



# INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

## A Multi-Stakeholder Cultivation Model for Wild and Non-Conventional Edible Plants to Enhance Nutritional Security and Environmental Sustainability

Dr. Savita Borse

Associate Professor

S.M.R.K. Arts & Fine Arts, B.K. Commerce &

A.K. Home Science Mahila Mahavidyalaya, Nashik

### Abstract

Rising population and climate shifts are putting growing strain on land, ecosystems, and agriculture, a trend expected to worsen. Although hybridization and genetic engineering have enhanced productivity in select food grains, these interventions inadequately address nutritionally balanced food requirements. Contemporary dietary patterns provide insufficient essential nutrients, contributing to deteriorating public health and degenerative diseases. There exists an urgent imperative to make available scientifically validated food derived from locally available wild and non-conventional edible plants. Their cultivation offers multiple co-benefits - conservation of local biodiversity, gainful employment, carbon dioxide sequestration, and *in situ* rainwater conservation. While botanical explorations have documented the diversity of edible plants in India, existing information on wild edible species remains substantially incomplete<sup>[3]</sup>. This study proposes a scientifically designed cultivation model for wild, non-conventional edible, nutritionally important, and medicinal plants. Implementation across forest and barren lands would address food and medicine demand while facilitating carbon sequestration, wasteland utilization, and biodiversity conservation through domestication creating gene pools for future breeding programs.

### Keywords

Wild edible plants, non-conventional agriculture, biodiversity conservation, carbon sequestration, nutritional security, sustainable cultivation.

### Introduction

The global food system faces an unprecedented confluence of challenges - anthropogenic climate change, population growth, land degradation, and water scarcity collectively threaten agricultural productivity and nutritional security<sup>[9]</sup>. Modern agricultural practices, despite remarkable gains in caloric productivity, have eroded dietary diversity and marginalized nutrient-dense traditional food sources<sup>[13]</sup>. The Green Revolution's legacy includes systematic displacement of indigenous, locally adapted food systems. Wild and non-conventional edible plants represent an underexploited reservoir of nutritional and medicinal potential. These species possess inherent resilience to environmental stressors, require minimal inputs, and thrive on marginal lands<sup>[16, 7]</sup>. They frequently exhibit superior

nutritional profiles higher concentrations of vitamins, minerals, antioxidants, and bioactive compounds compared to domesticated counterparts [21, 22]. India's diverse agro-ecological zones harbor extensive wild edible species, yet systematic documentation and mainstream cultivation remain insufficient [3]. This study addresses this gap by proposing a comprehensive, multi-stakeholder cultivation model.

## Rationale

The reassessment of wild edible plants is grounded in four interrelated factors -

1. **Nutritional Security** - Urbanizing populations increasingly depend on energy-dense, nutrient-poor foods, correlating with rising obesity, diabetes, and micronutrient deficiencies [20]. Wild edibles provide bioavailable micronutrients and phytonutrients absent from conventional crops.
2. **Climate Resilience** - Wild species have evolved adaptive mechanisms to drought, temperature extremes, and poor soils, making them promising for cultivation under climate change where conventional crops may fail [2].
3. **Biodiversity Conservation** - Systematic cultivation reduces harvest pressure on natural populations and creates economic incentives for habitat conservation, while domestication provides *ex situ* gene pools [17].
4. **Carbon Sequestration** - Perennial wild edibles, especially trees and shrubs contribute to long-term carbon storage in biomass and soil organic matter.

## Objectives

1. To develop a replicable methodology for identifying, documenting, and assessing wild edible plant populations in target regions.
2. To establish protocols for nutritional analysis, recipe development, and sensory evaluation of prioritized wild edible species.
3. To design a multi-stakeholder cultivation model that quantifies carbon sequestration potential, estimates implementation costs and returns, and promotes commercial-scale domestication.

