revive sugarcane cultivation as a diversified and resilient crop in Kerala
- b. Restore traditional jaggery-making as a viable rural enterprise
- c. Promote chemical-free, safe, and nutritious sweeteners
- d. Strengthen farmer incomes through value addition and branding
- e. Protect and promote Kerala's food heritage

Policy Recommendations for Reviving Traditional Jaggery Production

It is recommended that the Government of Kerala adopt and scale the Alangadan Jaggery Revival Model as a state-sponsored programme, with the following:

A. Step-by-Step Approach

a. Identification of Sugarcane-Suitable Zones

Undertake district-wise agro-climatic mapping to identify panchayats suitable for sugarcane cultivation, prioritising areas with favourable soil and water conditions, existing cane-growing traditions, and demonstrated community interest.

b. Formation of Producer Groups

Organise farmers into clusters, Farmer Producer Groups (FPGs), or cooperatives to enable collective cultivation, bulk procurement of inputs, shared use of machinery, and coordinated supply of cane to jaggery processing units.

c. Introduction of Suitable Cane Varieties

Promote high-yielding, high-sucrose sugarcane varieties such as CO 86032, well adapted to Kerala's conditions and particularly suitable for traditional jaggery production in terms of recovery, colour, and flavour.

d. Skill Development and Capacity Building

Conduct regular hands-on training programmes on chemical-free cultivation, hygienic processing, improved boiling practices, and quality control, in collaboration with ICAR-Krishi Vigyan Kendras (KVKs) and line departments.

e. Infrastructure and Technology Support

Establish or upgrade jaggery units with modern yet appropriate technologies, including electrically operated crushers, improved boiling pans, energy-efficient smokeless furnaces, juice filtration systems, and basic quality-testing facilities to ensure consistency and food safety.

f. Brand Development and GI Tagging

Develop district-specific jaggery brands highlighting unique taste, texture, and traditional processing methods. Explore Geographical Indication (GI) tagging to protect authenticity, enhance market value, and prevent imitation.

g. Market Linkages and Assured Procurement

Strengthen market access by building partnerships with cooperatives, Kudumbashree units, organic and specialty food stores, e-commerce platforms, and public retail networks such as HortiCorp and SupplyCo for stable and assured sales.

B. Institutional Convergence for Impact

A statewide revival of traditional jaggery requires coordinated action across departments and institutions:

- Department of Agriculture – Lead farmer mobilisation, supply quality planting material, extend input subsidies, and facilitate crop insurance coverage.
- Department of Industries – Support establishment of jaggery units through machinery subsidies, entrepreneurship development programmes, and credit facilitation.
- Local Self-Government Institutions (LSGIs) – Anchor implementation at the grassroots level, mobilise farmer groups, ensure local ownership, and integrate the initiative with local development plans.
- ICAR-KVKs – Act as technology partners by providing scientific protocols, varietal demonstrations, capacity building, and standardisation of production and processing practices.

The successful revival of Alangadan Sharkara demonstrates the effectiveness of such convergence. In Ernakulam district, ICAR-KVK Ernakulam provided technical guidance and machinery support; the Alangad Grama Panchayat ensured community mobilisation and leadership; and the Alangad Service Cooperative Society managed infrastructure, operations, and marketing—creating a sustainable and replicable model.

C. Market Access and Brand Positioning

For long-term sustainability, traditional jaggery revival must be supported by strong and structured marketing strategies:

- Establish a state-level jaggery producers' collective or dedicated marketing federation to pool production, standardise quality, and improve price realisation.
- Leverage public sector retail platforms such as HortiCorp, Supplyco, and cooperative outlets for steady and predictable market access.
- Develop distinctive branding and attractive packaging that emphasise Kerala's cultural heritage, chemical-free processing, and health attributes.
- Position Kerala's traditional jaggery in both mainstream and niche health-conscious markets by narrating its story of revival, sustainability, and farmer empowerment.

D. Scaling Up without Compromising Quality

Expansion must be carefully managed to preserve product integrity and consumer trust. This can be achieved through:

- Adoption of proven sugarcane varieties such as CO 86032 across production zones.
- Continuous capacity building by KVKs to maintain hygiene, chemical-free production, and standard processing practices.
- Introduction of quality certification, batch-wise tracking, and basic traceability systems.
- Strategic alignment of sugarcane cultivation area with processing unit capacity to avoid raw material gluts or under-utilised infrastructure.

With coordinated policy support, institutional convergence, and strong brand positioning, Kerala can successfully revive its traditional jaggery sector—creating sustainable income opportunities for farmers while offering consumers a healthier, culturally rooted alternative to refined sugar.

Expected Outcomes

- Economic: Enhanced farmer income, rural employment, local enterprise development
- Cultural: Safeguarding traditional jaggery-making practices and heritage foods
- Health & Nutrition: Increased availability of chemical-free, nutrient-rich sweeteners
- Market & Tourism: Development of premium brands and agro-heritage tourism circuits

Conclusion

The revival of Alangadan Sharkara demonstrates that traditional food systems, when supported by science, institutions, and policy convergence, can become engines of rural prosperity. Scaling this model offers Kerala a strategic pathway to combine livelihood generation, public health, cultural preservation, and sustainable agriculture.

