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We welcome the readers of Van Sangyan to write to us about their views and issues in forestry. Those who wish to share their knowledge and experiences can send them:

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The articles can be in English, Hindi, Marathi, Chhattisgarhi and Oriya, and should contain the writers name, designation and full postal address, including e-mail id and contact number. TFRI, Jabalpur houses experts from all fields of forestry who would be happy to answer reader's queries on various scientific issues. Your queries may be sent to The Editor, and the expert's reply to the same will be published in the next issue of Van Sangyan.

Cover Photo: Panoramic view of Achanakmar-Amarkantak Biosphere Reserve

From the Editor's desk

Non-timber forest products (NTFPs) are various resources derived from forests that are not primarily wood-based. These products include a wide range of goods such as fruits, nuts, seeds, resins, medicinal plants, fibers, honey, spices, mushrooms, and various other non-wood items. NTFPs are often collected, harvested, and processed by local communities who rely on forests for their livelihoods. NTFPs play a crucial role in the livelihoods of many rural and indigenous communities around the world. However, it's important to note that the sustainable management of NTFPs requires careful consideration of ecological and social factors. Overexploitation of these resources can lead to environmental degradation, loss of biodiversity, and negative impacts on local communities. Effective policies, community engagement, and collaboration between stakeholders are crucial to ensuring the long-term viability of NTFP-based livelihoods while also maintaining the health of forest ecosystems.

In line with the above this issue of Van Sangyan contains an article on Non-timber forest products (NTFPs): A potential source of rural livelihood in north-western himalayan region. There are also useful articles viz., Innovative bamboo products: The future of sustainable wood, Integrating sacred groves into forest management policies: Challenges and opportunities, Melia dubia: A good alternative for wood based industries, Bone setter plant-A miraculous herb for bone health, Role of agroforestry in organic farming, औषधीय और सुगंधित पौधे (हिमाचल प्रदेश), Forest trees seed certification: Need of the hour and From waste to fertilizer: Utilizing waste mica with potassium solubilizing bacteria for improved soil health.

*I hope that readers would find maximum information in this issue relevant and valuable to the sustainable management of forests. Van Sangyan welcomes articles, views and queries on various such issues in the field of forest science.
Looking forward to meet you all through forthcoming issues*

Dr. Naseer Mohammad
Chief Editor

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Non-timber forest products (NTFPs): A potential source of rural livelihood in north-western himalayan region

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Introduction

Non-timber forest products (NTFPs) are any product other than timber that is produced in forests. Non-timber forest products (NTFPs) are non-wood, minor, alternative and secondary forest products, useful substances /materials and/ or commodities obtained from forests. NTFP's are also defined as "any biological material other than timber that can be extracted from natural forest, managed plantations and that are used for subsistence or commercialization, or that have some type of social, cultural, or religious value". FAO defines Non-Timber Forest Products as "Products of biological origin other than wood derived from forests, other wooded land and trees outside forests. They may be gathered from the wild or produced in forest plantations and from trees outside forests." Non-Timber Forest Products (NTFPs) are used by human beings since time immemorial for a variety of purposes like food, fodder, fibre, traditional medicine, agricultural amenities, domestic materials, construction materials, and many of them

are associated with local cultural practices. (Vedeld *et al.*, 2007). Non-timber forest products (NTFPs) are crucial for rural livelihood improvement and sustenance in rural areas (Singh and Chatterjee, 2021). Livelihood refers to the "means of securing the basic necessities -food, water, shelter and clothing for life". Thus, livelihood is a set of activities, involving securing water, food, fodder, medicine, shelter, clothing and the capacity to acquire above necessities working either individually or as a group by using endowments. In addition to the villagers living in the forest fringe areas, other rural communities also harvest the NTFPs for earning cash by selling into the market for their livelihood. NTFP's are associated with socio-economic and cultural life of forest dependent communities inhabiting wide ecological and geo-climatic condition throughout the country. In India, an estimated 275 million poor people are dependents on NTFPs for at least part of their cash income, sustenance and livelihood (Pandey *et al.*, 2016)

Role of NTFP's in rural livelihood



Day-to-Day life

Non-Timber Forest Products (NTFP's) have historically been an integral part of the day-to-day needs and traditional lifestyle of indigenous people and local communities. Non-Timber Forest Products (NTFPs) play a significant role in day-to-day life in various ways:



Morchella esculanta



Pteridium aquilinum

Household and craft items

NTFPs are utilized in the production of household items and handicrafts. Materials such as bamboo, rattan, fibers, resins, and natural dyes are harvested from forests and used to create baskets, mats, furniture, traditional tools, decorations, and other artisanal products.