## Proposed Methodology

1. **Site Selection** - Site selection employs multi-stage sampling, comprising clusters of 5–10 villages characterized by a high natural occurrence of wild edible plants, documented traditional knowledge, diverse forest types, accessibility, and community willingness to participate.
2. **Botanical Inventory** - Botanical inventory involves seasonal sampling conducted across three distinct seasons per year by expert taxonomists with assistance from local informants. Quadrat sampling is employed with sizes determined by plant growth form: 5 m × 5 m for herbs, 10 m × 10 m for shrubs, and 20 m × 20 m for trees, allowing assessment of density, frequency, and abundance. Herbarium specimens are prepared and authenticated by the Botanical Survey of India.
3. **Ethnobotanical Survey** - A structured, door-to-door ethnobotanical survey is conducted to capture data on plant parts used, traditional preparation methods and recipes, frequency and quantity of consumption, collection practices, and medicinal applications. Species exhibiting population decline are listed as species of conservation concern.
4. **Nutritional and Anti-Nutritional Analysis** - Nutritional and anti-nutritional analysis quantifies proximate composition following AOAC methods; mineral content (calcium, iron, zinc, magnesium, potassium, phosphorus) using atomic absorption spectrophotometry; vitamin content (ascorbic acid, β-carotene, B-complex vitamins) via high-performance liquid chromatography (HPLC); phytochemicals (total phenolics, flavonoids, tannins) using spectrophotometric methods; and anti-nutrients including oxalates, phytates, cyanogenic glycosides, and trypsin inhibitors [4, 14].

**5. Recipe Development and Sensory Evaluation** - Professional chefs develop standardized recipes for edible parts of selected species. A sensory evaluation panel comprising 50–100 randomly selected individuals rates each recipe on a 10-point hedonic scale for attributes including appearance, aroma, taste, and overall acceptability. Recipes achieving a mean score of 7.0 or higher proceed to community validation under real-world conditions <sup>[8]</sup>.

**6. Species Prioritization** - Species prioritization is conducted using a multi-criteria decision matrix with the following weights: nutritional density (25%), sensory acceptability (20%), abundance/population status (15%), ease of propagation (15%), presence of multiple edible parts (10%), medicinal value (10%), and carbon sequestration potential (5%). Species attaining the highest composite scores are advanced to agronomic development.

**7. Agronomic Protocol Development** - Agronomic protocol development addresses propagation methods (seed pretreatment, vegetative propagation, nursery establishment), planting geometry and intercropping arrangements, organic nutrient management (green manuring, compost), irrigation scheduling (including rainfed production systems), pest and disease control with emphasis on biological control and host plant resistance, harvesting indices, and post-harvest handling. Adaptability trials are conducted to evaluate performance outside native ranges <sup>[18, 19]</sup>.

**8. Technology Transfer** - Technology transfer activities include the production of extension materials such as illustrated cultivation guides, recipe booklets, processing and value-addition manuals, and marketing and enterprise development resources. Training programs target farmers, self-help groups, and agricultural extension personnel, and demonstration plots are established on homesteads, community lands, and farmers' fields.

## Implementation Framework

### 1. Stakeholders and Roles

| Stakeholder                     | Primary Role                                  |
|---------------------------------|---|
| Forest Departments              | Land allocation, conservation oversight       |
| Horticulture/Agriculture Depts. | Technical support, extension, policy          |
| Research Institutions           | Documentation, analysis, protocol development |
| NGOs                            | Community mobilization, capacity building     |
| Corporate Sector                | Value chains, processing, marketing           |
| Farmer Cooperatives             | Cultivation, aggregation                      |

**2. Implementation Sites** - Degraded Forest areas, underutilized horticultural understories, barren agricultural lands, institutional lands, homestead compounds, urban landscapes, and vertical farming installations (select species).

**3. International Replication** - The framework is transferable to biodiversity-rich regions globally, requiring regional taxonomic expertise, local laboratory capacity, context-specific recipes, and appropriate partnerships.