Expanding this initiative across Kerala can help the state re-establish itself as a hub for premium, chemical-free jaggery, safeguard the livelihoods of farming communities, and preserve an irreplaceable element of its culinary heritage. It is proposed that immediate policy adoption and budgetary support are recommended to institutionalise this model as a flagship initiative for reviving sugarcane farming and traditional jaggery production in Kerala.

IISR PGPR Capsule: An Encapsulated Biofertilizer for Sustainable Black Pepper Cultivation

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Executive Summary

The IISR PGPR Capsule, developed as an encapsulated biofertilizer for black pepper, addresses major constraints of conventional biofertilizers such as short shelf life, difficult handling and storage. Promoted by ICAR-KVK, Idukki, the technology was disseminated through 10 FLDs, 4 OFTs, 220 training programmes and 321 extension activities, reaching 9,404 farmers. Field results demonstrated improvements in spike number, berry production and dry yield, with yield per vine increasing from 2.0 to 2.5 kg (22%). The technology also reduced cultivation costs by 6%, increased net returns by 32.7%, and improved the B:C ratio from 1.94 to 2.37, indicating strong agronomic and economic potential for smallholder pepper farmers.

Between 2020 and 2024, PGPR capsules achieved horizontal spread across 350–400 ha and more than 1,900 farmers in major pepper-growing areas of Idukki, supported by demonstrations, capacity building, farmer-to-farmer learning and convergence with government schemes. The technology offers additional benefits through improved soil health, reduced dependence on chemical inputs and enhanced resilience to biotic and abiotic stresses. Scaling through subsidy support, KVK-led demonstrations and training, FPO and private-sector partnerships, crop-specific research, and systematic monitoring can accelerate adoption of PGPR capsules and contribute to sustainable, climate-resilient and profitable black pepper production in Kerala.

Background and Context

Black pepper (*Piper nigrum* L.), widely regarded as the “king of spices,” holds high economic significance in India, especially in Kerala. It is a key contributor to the country's spice exports and plays a vital role in the livelihoods of smallholder farmers. Kerala cultivates approximately 82,000 ha of black pepper, contributing to over 59% of India's total pepper area, with Idukki district alone accounting for 51% of the state's pepper land and 59.5% of production.

Despite its economic importance, black pepper productivity remains low due to soil fertility constraints, poor nutrient management, and biotic and abiotic stresses. Continuous use of chemical fertilizers has degraded soil health, leading to reduced microbial activity, nutrient mining, and heightened susceptibility to diseases such as foot rot (*Phytophthora* spp.) and drought stress.

Plant Growth-Promoting Rhizobacteria (PGPR) are proven to improve nutrient uptake, promote root development, enhance stress tolerance, and suppress soil-borne diseases. However, their adoption in black pepper has been limited due to short shelf life, difficult handling, and storage challenges of conventional liquid biofertilizers.

Solution: The development of PGPR capsules, an encapsulated biofertilizer formulation, offers a stable, user-friendly, and effective solution that ensures longer shelf life, easy transport, and targeted microbial delivery to the rhizosphere.

Problem Statement

Black pepper cultivation in Kerala faces multiple challenges:

1. **Soil fertility issues:** Nutrient deficiencies, low organic matter, and reduced microbial activity due to overuse of chemical fertilizers.
2. **Biotic stresses:** Susceptibility to foot rot disease and other soil-borne pathogens.
3. **Abiotic stresses:** Drought and other climate-induced stresses affecting plant growth and yield.
4. **Low adoption of biofertilizers:** Conventional PGPR products are difficult to handle, have short shelf life, and are inconvenient for smallholder farmers.

These factors contribute to low productivity, increased cultivation costs, and economic vulnerability of black pepper farmers.

Interventions Undertaken

ICAR-KVK, Idukki, in collaboration with line departments and development schemes, implemented the following interventions to promote PGPR capsule technology:

Activities	Number	Farmers Covered
Frontline Demonstrations (FLD)	10	58
On-Farm Trials (OFT)	4	30
Trainings	220	6,439
Extension Activities	321	4,120
Total	465	9,404



Key Strategies

- **Capacity building:** In-house, off-campus, and sponsored training programs for farmers.
- **Awareness generation:** Field demonstrations, method demonstrations, farmer-scientist interactions, and exposure visits.
- **Convergence with schemes:** Collaboration with Department of Agriculture, Spices Board, State Horticulture Mission, ATMA, and FPOs for subsidy-linked distribution and integration into crop health management programs.

Outcomes and Impact

a) Agronomic Performance

Farmers adopting PGPR capsules reported significant improvements:

Parameter	Pre-Intervention	Post-PGPR Capsule	% Increase
Number of spikes per vine	31.32	35.65	+13.8%
Average spike length (cm)	10.04	10.88	+8.4%
Number of berries per spike	90.43	113.7	+25.7%
100-berry weight (g)	5.05	5.20	+3%
Dry spike yield per vine (g)	127.4	160.2	+25.7%
Dry berry yield per vine (g)	111.5	138.7	+24.4%
Yield per vine (kg)	2.0	2.5	+22%

Result: The data clearly indicate that PGPR capsules not only promote plant health and root development but also substantially increase black pepper yield. Improvements in spike number, spike length, berry count, and dry yield collectively translate into **higher farm productivity and economic benefits**, validating the technology as a sustainable and cost-effective intervention for smallholder farmers.