Energy and fuel

NTFPs serve as alternative sources of energy and fuel for cooking, heating, and lighting in many communities, particularly in rural areas. Biomass resources like firewood, charcoal, and biofuels derived from forest products contribute to fulfilling energy needs.

Personal care and cosmetics

Many NTFPs are employed in the manufacturing of personal care and cosmetic products. Natural ingredients such as essential oils, herbal extracts, waxes, butters, and plant-based fibers are

Food and nutrition

Many NTFPs serve as important sources of food, nutrition, and dietary diversity. Examples include fruits, nuts, seeds, mushrooms, honey, and various edible plants, contributing to our daily meals and enhancing our nutritional intake.

incorporated into soaps, lotions, shampoos, perfumes, and cosmetics.

Livelihood promotion and income diversification

Non-Timber Forest Products (NTFPs) play a crucial role in livelihood promotion and income diversification particularly in forest-dependent communities in following ways:

Income diversification

NTFPs offer opportunities for income generation. Local communities can collect, process, and trade NTFPs, creating economic activities that provide a source of income. This helps diversify income streams and reduce dependence on a single source of livelihood, such as agriculture.

Seasonal employment

NTFP collection often occurs seasonally, allowing communities to engage in additional income-generating activities



during specific periods. This seasonal employment helps supplement income and provides opportunities for individuals to participate in economic activities when agricultural activities are limited.

Value addition and processing

Value addition and processing of NTFPs can enhance their marketability and increase income potential. By converting raw NTFPs into higher-value products, such as processed foods, herbal medicines, handicrafts, or cosmetics, communities can capture more value along the supply chain.

Livelihood diversification

NTFPs provide a means for diversifying livelihoods. Forest-dependent communities often rely heavily on a single activity, such as agriculture, which can be vulnerable to environmental factors and market fluctuations. NTFP collection and trade allow communities to diversify their income sources, reducing vulnerability and enhancing resilience.

Sustainable Resource Management (SRM)

The sustainable harvesting of NTFPs promotes the conservation of forests and biodiversity. By adopting responsible collection practices and ensuring the long-term availability of NTFPs, communities contribute to environmental stewardship, which can result in more sustainable livelihoods and income streams.

Cultural preservation

NTFPs often hold cultural significance and are deeply rooted in traditional practices and knowledge. By engaging in NTFP-related activities, communities can preserve their cultural heritage and pass on traditional knowledge and skills to future generations, fostering cultural identity and cohesion.

Employment opportunities and poverty reduction

It is now widely acknowledged that NTFPs may help reduce poverty, especially for those who depend on the forest. In India, 40 percent of the total forest revenue and 55 percent of forest-based employment comes from Non-Timber Forest product. They are a vital source of fuel, fodder, food, medicine, building supplies, and livestock for millions of tribal and forest residents in India. More than 80% of forest dwellers in Orissa, Madhya Pradesh, Himachal Pradesh, and Bihar depend solely on NTFP, according to studies; 17% of landless people depend on daily wage labour, primarily consisting of NTFP collection; and 39% have NTFP collection as a secondary occupation. Collecting NTFPs can also be a source of income due to the growing economic value of NTFPs (Rasul, *G et al.*, 2008). In the J & K region of the North-Western Himalayas, Dwivediet *al.*, 2021 conducted a survey to evaluate the contribution of non-timber forest products (NTFPs) towards farmers' income. The survey's findings revealed that the overall gross and net income from Anardana was Rs7, 588.33 and Rs 5, 228.33 per kg with a cost benefit ratio of 3.34 and Kalazeera's overall gross and net income per kilogramme was Rs20, 566.67 and Rs17, 863 with a cost-benefit ratio of 7.94. In the Rajouri district, Anardana contributed 8.99% of all agriculture revenue, whilst Kalazeera contributed 49.45% in the Kishtwar district. Overall, NTFPs contributed 24.11% towards farm income.