## Environmental and Economic Benefits

- 1. Carbon Sequestration** - Mixed-species perennial systems project - Year 1 – 20 MT/ha dry biomass, 4 MT/ha carbon sequestered, plus ~2 MT/ha soil carbon. Years 2–5 – 25-35 MT/ha biomass, 5-7 MT/ha carbon annually. Mature plantations – 15-20 MT/ha biomass, 3-4 MT/ha carbon <sup>[1, 10]</sup>.
- 2. Biodiversity and Health Outcomes** - Benefits include *ex situ* and *in situ* conservation, habitat restoration, preservation of traditional knowledge <sup>[11, 12]</sup>, improved micronutrient status, enhanced dietary diversity, increased antioxidant intake <sup>[25]</sup>, and reduced dependence on processed foods <sup>[6]</sup>.
- 3. Economic Viability** - Revenue streams - direct product sales, planting material, ecosystem service payments (carbon credits, watershed protection), agro-tourism. Positive returns from year two onward <sup>[15]</sup>.

## Financial Analysis

The financial analysis indicates that survey and documentation costs amount to approximately INR 200,000 (USD 3,000) per village cluster over 12–18 months, covering reconnaissance, botanical inventory, household surveys, nutritional analysis, and recipe development. Plantation establishment costs INR 125,000 per hectare in the first year, INR 70,000 in the second, and INR 65,000 annually thereafter, with a cumulative cost of INR 260,000 by year three. Projected returns show a net loss of INR 125,000 in year one, followed by a net gain ranging from INR 35,000–85,000 in year three and INR 135,000–285,000 by year five.

## Recommended Species (Examples)

The recommended tree species for cultivation include *Cordia dichotoma* (Lasoda), valued for its fruit consumed fresh or in pickles; *Sesbania grandiflora* (Agasti), whose flowers and pods are used as vegetables; *Moringa oleifera* (drumstick), with edible pods and leaves; *Aegle marmelos* (bael), the fruit of which is processed into beverages and preserves; and *Madhuca indica* (mahua), yielding edible flowers and seeds for oil extraction <sup>[24]</sup>. Among herbs, shrubs, and climbers, the prioritized species comprise *Dioscorea bulbifera* (air potato), producing tubers and bulbils; *Momordica dioica* (spine gourd), cultivated for its fruits; *Amaranthus paniculatus* (rajgira), utilized for its leaves and seeds; *Carissa carandas* (karonda), a shrub bearing edible fruits; and *Embelia ribes* (false black pepper), valued for its medicinal fruits <sup>[5, 23]</sup>.

## Policy Recommendations

1. Establish a designated authority for wild edible plant conservation and commercialization.
2. Provide subsidies for planting material, organic inputs, and irrigation, comparable to conventional crops.
3. Allocate dedicated research funding for germplasm collection, varietal development, and value addition.
4. Develop streamlined IP mechanisms to prevent biopiracy while ensuring benefit-sharing.
5. Create market linkages, quality standards, and certification systems (including organic).
6. Integrate wild edible plantations into carbon credit methodologies.
7. Incorporate wild edible cultivation into agricultural extension curricula.

## Conclusion

The cultivation of wild and non-conventional edible plants represents an underexploited opportunity to address nutritional insecurity, biodiversity loss, land degradation, and climate change simultaneously. This study presents a scientifically rigorous, multi-stakeholder model integrating botanical inventory,

nutritional analysis, sensory evaluation, agronomic development, and economic assessment. Implementation across India's forest and barren lands would enhance food security, provide sustainable livelihoods, conserve biodiversity, and augment terrestrial carbon sinks. Initial investment (~INR 200,000 per village and per hectare) generates positive returns from year two while delivering environmental co-benefits. As climate change intensifies, the resilience, nutritional density, and ecological adaptability of wild edible plants become not merely advantageous but essential. Systematic domestication, drawing on traditional knowledge and modern science, offers a pathway toward sustainable, nutritious, and resilient food systems.