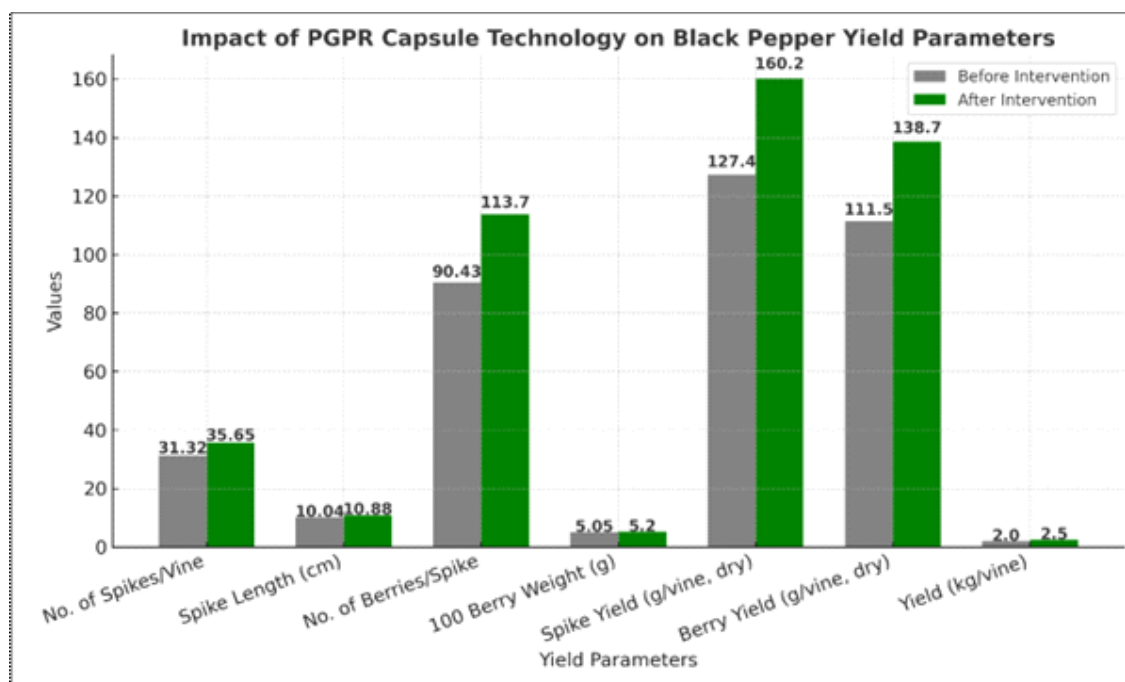


Fig. 1: Impact of PGPR capsule technology on black pepper yield parameters

b) Economic Impact

Cost & Return (₹/ha)	Before Intervention	After PGPR Capsule	% Change
Gross cost of cultivation	1,16,250	1,09,250	-6%
Net returns	1,09,250	1,45,039	+32.7%
Gross returns	2,25,500	2,51,289	+11.4%
BenefitCost Ratio (BCR)	1.94	2.37	+22%

Observation: PGPR capsule technology reduced reliance on chemical fertilizers, lowered cultivation costs, and improved profitability, thereby enhancing economic resilience for smallholder farmers.

