

Role of Economic Botany in Sustainable Development and Human Welfare

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Abstract

Economic Botany is an interdisciplinary branch of botanical science concerned with plants of direct or indirect value to human society. It examines the utilization, cultivation, management, conservation and economic significance of plants used as food, medicine, fibre, fuel, timber, beverages, oils, gums, resins, dyes, spices and industrial raw materials. In the context of increasing population pressure, climate change, biodiversity loss and resource scarcity, Economic Botany has acquired renewed importance for sustainable development and human welfare. Plant resources provide essential goods and ecosystem services while supporting agriculture, rural livelihoods, traditional healthcare, industries and local economies. This article reviews the role of economically important plants in food and nutritional security, healthcare, livelihoods, biodiversity conservation, sustainable agriculture, climate-change adaptation and the emerging bioeconomy. Particular attention is given to medicinal plants, neglected and underutilized crops, forest products, plant genetic resources, natural fibres and plant-based industrial products. Recent global policy frameworks emphasize that biodiversity conservation and sustainable use are fundamental to sustainable development. The 2025 FAO assessment of plant genetic resources highlights their importance for resilient and sustainable agrifood systems, while the WHO Global Traditional Medicine Strategy 2025–2034 emphasizes evidence, safety, sustainability and biodiversity in traditional medicine. The article finds that Economic Botany can contribute significantly to the Sustainable Development Goals by connecting plant biodiversity with food security, health, employment, poverty reduction, environmental sustainability and inclusive economic development. However, overexploitation, habitat destruction, climate change, genetic erosion, commercialization without benefit sharing and loss of traditional knowledge remain major challenges. The study recommends integrated conservation, sustainable harvesting, cultivation of medicinal and underutilized plants, value addition, community participation, scientific research, documentation of traditional knowledge and equitable benefit-sharing mechanisms. Strengthening Economic Botany education and research can therefore help transform plant diversity into a foundation for sustainable development and improved human welfare.

Keywords: *Economic Botany; plant resources; sustainable development; biodiversity; medicinal plants; food security; traditional knowledge; livelihoods; bioeconomy; human welfare.*

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Introduction

Plants have been fundamental to human civilization since prehistoric times. Human societies depend on plants for food, medicine, clothing, shelter, fuel, beverages, tools, agricultural inputs and industrial raw materials. The systematic study of these relationships forms the basis of Economic Botany. Unlike purely descriptive botanical studies, Economic Botany focuses on the practical, cultural, ecological and economic value of plants and their sustainable utilization. The importance of plant resources has increased substantially in the twenty-first century. Rapid population growth, urbanization, industrialization, climate change and unsustainable consumption are increasing pressure on natural resources. At the same time, biodiversity loss threatens the genetic and ecological resources needed for future food production, medicine and economic development. FAO emphasizes that biodiversity is indispensable to food security, sustainable development and the ecosystem services on which human societies depend. Plant diversity represents an important form of natural capital. Agricultural crops, wild relatives, medicinal plants, forest species, fruits, vegetables, oilseeds, spices, fibre plants and other useful species provide both direct products and indirect ecological services. Plant genetic diversity also provides options for developing crops capable of tolerating drought, heat, pests, diseases and other environmental stresses. The importance of plant genetic resources has been reinforced by the Third Report on the State of the World's Plant Genetic Resources for Food and Agriculture, published by FAO in 2025. The assessment drew on information from 128 countries, international research centres and more than 1,600 experts and examined progress and remaining challenges in the conservation and sustainable use of plant genetic resources.

Economic Botany is therefore no longer limited to the cataloguing of useful plants. It increasingly involves sustainable resource management, biodiversity conservation, climate resilience, value-chain development, traditional knowledge, biotechnology and the transition towards a plant-based bioeconomy. The relationship between Economic Botany and sustainable development is particularly important in India. India possesses substantial plant diversity and a long history of traditional plant utilization. Medicinal plants, cereals, pulses, millets, fruits, vegetables, spices, plantation crops, forest products, bamboo, fibres and oil-yielding plants contribute to agriculture, industry, healthcare and rural livelihoods. The Kunming–Montreal Global Biodiversity Framework adopted under the Convention on Biological Diversity provides a major international framework for biodiversity conservation and sustainable use. It establishes four long-term goals and 23 targets for 2030, including targets concerning sustainable use, restoration, financing, technology and benefit sharing. India's updated National Biodiversity Strategy and Action Plan 2024–2030 similarly recognizes biodiversity as fundamental to ecological stability, food security, climate resilience, livelihoods and human well-being. Thus, Economic Botany provides an important scientific and policy bridge between plant diversity, economic development and human welfare.