Improving indigenous people's health care system



Over the course of history, medicinal plants have played a significant role in human wellness and continue to do so in forest dweller communities. Modern healthcare and medicine are frequently out of the reach of most people in rural areas since they are both expensive and difficult to get. But on the other hand, traditional medicines are locally available at low or free of cost (Shackleton et al, 2011). Medicinal plants are important in almost all the countries in the Asia and Pacific region. More than 80 percent of the

population in the developing countries of the region is believed to be dependent on medicinal plants for curing diseases. The Himalayan hills are the abode of medicinal and aromatic plants and the Western Himalaya excels in producing herbs of high medicinal value ever since Vedic times. In the Western Himalayan region, the sources of nearly 80 percent of Ayurvedic Medicines raw materials are existing which also contribute significantly to the national economy.

Table: 1 Some important medicinal plants used in pharmaceutical preparations

Botanical Name	Vernacular name
<i>Terminalia chebula</i>	Hararrh
<i>Terminalia bellirica</i>	Bahera
<i>Embelica officinalis</i>	Amla
<i>Glycyrrhiza glabra</i>	Yashtimadhu
<i>Justicia adhatoda</i>	Vasaka
<i>Withania somnifera</i>	Ashwagandha
<i>Cyperus rotundus</i>	Mustaka
<i>Tinospora cordifolia</i>	Gulanchara
<i>Berberis aristata</i>	Daruharidra
<i>Tribulus terrestris</i>	Gokshuru
<i>Aegle marmelos</i>	Bael
<i>Boerhaavia diffusa</i>	Punarnava
<i>Acorus calamus</i>	Vacha

(Samant et al., 2007)

Table: 2 Parts Used of Medicinal and Aromatic Plants for Economic and Health purposes

Botanical Name	Part (s) used
<i>Aconitum heterophyllum</i>	Rt
<i>Acorus calamus</i>	Rh
<i>Aegle marmelos</i>	Bk, Lf, Fr
<i>Aloe vera</i>	Ghritkumari
<i>Andrographis paniculata</i>	Shoot



<i>Asparagus racemosus</i>	Rt
<i>Berberis aristata</i>	Rt, St
<i>Bergenia ligulata</i>	Rh, Rt
<i>Boerhaavia diffusa</i>	Lf, Rt, Wp
<i>Cassia fistula</i>	Fr, Gum, Sd
<i>Centella asiatica</i>	Lf
<i>Cinnamomum tamala</i>	Lf
<i>Commiphora wightii</i>	Gum
<i>Curculigo orchoides</i>	Rt
<i>Dactylorhiza hatagirea</i>	Rt
<i>Derris indica</i>	Sd
<i>Eclipta alba</i>	Shoot
<i>Embelica officinalis</i>	Fr
<i>Eulophia campestris</i>	Rt
<i>Evolvulus alsinoides</i>	Wp
<i>Glycyrrhiza glabra</i>	Rt
<i>Gymnema sylvestre</i>	Sd
<i>Hedychium spicatum</i>	Rh, Rt
<i>Malaxis muscifera</i>	Rt
<i>Mucuna pruriens</i>	Sd
<i>Murraya koenigii</i>	Lf
<i>Myrica esculenta</i>	Bk
<i>Nardostachys grandiflora</i>	Rh/Rt
<i>Ocimum sanctum</i>	Lf
<i>Picrorrhiza kurrooa</i>	Rh, Rt
<i>Piper longum</i>	Fr
<i>Pistacia integerrmia</i>	Lf
<i>Plumbago zeylanica</i>	Rt
<i>Rauvolfia serpentina</i>	Rt
<i>Sapindus mukorossii</i>	Fr
<i>Saussurea costus</i>	Rt
<i>Solanum nigrum</i>	Wp, Lf
<i>Swertia chirata</i>	Wp
<i>Syzigium cumini</i>	Sd
<i>Terminalia arjuna</i>	Bk
<i>Terminalia bellirica</i>	Fr
<i>Terminalia chebula</i>	Fr
<i>Tinospora cordifolia</i>	St
<i>Tribulus terrestris</i>	Fr
<i>Valeriana jatamansi</i>	Rh
<i>Withania somnifera</i>	Rt