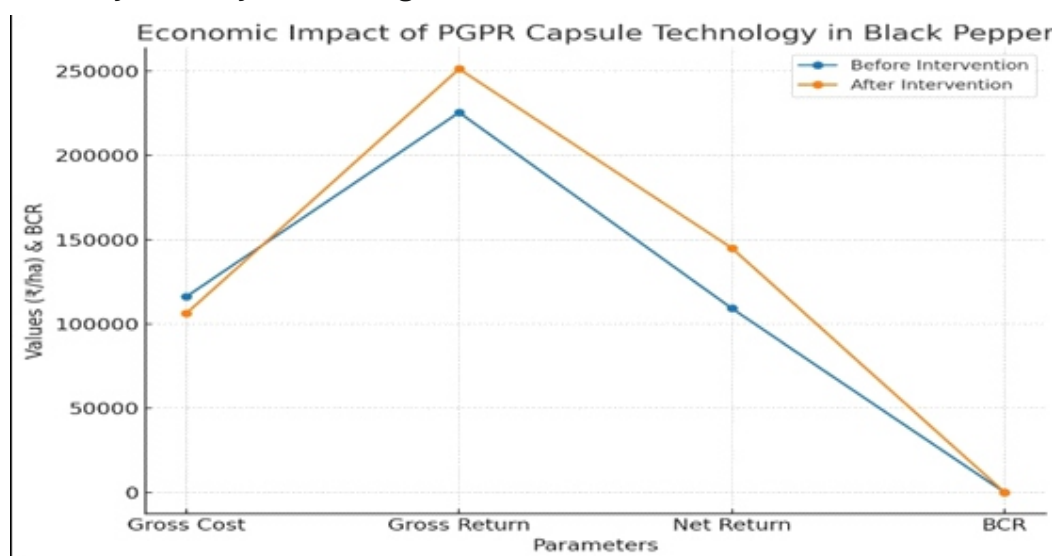


Fig. 2: Economic impact of PGPR capsule technology in black pepper

c) Additional Benefits

- Enhanced plant health and reduced mortality.
- Improved soil microbial diversity and soil fertility.
- Reduced chemical fertilizer and pesticide usage, contributing to environmental sustainability.
- Increased resilience against biotic and abiotic stresses.

Spread and Adoption

Between 2020 and 2024, the PGPR capsule technology achieved substantial adoption and dissemination across Idukki district, reflecting both the effectiveness of the intervention and the responsiveness of the farming community. During this period, the technology was implemented over an area of 350–400 hectares, reaching more than 1,900 farmers across major black pepper-growing blocks including Adimaly,

Nedumkandam, Kattappana, and Kumily. This coverage represented approximately 10–12% of the total target pepper-growing area, demonstrating significant traction for a relatively new biofertilizer innovation. The horizontal spread of the technology was facilitated through a combination of strategies: intensive capacity-building programs, hands-on field demonstrations, and method demonstrations, which allowed farmers to observe the tangible benefits of PGPR capsules on their crops. Additionally, peer-to-peer learning played a critical role in expanding adoption, as early users shared their experiences and encouraged neighboring farmers to adopt the technology. Convergence with government schemes and institutional support from KVK further ensured accessibility and affordability, enabling steady diffusion from small pilot plots to larger plantations and fostering sustainable, long-term adoption of PGPR capsules in the district.



Policy Implications:

- PGPR capsules represent a scalable, cost-effective, and sustainable biofertilizer solution for high-value crops like black pepper.
- Adoption of such microbial technologies aligns with National Mission on Sustainable Agriculture (NMSA), Paramparagat Krishi Vikas Yojana (PKVY), and National Horticulture Mission (NHM) goals on eco-friendly nutrient management.
- Enhanced use of PGPR can reduce chemical inputs, improve soil health, and contribute to climate-resilient agriculture.

Recommendations:

1. Promotion and Subsidy: Integrate PGPR capsule technology into state and central subsidy schemes for black pepper cultivation.
2. Capacity Building: Expand farmer training, demonstration programs, and field schools to accelerate adoption.
3. Research and Development: Support scaling, crop-specific adaptation, and long-term monitoring of PGPR capsules in black pepper and other spices.
4. Public-Private Partnerships: Encourage collaboration with input manufacturers and farmer producer organizations (FPOs) to ensure availability and affordability.
5. Monitoring and Evaluation: Establish robust mechanisms to track adoption, yield gains, and soil health improvements.

Conclusion

PGPR capsule technology offers a scientifically validated, economically viable, and environmentally sustainable solution for improving black pepper productivity in Kerala. Successful interventions in Idukki district demonstrate that encapsulated biofertilizers can enhance yields by up to 22%, increase net returns, reduce chemical fertilizer usage, and improve soil health. Scaling this technology through training, subsidies, and institutional support can strengthen the resilience and profitability of black pepper farmers, contributing to sustainable spice production and rural livelihood security in India.

Policy Brief 8

Promotion of Saffron Cultivation in Idukki District, Kerala-A *Climate-Smart, High-Value Crop Diversification Initiative*

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Executive Summary

Saffron (*Crocus sativus* L.), globally acclaimed as “Red Gold,” is among the most valuable spices due to its culinary, medicinal, and cosmetic applications. Traditionally confined to temperate regions such as Jammu & Kashmir, recent climate variability and technological advancements have opened new opportunities for its introduction into non-traditional high-altitude regions.

Preliminary trials conducted during 2023–24 by ICAR–Krishi Vigyan Kendra (KVK), Idukki, in Vattavada, Kanthallur, and Vandenmedu, demonstrated the feasibility of saffron flowering under select micro-climatic conditions of Kerala's high ranges. Although stigma yield was moderate, the results indicate strong potential for further refinement and scale-up.

This policy brief proposes a phased, research-backed, and market-oriented framework for promoting saffron cultivation in Idukki district, aligning with GoI priorities on crop diversification, doubling farmers' income,

Background and Context

Kerala's hill agriculture faces multiple challenges including:

- Declining profitability of traditional crops,
- Climate stress,
- Rising cost of cultivation, and
- Limited scope for horizontal expansion.

Idukki district, with elevations exceeding 1,500 m above mean sea level, cool night temperatures, and well-drained loamy soils, presents agro-ecological conditions comparable to saffron-growing regions. Introducing saffron as a high-value, low-volume crop can enhance farm incomes, particularly for small and marginal farmers, while conserving land and water resources.