Objectives of the Study

The major objectives of this article are:

1. To examine the concept and scope of Economic Botany in the context of sustainable development.
2. To analyze the contribution of economically important plants to food and nutritional security.
3. To examine the role of medicinal and aromatic plants in human healthcare and livelihoods.
4. To assess the importance of plant resources in rural employment and economic development.
5. To examine the contribution of plant biodiversity and genetic resources to sustainable agriculture.
6. To analyze the role of Economic Botany in biodiversity conservation and climate resilience.
7. To identify major challenges associated with the unsustainable exploitation of plant resources.
8. To suggest strategies for sustainable utilization, conservation and value addition of economically important plants.

Review of Literature

Economic Botany and Human Welfare: Economic Botany has traditionally focused on the relationship between plants and human societies. Studies of useful plants demonstrate that plant resources form the foundation of many sectors of human activity, including agriculture, medicine, forestry, food processing and manufacturing. The economic value of plants extends beyond marketed commodities. Plants provide ecosystem services such as carbon sequestration, soil stabilization, water regulation, pollination support and habitat provision. Consequently, the economic importance of plants must be evaluated in terms of both market and non-market benefits.

Plant Genetic Resources and Sustainable Agriculture: Plant genetic resources constitute the biological foundation of sustainable agriculture. They include traditional varieties, modern cultivars, crop wild relatives, wild food plants and breeding materials. FAO's 2025 global assessment emphasizes their importance for sustainable agrifood systems and future adaptation to environmental and socioeconomic challenges. Genetic diversity enables plant breeders and farmers to develop varieties with improved resistance to drought, salinity, pests, diseases and temperature extremes. Conservation of traditional varieties and crop wild relatives is therefore essential for long-term food security.

Medicinal Plants and Traditional Knowledge: Medicinal plants have played an important role in traditional healthcare systems for centuries. Ayurveda, traditional Chinese medicine, African traditional medicine and numerous indigenous healthcare systems are closely associated with plant resources. The WHO Global Traditional Medicine Strategy 2025–2034 emphasizes evidence-based traditional medicine, safety, quality, sustainability, equity and respect for biodiversity and traditional knowledge.

Medicinal plant resources therefore have both healthcare and economic importance. However, excessive collection from wild populations can threaten vulnerable species. FAO has documented cases in India where unplanned harvesting and overexploitation of medicinal plants have resulted in declining populations and, in some cases, local extinction.

Neglected and Underutilized Plants: Neglected and underutilized species have received increasing attention because they can contribute to dietary diversity, climate resilience and rural livelihoods. Research has highlighted the importance of broadening the range of edible plants beyond major crops to improve food security and ecological sustainability. Millets, traditional pulses, indigenous vegetables, wild edible plants and lesser-known fruits can provide nutritional and economic opportunities while reducing dependence on a limited number of major crops.

Biodiversity and Sustainable Development: The Convention on Biological Diversity recognizes biodiversity conservation, sustainable use and equitable benefit sharing as interconnected objectives. The Kunming–Montreal Global Biodiversity Framework further integrates biodiversity with sustainable development, human well-being and economic transformation. FAO similarly emphasizes the integration of biodiversity conservation with sustainable agriculture and the protection of livelihoods of small-scale producers and Indigenous Peoples and local communities.

Role of Economic Botany in Sustainable Development

- a. **Contribution to Food Security:** The most fundamental contribution of plants to human welfare is food production. Cereals, pulses, oilseeds, fruits, vegetables, tubers, roots and spices form the basis of human diets. Major crops such as rice, wheat, maize, sorghum and millets provide energy, while pulses contribute protein and oilseeds provide dietary fats. Fruits and vegetables supply vitamins, minerals, antioxidants and dietary fibre. Economic Botany encourages the identification and sustainable utilization of a broader range of food plants. This is particularly important in the context of climate change, because diversified cropping systems can improve resilience.