(Source: Samant et al., 2007)



Abbreviations: Rt = Root, Rh = Rhizome; Tb = Tuber; Bk = Bark; Wp = Whole plant; Lf = Leaf; Fr = Fruit; Fl = Flower; Res = Resin; Sd = Seed

NTFP's based bio-economy

NTFP-based bioeconomy refers to an economic model that revolves around the sustainable and value-added utilization of non-timber forest products (NTFPs). The bioeconomy aspect emphasizes the sustainable extraction, processing, and commercialization of these NTFPs to generate economic growth while promoting environmental and social well-being.

In an NTFP-based bioeconomy, the focus is on harnessing the potential of NTFPs in a manner that ensures the long-term viability of forest resources. This involves adopting sustainable harvesting practices, promoting biodiversity conservation, and fostering local community engagement and ownership. By adding value to NTFPs through processing, such as extraction, purification, and transformation into higher-value products, the bioeconomy seeks to maximize the economic benefits derived from these resources.

NTFP-based bio economies can have numerous benefits, including the diversification of rural economies, poverty alleviation, job creation, and the preservation of traditional knowledge and cultural practices associated with NTFP use. Moreover, the sustainable management of forests and NTFPs contributes to climate change mitigation, ecosystem

resilience, and the protection of biodiversity.

Constraints

However, there are also challenges associated with the sustainable management and harvesting of NTFPs. These include issues around governance and access to resources, as well as concerns around over-harvesting and unsustainable management practices. Addressing these challenges will require the involvement of multiple stakeholders, including governments, NGOs, and local communities.

Conclusion

The potential of NTFPs as a source of rural livelihoods is increasingly being recognized by governments and international organizations. However, there are still challenges need to be addressed, such as threats to forest-based resources from overharvesting, which might result in ecological imbalance and environmental degradation, are a key worry with the commercialization of NTFPs. Therefore, the sustainable use of resources should be explored with the active involvement of the community in order to maximize the advantages of NTFP commercialization. Beside this there are a number of additional issues that require addressing, including ensuring the equitable distribution of benefits, promoting sustainable harvesting practices, and addressing the impacts of climate change on NTFP availability and quality.

Overall, NTFPs have the potential to provide a valuable source of income and livelihoods for rural communities, while also contributing to the conservation of forest ecosystems.

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Innovative bamboo products: The future of sustainable wood

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Introduction

Bamboos, the most diverse group of plants in the grass family, are members of the Poaceae family's Bambusoideae subfamily (Gramineae). The world's tropical, subtropical, and mild temperate regions are home to bamboo, which are perennial plants that grow quickly. The geographic distribution of bamboo is mostly influenced by climatic factors like precipitation, temperature, altitude, and soil conditions. East Asia, South Asia, and Southeast Asia now have a higher share of the world's bamboo forests and nearly 80% of the world's bamboo species (Dlamini *et al.*, 2022). Tropical Asian nations between 15 and 25 North latitudes contain substantial areas of natural bamboo forest. Except for the Kashmir area, bamboo grows naturally everywhere in India. There are around 1,200 species of bamboo in 90 genera worldwide, according to an FAO estimate from 2007. About 125 native and 11 foreign species of bamboo from 23 genera are found in India. India's total bamboo-bearing area is estimated to be 15 million hectares (FSI 2021). According to recent government figures, India produced 16.22 million tonnes of bamboo in 2018-19 and Bamboo has been planted over 23756 hectares of non-forest land (Ministry of Agriculture and Farmers Welfare, Government of India). This included 12.8 million tonnes grown in natural forests and 3.4 million tonnes

cultivated in plantations. Bamboo regenerates fastly which is capable of restoring degraded lands and store carbon (Nkeuwa *et al* 2022). The use of many uncommon species has been promoted by the rise in demand for timber and the loss of natural forests. Bamboo has been used as timber for a very long time (Gill and Kumar, 2016). In subtropical and tropical areas, millions of people depend on bamboo for their everyday needs. Recent years' increased study has made significant contributions to our understanding of these crucial arborescent grasses as well as to better processing for broader applications (Liese, W 1987).