Strategic Rationale

a. Agro-Climatic Suitability

The high-altitude tracts of Idukki district, particularly regions such as Vattavada, Kanthallur, and Vandenmedu, exhibit agro-climatic conditions that are conducive to saffron cultivation. These areas experience a cool temperature regime ranging from 0–20°C, especially during winter and early spring, which is critical for flower initiation and stigma development in *Crocus sativus*. The altitudinal advantage of locations above 1,500 m above mean sea level ensures lower night temperatures and reduced heat stress, closely resembling the climatic conditions of traditional saffron-growing regions. Additionally, the presence of well-drained loamy soils, rich in organic matter and free from waterlogging, supports healthy corm development and minimizes the risk of fungal diseases. Importantly, saffron cultivation is compatible with the existing high-range vegetable-based cropping systems, as it fits well into crop rotations with cabbage, carrot, and potato, allowing efficient land use without disrupting current farm practices. This compatibility enhances farmers' willingness to adopt saffron as a diversification option while maintaining food and income security.

b. Economic Significance

Saffron offers exceptional economic viability due to its very high market value per unit weight, making it one of the most remunerative spice crops in the world. Even small quantities of dried saffron stigma fetch premium prices in domestic and international markets, allowing farmers to generate substantial income from limited land holdings. The crop also has low bulk handling and storage requirements, as the harvested produce is lightweight, non-perishable when properly dried, and easy to transport, reducing post-harvest losses and logistics costs. Furthermore, saffron cultivation and processing—particularly activities such as flower harvesting, stigma separation, drying, grading, and packaging—are labour-intensive but skill-based, making it highly suitable for women-led and family-based enterprises. This characteristic aligns well with rural livelihood models in hill regions,

c. Policy Alignment

- National Mission on Sustainable Agriculture (NMSA)
- Mission for Integrated Development of Horticulture (MIDH)
- Hi-Tech Agriculture Mission (Kerala)
- ICAR's mandate on climate-resilient agriculture

Current Status of Saffron Trials

During 2023–24, ICAR–Krishi Vigyan Kendra (KVK), Idukki implemented pilot-scale saffron cultivation trials in select high-altitude locations of Kanthallur, Vattavada, and Vandenmedu using limited experimental plots. The trials successfully demonstrated flower initiation and blooming, confirming the basic agro-climatic suitability of these regions for saffron cultivation. Farmers and researchers observed moderate stigma yields, indicating the crop's production potential under local conditions. However, corm multiplication was found to be poor under open-field cultivation, underscoring critical constraints related to planting material management and micro-climate control. Overall, the trial outcomes validate the technical feasibility of saffron cultivation in Idukki while clearly emphasizing the need for protected cultivation structures, assured supply of quality corms, and focused capacity building of farmers to enable sustainable productivity and future scale-up.



Key Constraints and Challenges

1. Poor corm multiplication in open-field environments
2. Limited technical knowledge on:
 - Corm dormancy and handling
 - Flower induction cycles
 - Post-harvest drying and storage
3. Non-availability of certified, high-quality saffron corms
4. High initial investment costs
5. Absence of localized processing and drying infrastructure
6. Uncertain market linkages, branding, and quality certification

Policy Objectives

- Establish saffron as a niche high-value crop in Idukki high ranges
- Enhance income of hill farmers through crop diversification
- Develop localized production, processing, and marketing ecosystems
- Reduce dependence on imported saffron through domestic innovation
- Strengthen research–extension–market convergence

Policy Recommendations and Strategic Interventions

A. Research and Extension Support

- Formal collaboration with Sher-e-Kashmir University of Agricultural Sciences & Technology (SKUAST-K) and ICAR institutes for:
 - Cultivation protocols
 - Corm multiplication techniques
 - Protected cultivation models
- Establish Adaptive Research Trials (ARTs) under KVK leadership
- Develop location-specific Package of Practices for Kerala conditions

B. Input and Cultivation Support

- Subsidized supply of quality saffron corms through:
 - Horticorp
 - Farmer Producer Organizations (FPOs)
 - Agricultural cooperatives
- Promotion of mini polyhouses, low tunnels, and shade nets for:
 - Controlled flowering
 - Corm multiplication
- Inclusion of saffron under Hi-Tech Agriculture Mission cluster approach
- Financial assistance for initial establishment costs under MIDH/State schemes

C. Post-Harvest Management and Value Addition

- Establish community-level solar dryers or dehydration units
- Capacity building on:
 - Stigma separation
 - Scientific drying
 - Hygienic storage and packaging
- Encourage value-added products:
 - Herbal formulations
 - Natural cosmetics
 - Ayurvedic inputs

D. Marketing, Branding, and Certification

- Develop and promote “Idukki Saffron” as a niche premium brand
- Market linkage with:
 - Ayurveda industry
 - Spice exporters
 - Organic and gourmet markets
- Support for organic certification and quality standards
- Initiate Geographical Indication (GI) registration upon consistency in quality and volume

E. Institutional and Private Sector Engagement

- Pilot contract farming or buy-back arrangements with:
 - Agri-startups
 - Natural cosmetics and herbal product companies
- Strengthen FPO-led aggregation and marketing models
- Integrate saffron promotion with rural entrepreneurship and women SHGs