Examples of economically important food plants

Plant group	Examples	Major economic significance
Cereals	Rice, wheat, maize, sorghum	Food security and livelihoods
Millets	Pearl millet, finger millet, sorghum	Nutrition and climate resilience
Pulses	Chickpea, pigeon pea, black gram	Protein and soil fertility
Oilseeds	Groundnut, sesame, mustard	Edible oil and industry
Fruits	Mango, banana, citrus, guava	Food, processing and trade
Vegetables	Tomato, onion, brinjal, leafy vegetables	Nutrition and employment
Spices	Turmeric, pepper, cardamom	Food, medicine and exports
Tubers	Cassava, sweet potato, yam	Food and starch

- b. **Nutritional Security:** Economic Botany contributes to nutritional security by promoting dietary diversification. Traditional plant foods can provide micronutrients and bioactive compounds that may be absent or insufficient in highly simplified diets. Underutilized crops and wild edible plants can serve as additional sources of nutrition, particularly for rural communities. Conservation of traditional food plants therefore has nutritional as well as cultural significance.
- c. **Medicinal and Healthcare Applications:** Plants are important sources of traditional medicines and bioactive compounds. Economically significant medicinal plants include *Azadirachta indica* (neem), *Withania somnifera* (ashwagandha), *Tinospora cordifolia* (giloy), *Aloe vera*, *Ocimum tenuiflorum* (tulsi), *Rauvolfia serpentina* and *Phyllanthus* species. Their significance extends across traditional medicine, pharmaceutical research, herbal products and wellness industries. However, commercialization must be accompanied by scientific validation, quality control, sustainable cultivation and conservation. WHO's current traditional medicine strategy specifically emphasizes evidence, safety, regulation, sustainability and appropriate integration into health systems.
- d. **Employment and Rural Livelihoods:** Plant resources generate employment throughout their value chains. Activities include cultivation, collection, harvesting, processing, transportation, storage, marketing and manufacturing. Non-timber forest products can be particularly important for forest-dependent communities. Forest ecosystems provide food, fuel, medicine, income and other resources, while also supporting biodiversity and ecosystem services. FAO notes the major contribution of forests to food security, nutrition and livelihoods. Sustainable commercialization of plant products can therefore contribute to poverty reduction and rural development.
- e. **Natural Fibres and Sustainable Materials:** Plants provide renewable fibre resources that can substitute, in some applications, for fossil-based or environmentally intensive materials.

Important fibre plants include:

- Cotton
- Jute
- Flax
- Hemp
- Coir
- Bamboo
- Sisal

Plant fibres are used in textiles, packaging, construction materials, ropes, paper and composite materials.

The development of biodegradable and renewable plant-based materials is particularly relevant to the transition towards a circular economy.

- f. **Forest Resources and Non-Timber Forest Products:** Forests are major reservoirs of economically useful plant resources. Timber provides construction materials and industrial raw materials, while non-timber forest products include fruits, leaves, flowers, seeds, gums, resins, fibres, medicinal plants and edible products. Sustainable harvesting can generate income without necessarily requiring the conversion of forests to alternative land uses. However, extraction levels must remain within ecological limits. Community-based forest management can improve conservation outcomes when local communities receive meaningful rights, incentives and benefits.
- g. **Plant Biodiversity Conservation:** Economic Botany can strengthen conservation by demonstrating that plant diversity has tangible economic, social and ecological value.

Species that are economically useful can receive greater attention for:

- Seed conservation
- Botanical gardens
- Germplasm banks
- Field gene banks
- Community conservation
- In-situ conservation
- Ex-situ conservation
- Habitat restoration

However, economic value should not become the sole criterion for conservation. Species with limited immediate commercial value may possess ecological, genetic or future potential.

The Kunming–Montreal Global Biodiversity Framework emphasizes conservation and sustainable use while recognizing the importance of biodiversity to human well-being.

- h. **Climate Change Adaptation:** Climate change creates major challenges for agriculture and plant-based livelihoods. Drought, heat stress, floods, salinity, pests and changing rainfall patterns can reduce crop productivity. Plant genetic diversity provides a resource for adaptation. Traditional varieties and crop wild relatives may contain genes associated with tolerance to environmental stresses. Therefore, conservation of plant genetic resources is an important component of climate-resilient development.
- i. **Sustainable Agriculture:** Economic Botany supports sustainable agriculture through:
1. Crop diversification
 2. Agroforestry
 3. Organic farming
 4. Integrated farming systems
 5. Conservation of traditional varieties
 6. Use of locally adapted crops
 7. Reduced dependence on external inputs
 8. Sustainable use of medicinal and aromatic plants

FAO's biodiversity strategy emphasizes sustainable use and management of biodiversity, conservation and restoration, sustainable food systems and protection of small-scale producers and local communities.