Bamboo culms are more robust, flexible, durable, and wear-resistant than wood. For use in both modern bio-based industrial and architectural applications as well as conventional furniture, all these qualities make bamboo a feasible substitute for the world's diminishing timber supply (Nkeuwa *et al* 2022). Bamboo is a great wood alternative that can be used for a variety of things, including furniture, house construction, roofing, flooring, walls, charcoal, cookware, ceiling, paper, and fabric (Ekhuemelo, 2018).

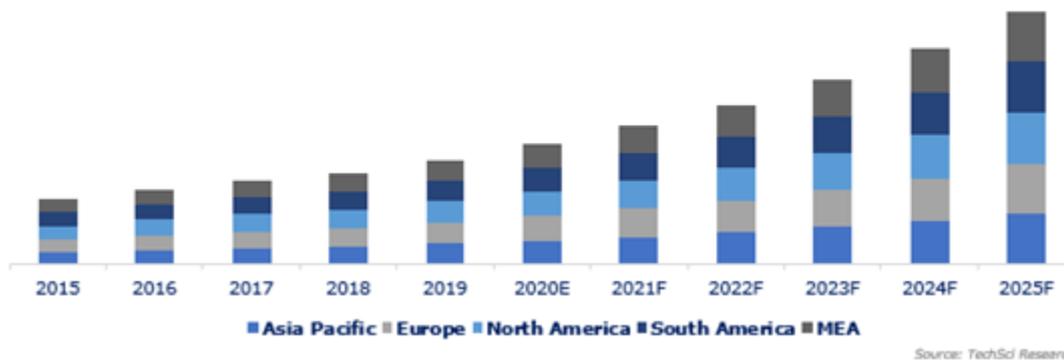
According to the Food and Agriculture Organization (FAO) of the United Nations, global bamboo production has been increasing steadily over the past decade, reaching 167 million metric tons in 2019.



Due to bamboo's expanding use across a range of industries, the worldwide bamboo market is anticipated to rise significantly over the coming years. The outstanding physical and environmental qualities of bamboo make it a valuable resource for end users. Furthermore, bamboo is quickly replacing wood in the production of paper, pulp, and board, driving up demand for

bamboo globally. *Bambusa Vulgaris* is anticipated to dominate the market, which is categorised by species, kind, structure, length, and region. Due to the widespread cultivation of bamboo in tropical and subtropical countries, particularly in India, China, Indonesia, and Vietnam, the Asia-Pacific region is predicted to dominate the global market for bamboo.

Global Bamboo Market Size, By Region, By Value, 2015-2025F



(Source: <https://www.techsciresearch.com/report/bamboo-market/4363.html>)

Bamboo based wood products

Different types of bamboo-based composites and wood substitutes (Pande, 2008).

Bamboo mat board

These are made of layers of woven bamboo mats that have been resin-impregnated and joined together in a hot press. Depending on the needed mat board thickness, it is often made by stacking three to nine layers of woven mats. A variety of common sizes and thicknesses can be made. Bamboo mat-veneer composite boards are made by interlacing wood veneers with bamboo boards to create thicker laminated boards. In comparison to plywood made from wood, bamboo mat boards are stronger, more

solid, and longer-lasting. They also withstand surface abrasion, insect invasion, harsh weather, and fire. In India, bamboo mat board is already produced in seven facilities.



Bamboo mat board

Use

It is a composite material made from bamboo mats and casein glue which can be used as an alternative to plywood in interiors



Bamboo mat corrugated sheets

This is an improved method for making bamboo mat boards that produce corrugated bamboo mat sheets instead of asbestos corrugated sheets, which are thought to be harmful to the environment and human health. When compared to asbestos cement roof sheets, bamboo mat corrugated roof sheets (BMCs) offer better properties such as hardness, resilience, and ductility. However, they still adhere to the same standards. BMCs also offer excellent fire resistance, use less energy, and are environment friendly. There are more than three facilities in India that make BMCs.

**Bamboo mat corrugated sheets****Use**

They can be used for packing and insulation purposes, as well as for roofing and walling in construction.

Flattened bamboo boards

Bamboo is cross-cut, divided into longitudinal strips, flattened, and planned for these boards. The strips are then combined into sheets using adhesive, heat, and/or UV radiation. These may be used for shuttering plywood, partitions, and panels. In India, there are five facilities producing flattened bamboo boards.