Monitoring, Evaluation, and Learning Framework

Key performance indicators (KPIs):

- Flowering percentage
- Stigma yield per unit area
- Corm multiplication rate
- Cost–benefit ratio
- Market price realization

Seasonal reviews by ICAR-ATARI, State Agriculture Department, and KVKs to guide:

- Continuation
- Course correction
- Gradual scale-up

Expected Outcomes

- Establishment of saffron as a climate-resilient niche crop in Kerala
- Enhanced farm income and livelihood security for hill farmers
- Creation of localized processing and marketing infrastructure
- Contribution to India's spice diversification and import substitution
- Strengthening Kerala's legacy as a premium spice-producing region

Conclusion

The pilot introduction of saffron cultivation in the high-altitude regions of Idukki district has demonstrated clear technical feasibility, as evidenced by successful flowering and acceptable stigma yield under local agro-climatic conditions. The results affirm that areas such as Kanthallur, Vattavada, and Vandenmedu possess the essential environmental parameters required for saffron growth, positioning the crop as a promising option for high-value crop diversification in Kerala's hill agriculture. At the same time, limitations observed in corm multiplication under open-field conditions highlight the need for targeted interventions, particularly protected cultivation, access to quality planting material, and enhanced farmer skills in crop and post-harvest management. With structured research support, extension-led capacity building, and policy-driven investment in infrastructure and market linkages, saffron can evolve from an experimental crop to a sustainable niche enterprise, contributing to income enhancement, climate resilience, and the long-term transformation of high-range farming systems in Idukki.

Policy Brief 9

Promoting Sustainable Honey Farming, Entrepreneurship, and Farmer Producer Organizations for Augmenting Farmers' Income

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Executive Summary

Sustainable honey farming offers a low-investment and eco-friendly livelihood opportunity for small and marginal farmers, landless workers, women, rural youth and tribal communities. In addition to income from honey and other bee products, beekeeping enhances pollination, crop productivity and biodiversity. ICAR-KVK Kasaragod has demonstrated a successful model through training of more than 1,000 farmers, entrepreneurship development, provision of beekeeping support, and facilitation of the Tulunadu Ecogreen Farmers Producer Company, which has about 1,500 members. Collective aggregation, processing, branding under “Ecogold”, quality management and market linkages have strengthened the economic viability of honey enterprises.

The experience highlights the need to mainstream beekeeping into agricultural extension and promote honey-based FPOs through access to finance, processing infrastructure, quality testing, certification, branding, digital marketing and entrepreneurship support. Convergence with schemes such as the Agri-Infrastructure Fund and stronger support from KVKs, agricultural universities and rural entrepreneurship institutions can facilitate scaling of the model. Such an integrated approach can enhance farmers' incomes while promoting pollination services, biodiversity conservation, women and youth entrepreneurship, and sustainable rural livelihoods.

Background and Rationale

Beekeeping represents a sustainable agri-allied activity that combines ecological conservation with income generation. It requires minimal land and investment, making it highly suitable for small and marginal farmers, landless workers, tribal communities, and women entrepreneurs. Honey production provides not only honey but also ancillary products such as beeswax, royal jelly, and pollen.

Beyond economic gains, bees play a critical role in pollination, improving crop productivity in horticulture, oilseeds, and pulses, thereby contributing to national food security. Sustainable honey farming relies on:

- Use of native bee species
- Natural hive management practices
- Minimal chemical inputs
- Conservation of forage biodiversity

These practices align with climate-resilient and eco-friendly agriculture.

Challenges: Despite its potential, honey farming faces obstacles including poor quality control, adulteration, limited processing facilities, weak branding, and fragmented marketing channels. Addressing these issues requires institutional support, training, certification, and market regulation.

Role of ICAR-KVK Kasaragod in Honey Farming and Entrepreneurship

ICAR-KVK Kasaragod has played a pivotal role in promoting honey farming as a sustainable livelihood and entrepreneurial opportunity:

- **Capacity Building:** Trained over 1,000 farmers on beekeeping, honey production, and value addition. Provided hands-on support and supplied bee hives for practical learning.
- **Entrepreneurship Promotion:** Organized programs for women, rural youth, and farmers to establish honey-based businesses. Many trained farmers have become successful master beekeepers and entrepreneurs.
- **Formation of FPOs:** With NABARD support, KVK facilitated the creation of the Tulunadu Ecogreen Farmers Producer Company in Kasaragod, now comprising 1,500 members. FPO membership provides access to collective resources, better prices, and market linkages.

• Infrastructure and Market Support:

- Aggregates honey and bee products to ensure uniform quality and volume.
- Established common infrastructure such as honey extractors and packaging units.
- Facilitated branding and certification under “Ecogold.”
- Trained members on good beekeeping practices, value addition, and traceability.
- Enabled direct market access to wholesale and retail buyers, eliminating intermediaries.

Impact

Honey farming has significantly improved livelihoods, particularly in tribal and forested regions with rich floral diversity. It also contributes to environmental sustainability by enhancing pollination and biodiversity.