- j. **Plant-Based Bioeconomy:** The emerging bioeconomy provides new opportunities for Economic Botany. Plant biomass can be converted into food ingredients, natural dyes, pharmaceuticals, biofuels, bioplastics,

fibres, cosmetics, nutraceuticals and other value-added products. A sustainable plant-based bioeconomy can create rural employment while reducing dependence on non-renewable resources. However, bioeconomy development must avoid creating new pressures on biodiversity. Sustainable sourcing, life-cycle assessment, ecological safeguards and equitable benefit sharing are therefore essential.

Economic Botany and Sustainable Development Goals: Economic Botany is closely connected with several Sustainable Development Goals (SDGs).

SDG	Contribution of Economic Botany
SDG 1 – No Poverty	Plant-based livelihoods and rural enterprises
SDG 2 – Zero Hunger	Crops, wild foods and genetic diversity
SDG 3 – Good Health	Medicinal and nutritional plants
SDG 5 – Gender Equality	Women's participation in plant-based value chains
SDG 8 – Decent Work	Employment and entrepreneurship
SDG 9 – Industry and Innovation	Plant-based technologies and biomaterials
SDG 12 – Responsible Consumption	Sustainable utilization and circular bioeconomy
SDG 13 – Climate Action	Carbon sequestration and climate-resilient crops
SDG 15 – Life on Land	Plant biodiversity conservation
SDG 17 – Partnerships	Community, government and research collaboration

The integration of biodiversity into sustainable development is also explicitly recognized in the Kunming–Montreal Global Biodiversity Framework.

Findings of the Study: The major findings of the study are as follows:

1. **Plant resources are fundamental to human welfare:** Plants provide food, medicines, fibres, fuel, timber, industrial materials and numerous ecosystem services. Their contribution extends from household consumption to international trade.
2. **Economic Botany contributes directly to sustainable development:** The sustainable management of plant resources can simultaneously support economic development, environmental protection and social welfare.
3. **Plant genetic diversity is essential for future food security:** Traditional varieties, crop wild relatives and other genetic resources provide important material for crop improvement and climate adaptation. FAO's 2025 global assessment confirms the continuing importance of conservation and sustainable use of plant genetic resources.
4. **Medicinal plants have increasing economic and social importance:** Medicinal plants support traditional healthcare and growing herbal and wellness sectors. Their sustainable management is essential to prevent resource depletion.
5. **Underutilized plants represent an important opportunity:** Neglected crops and traditional food plants can improve dietary diversity, strengthen climate resilience and create new economic opportunities.
6. **Plant resources can support rural employment:** Cultivation, processing, value addition and marketing of plant products can generate employment and entrepreneurship opportunities in rural areas.
7. **Conservation and utilization must be integrated:** Conservation cannot be separated from sustainable utilization. Local communities should receive incentives to conserve resources while obtaining fair economic benefits.
8. **Traditional knowledge requires protection:** Traditional knowledge concerning medicinal, food and useful plants represents an important cultural and scientific resource. It should be documented ethically and protected from unauthorized commercial exploitation.

9. **Climate change increases the need for plant diversity:** Genetically diverse crops and resilient plant species can contribute to adaptation to changing environmental conditions.
10. **Scientific research is essential:** Modern biotechnology, genomics, phytochemistry, ecological monitoring and digital databases can strengthen the sustainable utilization and conservation of economically important plants.

Major Challenges: Despite its potential, Economic Botany faces several challenges.

- a. **Overexploitation:** Excessive harvesting of medicinal plants, timber and non-timber forest products can reduce natural populations.
- b. **Habitat destruction:** Deforestation, urbanization, mining, infrastructure development and agricultural expansion can destroy habitats of economically important species.
- c. **Climate Change:** Temperature increases, altered rainfall, droughts, floods and extreme weather events threaten plant diversity and productivity.
- d. **Genetic Erosion:** Replacement of traditional varieties by a limited number of modern cultivars can reduce genetic diversity.
- e. **Loss of Traditional Knowledge:** Modernization and generational changes can lead to the disappearance of traditional knowledge about useful plants.
- f. **Weak Value Chains:** Farmers and collectors often receive a small share of the final market value because of inadequate processing facilities, market information and bargaining power.
- g. **Unsustainable Commercialization:** Rapid commercialization without ecological safeguards can transform valuable plant resources into threatened resources.
- h. **Inadequate Research and Documentation:** Many economically useful plants remain poorly studied with respect to cultivation, phytochemistry, nutritional properties, ecological requirements and market potential.