## References

1. Bajorun, T., Neerghen, V.S., & Aruoma, O.I. (2005). Phytochemical constituents of *Cassia fistula*. *African Journal of Biotechnology*, 4(13), 1530-1540.
2. Borse, S., & Patwardhan, A. (2011). Wild edible plants of Western Ghats. *Swayamprakash*, 1, 64-72.
3. Choudhury, D., Sahu, J.K., & Sharma, G.D. (2012). Value addition to wild edible plants. *Indian Journal of Traditional Knowledge*, 11(2), 242-249.
4. Deshmukh, B.S., & Shinde, V. (2010). Nutritional potential of wild edible plants. *International Journal of Pharma & Bioscience*, 1(2), 15.
5. Eze, J.M., & Maduewesi, J.N. (1990). Antinutritional factors in African vegetables. *Nigerian Journal of Plant Protection*, 13, 26-34.
6. Geetha Devi, V., & Prasad, J. (2016). Medicinal wild edibles of India. *International Journal of Advanced Research in Medical & Pharmaceutical Sciences*, 1(2), 6-9.
7. Hillocks, R. (2011). Indigenous vegetables for nutrition security. *African Journal of Food, Agriculture, Nutrition and Development*, 11(2), 4688-4707.
8. Joseph, A., Mathew, S., Skaria, B.P., & Sheeja, E.C. (2011). Nutritional evaluation of wild edibles. *Indian Journal of Natural Products and Resources*, 2(3), 286-291.
9. Kala, C.P. (2010). Medicinal and wild edible plants of Uttarakhand. *Journal of Forest Science*, 56(8), 373-380.
10. Khyade, M.S., Kolhe, S.R., & Deshmukh, B.S. (2009). Wild edible plants from Maharashtra. *Ethnobotanical Leaflets*, 13, 1328-1336.
11. Krishnaveni, A., & Santh Rani, T. (2009). Wild edible plants of Tamil Nadu. *Ethnobotanical Leaflets*, 13, 293-300.
12. Krishnaveni, A., & Santh Rani, T. (2011). Nutritional status of wild edibles. *International Journal of Pharmacy*, 2(2), 28-31.
13. Maikhuri, R.K., Nautiyal, S., Rao, K.S., & Semwal, R.L. (2000). Indigenous knowledge of wild edibles. *Indigenous Knowledge and Development Monitor*, 8, 7-13.
14. Makhija, I.K., & Khamar, D. (2010). Anti-nutritional factors in wild plants. *Der Pharmacia Lettre*, 2(5), 399-411.
15. Meher, A., Agrhari, A.K., & Padhan, A.R. (2011). Phytochemical screening of wild edibles. *IJRAP*, 2(5), 1501-1504.
16. Mensah, J.K., Okoli, R.I., Ohaju-Obodo, J.O., & Eifediyi, K. (2008). Nutritional value of wild vegetables. *African Journal of Biotechnology*, 7(14), 2304-2309.

17. Misra, S., Maikhuri, R.K., Kala, C.P., Rao, K.S., & Saxena, K.G. (2008). Wild edibles for food security. *Journal of Ethnobiology and Ethnomedicine*, 4, 15.
18. Modi, A.J., Khadabadi, S.S., Deokate, U.A., Farooqui, I.A., Deore, S.L., & Gangwani, M.R. (2010). Pharmacognostic studies of *Holarrhena antidysenterica*. *Journal of Pharmacognosy and Phytotherapy*, 2(3), 34-42.
19. Modi, A.J., Khadabadi, S.S., Farooqui, I.A., & Deore, S.L. (2010). *Wrightia tinctoria* - A review. *International Journal of Pharmaceutical Sciences Review and Research*, 2(2), 14-21.
20. Mohan, V.K., & Narnavar, S.D. (2003). *Kartoli - Spine Gourd*. Green Publication.
21. Oscarsson, K.V., & Savage, G.P. (2006). Composition of underutilized vegetables. *Food Chemistry*, 101, 559-562.
22. Polycarp, D., Afoakwa, E.O., Budu, A.S., & Otoo, E. (2012). Nutritional composition of wild edibles. *International Food Research Journal*, 19(3), 985-992.
23. Subhash, C., Sarla, S., Abhay, M.P., & Anoop, B. (2012). Wild edible plants of Madhya Pradesh. *International Research Journal of Pharmacy*, 3(5), 289-294.
24. Thakur, J., Sharma, S., Mukhija, M., & Kalia, A.N. (2013). Nutritional potential of wild edibles. *IJPRBS*, 2(6), 557-574.
25. Wang, T.S., Lii, C.K., Huang, Y.C., Chang, J.Y., & Yang, F.Y. (2011). Antioxidant properties of wild plants. *Journal of Medicinal Plants Research*.