Policy Context

India is one of the leading global producers of honey, with rising domestic consumption and export demand. Honey farming offers:

- Low input costs and high profitability
- Cross-sectoral benefits such as improved crop yields and biodiversity conservation
- Opportunities for rural entrepreneurship and women/youth empowerment

However, its potential remains underutilized due to fragmented efforts, lack of awareness, quality assurance challenges, and limited market access.

Recommendations**a. Integrate Beekeeping into Agricultural Extension:**

Include honey farming as a key income-generating activity in extension programs, especially in rain-fed, tribal, and hilly regions.

b. Promote Honey-focused FPOs:

Encourage the formation of FPOs under agriculture, rural development, and MSME schemes. Facilitate convergence with e-commerce platforms, trade fairs, and linkages to national/international buyers.

c. Provide Capital and Infrastructure Support:

Support FPO infrastructure (factory buildings, cold storage, bottling units, mobile processing vans) through the Agri-Infrastructure Fund. Offer startup grants and soft loans for micro-enterprises in honey and value-

d. Strengthen Quality Control:

Establish regional testing laboratories and enforce standards via FSSAI and APEDA to ensure honey quality and prevent adulteration.

e. Support Branding and Product Innovation:

Encourage GI tagging for regional honey varieties (e.g., Sundarbans Mangrove Honey, Kashmir Acacia Honey). Promote product diversification: flavored honey, medicinal honey, and honey-based cosmetics.

f. Develop National Honey Marketplace:

Create an e-marketplace under e-NAM to link FPOs with bulk buyers, retailers, and exporters. Incentivize youth- and women-led honey startups with training, incubation, and concessional finance.

g. Skill Development and Incubation:

Strengthen KVKs, RSETIs, and agricultural universities to provide skill development, entrepreneurship training, and incubation support for honey-based enterprises.

Conclusion

Sustainable honey farming offers a transformative opportunity for India's rural economy. Beyond boosting farmers' incomes, it conserves biodiversity, enhances crop productivity, and fosters rural entrepreneurship. Integrating honey farming into the FPO framework, coupled with policy support, market access, and innovation, can create a scalable, inclusive, and eco-friendly rural enterprise model. With targeted interventions, honey farming can become a golden pathway for income generation, ecological conservation, and Atmanirbhar Bharat.

Strengthening Gender Empowerment and Equality through Krishi Vigyan Kendras : Evidence from Women-led Agripreneurship Model in Kerala

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Executive Summary

Gender empowerment and gender equality are central to India's inclusive growth agenda, particularly within agriculture and allied sectors where women constitute a significant share of the workforce. Krishi Vigyan Kendras (KVKs), as district-level knowledge and technology dissemination institutions under ICAR, have emerged as effective platforms for enhancing women's skills, livelihoods, and entrepreneurial capacities. Evidence from KVK-led human resource development programmes demonstrates significant reductions in gender disparities in employment, income generation, and decision-making power among women beneficiaries.

This policy brief outlines the role of KVKs in advancing women's agripreneurship, identifies gaps in current implementation, and proposes a mission-mode framework under the Government of India to scale, institutionalize, and replicate successful women-led enterprises, with special reference to the Jaithri Foods model from Thrissur, Kerala.

Policy Context and Rationale

Women play a pivotal role in Indian agriculture, yet face systemic constraints including limited access to skills, credit, markets, and institutional support. National priorities such as *Atmanirbhar Bharat*, *Skill India*, *National Policy for Women*, *DAY-NRLM*, and *Doubling Farmers' Income* underscore the need for targeted interventions that enhance women's economic participation.

KVKs, with their mandate for technology assessment, refinement, and capacity building, are strategically positioned to address gender gaps by:

- Enhancing employability and self-employment opportunities for women
- Facilitating income diversification and value addition
- Strengthening women's leadership and decision-making roles at household and community levels

Key Findings and Evidence

a. Impact on Employment and Income

KVK-led skill development programmes have played a crucial role in facilitating women's entry into agriculture and allied sector employment while also ensuring continuity and sustainability of their livelihoods. The resulting enhancement of technical and entrepreneurial skills has led to substantial increases in income among women beneficiaries, reflecting clear improvements in their economic status and contributing to poverty alleviation. Beyond income gains, these interventions have strengthened women's financial independence and significantly enhanced their role in household-level economic decision-making, underscoring the broader empowerment outcomes of KVK initiatives.

b. Institutional Convergence

- Linkages with government schemes, banking institutions, and development programmes have amplified the impact of KVK interventions.
- Case studies demonstrate that KVK-led handholding transforms skill training into sustainable enterprises.

c. Transformational Outcomes

KVK interventions have enabled women-led collectives to progress beyond the role of trainees to become successful entrepreneurs, job creators, and mentors for other aspiring women. These transformational outcomes demonstrate the ability of KVK-supported agribusiness models to generate sustainable livelihoods while also highlighting their scalability and replicability across regions, thereby offering a robust pathway for inclusive and women-centric agricultural development.