Suggestions and Policy Recommendations

- **Promote Sustainable Cultivation:** Medicinal, aromatic, fibre and other commercially valuable plants should increasingly be cultivated rather than harvested excessively from wild populations.
- **Strengthen In-Situ and Ex-Situ Conservation:** Protected areas, community conservation areas, seed banks, botanical gardens, field gene banks and tissue-culture facilities should be strengthened.
- **Develop Plant-Based Rural Enterprises:** Governments and institutions should support small-scale processing units for herbal products, natural fibres, essential oils, spices, food products and other plant-based commodities.
- **Promote Value Addition:** Farmers should be encouraged to move from raw-material production to processing and value-added products. This can substantially increase income.
- **Strengthen Traditional Knowledge Documentation:** Traditional knowledge concerning useful plants should be documented with the participation and consent of knowledge-holding communities.
- **Ensure Equitable Benefit Sharing:** Commercial benefits derived from biological resources and associated knowledge should be shared fairly with local communities in accordance with applicable biodiversity and access-and-benefit-sharing frameworks.
- **Encourage Climate-Resilient Crops:** Research programmes should identify traditional varieties and crop wild relatives with tolerance to drought, salinity, heat, pests and diseases.
- **Improve Scientific Research:** Universities and research institutions should strengthen multidisciplinary research combining botany, ecology, biotechnology, pharmacology, agriculture, economics and social sciences.
- **Develop Digital Plant-Resource Databases:** Digital databases can document species distribution, traditional uses, conservation status, cultivation methods, genetic resources and market information.

- **Strengthen Economic Botany Education:** Economic Botany should receive greater emphasis in undergraduate and postgraduate curricula. Field studies, herbarium development, ethnobotanical surveys and community-based research can improve practical learning.
- **Encourage Women and Youth Entrepreneurship:** Training and financial support should encourage women and young people to establish enterprises based on medicinal plants, food processing, natural fibres, nursery production, floriculture and other plant-based activities.
- **Integrate Biodiversity into Development Planning:** Agriculture, forestry, health, industry, education and rural development policies should incorporate biodiversity conservation and sustainable plant-resource management.

Conclusion

Economic Botany occupies an important position at the intersection of plant science, human welfare, environmental sustainability and economic development. Plants are not merely biological organisms; they constitute essential natural capital supporting food systems, healthcare, livelihoods, industries, cultural traditions and ecosystem stability. The sustainable utilization of plant resources can contribute to poverty reduction, food and nutritional security, rural employment, healthcare, climate resilience and biodiversity conservation. At the same time, unsustainable exploitation can result in habitat destruction, genetic erosion and loss of valuable biological resources. Recent international developments reinforce the importance of integrating biodiversity conservation with sustainable development. The Kunming–Montreal Global Biodiversity Framework provides a global pathway for conserving and sustainably using biodiversity, while the 2025 FAO assessment highlights the continuing importance of plant genetic resources for resilient agrifood systems. The WHO Global Traditional Medicine Strategy 2025–2034 further demonstrates the increasing importance of evidence-based, sustainable and equitable approaches to plant-associated traditional medicine. For India, Economic Botany offers considerable opportunities because of the country's rich plant diversity, agricultural traditions and extensive indigenous knowledge. Medicinal plants, millets, traditional crops, spices, fruits, forest products, bamboo, natural fibres and other plant resources can contribute to a more inclusive and sustainable economy.

The future of Economic Botany should therefore move beyond simply identifying useful plants towards sustainable utilization, conservation, value addition, technological innovation, community participation and equitable benefit sharing. Greater collaboration among botanists, agricultural scientists, economists, pharmacologists, environmental scientists, policymakers, entrepreneurs and local communities is essential. Ultimately, the sustainable management of plant resources can help establish a stronger relationship between biodiversity conservation, economic prosperity and human welfare. Economic Botany can consequently become an important scientific foundation for achieving sustainable development and building a resilient, inclusive and plant-based green economy.

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