Use

They can be used for making furniture, flooring, and paneling in interiors.

**Flattened bamboo boards****Bamboo–jute composites**

Another great alternative to wood is a resin-bonded bamboo-jute composite with a jute composition of 35–40% (the ratio of bamboo to jute is 75:25). The goods are quite comparable to plywood and resin-bonded bamboo mat boards, but they are stronger and contain more resin, which lessens their sensitivity to moisture absorption and increases their resistance to usage in external applications. This composite is produced by a single production facility in West Bengal.

Use

They can be used for making textiles, mats, and handicrafts.

**Bamboo–jute composites****Bamboo flooring**

Laminate bamboo flooring, sometimes referred to as laminate bamboo parquet, is a distinctive style of flooring (block flooring). Only a few of its many



advantages include smoothness, stability, resistance to damage, sound insulation, resistance to moisture, resistance to pressure, and flexibility. High-quality bamboo culms with a minimum wall thickness of 12 to 15 mm and minimum diameter of 10 cm are cross-cut and divided into thick pieces, which are then planed for antifungal properties, bleached, dried, and glued together to produce sheets. These distinct layers are bonded to one another (either at the sheet level or at the level of the individual segment). After that, the bonded material is roughly cut to 900 x 90 x 15 mm in size, varnished, and heat-stabilized.

Use

It can be used for flooring in both residential and commercial buildings and is known for its durability and sustainability.



Bamboo flooring

Bamboo Ply woods

Bamboo plywood is formed of thin layers of parallel-laying bamboo strips. The stripes are kiln dried, smoothed, then bonded edge to edge to form a single ply panel. These panels are laminated again to generate multiple bamboo plywood with no formaldehyde emissions. To give stability and avoid warping, the numerous layers are cross laminated and heat pressed together.



Use

Utilized sensibly in construction applications such as doors, fences, house roofs, trusses and rafters.



Bamboo Ply woods

Bamboo handicrafts

Bamboo handicrafts are among the oldest crafts known to mankind. Thousands of people in India work full-time making crafts out of bamboo cane.

Use

They can be used as decorative items for homes, offices, and public spaces, as well as for gift items.



Bamboo handicrafts

Bamboo as a better choice than wood

Bamboo is a superior choice than other wood planks for a variety of reasons. Bamboo outperforms wood in terms of strength, eco-friendliness, water resistance, pricing, soil protection, and its role in influencing air quality. With regular care and maintenance, you may expect to use bamboo-made items for a longer amount of time. As a result of laxer rules; getting permission to harvest bamboo in India is

also simpler than getting permission to collect wood. As a result, bamboo is a practical and sustainable substitute for wood in India.

Institutions working on Bamboo based wood products

International Network for Bamboo and Rattan (INBAR), Bamboo Industries Development Association (BIDA), World Bamboo Organization (WBO), Indian Plywood Industries Research and Training Institute (IPIRTI), Bamboo Society of India (BSI), Cane and Bamboo Technology Center (CBTC), National Bamboo Mission (NBM), Bamboo and Cane Development Institute (BCDI) and North East Cane and Bamboo Development Council (NECBDC).

Conclusion

Bamboo is a flexible and sustainable substitute that may be used in place of wood in the number of applications. Bamboo plants with their rapid growth rate and ability to rejuvenate play an important role in reducing climate change by carbon sequestration. Bamboo-based wood products such as bamboo flooring, bamboo mat boards, and bamboo plywood are more popular as an environmentally friendly alternative to traditional structural wood products.

The usage of bamboo-based goods can help millions of people who rely on bamboo for their everyday needs. Bamboo-based wood products will continue to offer a viable answer to the problem of promoting sustainability in the forestry sector as more research and development is performed.

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Integrating sacred groves into forest management policies: Challenges and opportunities

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Introduction

Sacred groves are forest patches that local communities protect and revere for their religious, cultural, and ecological significance. They occur in various parts of the world, including India, where they harbor a rich diversity of flora and fauna as well as traditional knowledge and practices (Warrier *et al.*, 2023). They are known by various names such as orans, law kyntang, devarakadu, etc. Sacred groves are considered to be repositories of biodiversity, water resources, traditional knowledge and cultural heritage. They also provide various ecosystem services such as soil conservation, climate regulation, carbon sequestration and pollination. They host many endemic and endangered species of plants and animals and have a high carbon sequestration potential (Moradi & Shabanian, 2023).