Identified Gaps and Challenges

Despite progress, several structural constraints persist:

- Limited awareness among women regarding government schemes, credit facilities, and subsidies
- Lengthy and complex application procedures for loans and schemes
- Insufficient financial literacy and enterprise management skills
- Absence of structured feedback and monitoring mechanisms

These gaps restrict women's ability to fully leverage existing policy and financial support systems.

Policy Recommendations

a. Expand Outreach and Awareness

- Implement targeted awareness campaigns through KVKs using community engagement, SHGs, FPOs, Panchayati Raj Institutions, and local networks.
- Focus on rural, tribal, and underserved regions to ensure equitable access.

b. Strengthen Skill Development and Upskilling

- Align training programmes with emerging market demands in agri-processing, value addition, agri-services, and allied sectors.
- Introduce periodic needs assessments and impact evaluations to refine training content and delivery.

c. Promote Financial Literacy and Inclusion

- Integrate financial literacy, bookkeeping, savings, credit management, and investment planning into all women-focused KVK programmes.
- Facilitate linkages with banks, NABARD, and digital financial platforms.

d. Establish Robust Feedback and Monitoring Systems

- Create structured beneficiary feedback mechanisms to capture challenges, outcomes, and best practices.
- Use feedback for adaptive programme design and policy refinement.

Way Forward: Mission Mode for Women Agripreneurship

To institutionalize women's entrepreneurship in agriculture, a Mission Mode Programme anchored at KVKs is proposed, with the following service verticals:

a. Meet Your Mentor

- Regular mentoring sessions with successful women entrepreneurs, scientists, and industry experts to build leadership and enterprise capabilities.

b. See to Feel (Exposure and Learning)

- Exposure visits to successful women-led enterprises and agri-industrial units for experiential learning.

c. Source the Fund

- Simplified and facilitated access to credit, subsidies, and grants through convergence with SCSP, NRLM, PMFME, and banking institutions.

d. Launch the Venture

- Incubation, infrastructure, and technology support through KVKs, agri-incubators, and common facility centers.

e. Market Connect

- Participation in national and international trade fairs, exhibitions, and e-commerce platforms to strengthen market linkages and branding.

Case Study: Jaithri Foods – A Replicable Model

The Jaithri Foods women's collective from Pananchery Grama Panchayat, Thrissur, stands as a compelling illustration of the transformative impact of KVK-led interventions in promoting women's agripreneurship. The initiative began with systematic capacity building on fruit and vegetable value addition, complemented by advanced vocational training programmes that strengthened technical competence, quality control, and business understanding. Continuous mentoring and handholding by the KVK further enabled the group to translate acquired skills into entrepreneurial confidence and leadership. Comprehensive enterprise development support—including facilitation of institutional funding, procurement of modern processing



equipment, incubation services, and access to appropriate infrastructure—played a critical role in enabling the launch and subsequent expansion of the enterprise. These efforts were further strengthened through the establishment of the Peechi Agri-Industrial Park under the Mega Agri-Eco-Tourism Project, which provided state-of-the-art processing, packaging, and safety-certified facilities, creating a robust agri-industrial ecosystem. As a result, Jaithri Foods has achieved an annual turnover of ₹75 lakh, generated direct employment for 19 individuals, and supported indirect livelihoods for more than 500 farmers through organized cluster-based linkages.

This model clearly demonstrates how an integrated approach combining skilling, infrastructure, finance, and market access can effectively harness women's potential and convert it into a sustainable, scalable, and replicable agribusiness enterprise.

Conclusion and Policy Imperatives

In conclusion, the Jaithri Foods experience clearly demonstrates that KVK-led, integrated interventions can serve as powerful catalysts for women's empowerment and inclusive rural development. By systematically combining skill development, continuous handholding, access to finance, incubation support, and market linkages within a supportive agri-industrial ecosystem, KVKs have enabled women to transition from trainees to successful agripreneurs and employment generators. The tangible outcomes in terms of income enhancement, employment creation, and farmer linkages highlight the economic viability and social impact of such models. This evidence underscores the need for institutionalizing and scaling similar KVK-driven approaches across districts, positioning KVKs as nodal technology and capacity-building hubs for women's agripreneurship, and thereby advancing national goals of gender equality, livelihood security, and sustainable agricultural growth.

Policy Imperative

National, State, and Local Governments should formally recognize and designate Krishi Vigyan Kendras in each district as nodal agencies and technology hubs for implementing skilling, upskilling, and reskilling missions for women in agriculture and allied sectors.

Such an approach will accelerate inclusive growth, strengthen rural economies, and contribute significantly to India's gender equality and empowerment goals under the Government of India framework.



Kerala

Green Farms | Blue Waters | Sustainable Tomorrow

Kerala's agriculture and allied sectors hold immense potential for inclusive growth, food and nutritional security, and climate resilience. These policy briefs highlights key strategies and actionable recommendations to promote sustainable agricultural practices, strengthen value chains, enhance climate adaptation, and improve livelihoods of farming communities in Kerala.

Drawing on research and field experiences, it aims to support evidence-based policy and program decisions for a resilient, prosperous and green Kerala.



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