However, sacred groves face many challenges and threats due to rapid socio-economic and environmental changes. These include deforestation, encroachment, overexploitation, pollution, climate change, loss of traditional institutions and values, and lack of legal recognition and support. These challenges endanger the conservation and management of sacred groves and their ecosystem services. Warrier *et al.* (2023) reported that 70% of the sacred groves in India are degraded due to various anthropogenic pressures. Therefore, there is

a need to integrate sacred groves into forest management policies and practices to ensure their conservation and sustainable use (Sharma & Kumar, 2021).

Overview of sacred groves

Sacred groves can be defined as “segments of landscape, containing vegetation, life forms and geographical features, delimited and protected by human societies under the belief that to keep them in a relatively undisturbed state is expression of an important relationship of humans with the divine or with nature” (Hughes & Chandran, 1998). Sacred groves are characterized by their diversity, size, location, ownership and management regimes. They may range from a few trees to hundreds of hectares, from plains to hills, from private to common lands, and from strict to flexible rules of access and use.

These are associated with various traditional beliefs and cultural practices that reflect the reverence and respect of local communities towards nature. Sacred groves are of great ecological importance for biodiversity conservation. They act as refuges and reservoirs for many endemic, rare, threatened and endangered species of plants and animals. They also maintain genetic diversity and evolutionary processes and contribute to the maintenance of ecological functions.

Challenges in integrating sacred groves into forest management policies



Despite their ecological, social and cultural value, sacred groves are facing several challenges that threaten their existence and integrity. Some of the major challenges are:

Lack of recognition and protection

One of the main challenges is the lack of adequate legal framework for the conservation of sacred groves in India. Although some sacred groves are located within protected areas or reserve forests, many others are outside the purview of formal forest laws and regulations. This makes them vulnerable to external pressures and conflicts. Moreover, there is no specific policy or legislation that recognizes the rights and roles of local communities in managing and conserving sacred groves. The existing forest policies and laws often ignore or undermine the customary norms and practices of local communities that have sustained sacred groves for centuries. For instance, the Indian Forest Act of 1927 and the Wildlife Protection Act of 1972 prohibit or restrict the collection and use of forest products from protected areas, which may affect the livelihoods and cultural practices of local communities dependent on sacred groves (Gadgil & Vartak, 1976).

Another challenge is the encroachment and degradation of sacred groves due to various factors such as population growth, poverty, migration, urbanization, industrialization, agriculture expansion, infrastructure development, mining, logging, etc. These factors may lead to the loss or fragmentation of sacred groves, or to the overexploitation or pollution of their resources. These factors may also affect the quality and quantity of water resources associated with sacred groves, such as

springs, streams, ponds, etc. Moreover, these factors may also erode or weaken the traditional beliefs and values that underpin the protection of sacred groves.

Institutional barriers

Another challenge is the limited institutional arrangements and coordination for the management of sacred groves in India. There is no clear or consistent definition or classification of sacred groves among various government agencies and departments. There is also no comprehensive inventory or mapping of sacred groves at the national or state level. This hampers the recognition and inclusion of sacred groves in forest management plans and policies. Moreover, there is a lack of coordination and collaboration among various agencies and organizations involved in forest management, such as the forest department, the revenue department, the panchayats, the NGOs, the research institutions and the local communities. This may lead to duplication, confusion or conflict of interests and responsibilities.

Another challenge is the lack of capacity for managing sacred groves among various stakeholders. There is a lack of adequate human, financial and technical resources for the conservation and management of sacred groves. There is also a lack of training and awareness on the ecological, social and cultural value of sacred groves. There is also a lack of scientific research and monitoring on the status, trends and impacts of sacred groves. Moreover, there is a lack of incentives and rewards for local communities for their contribution to forest conservation and restoration in sacred groves.

Conflicts between traditional practices and modern conservation strategies



Another challenge is the conflicts between traditional practices and modern conservation strategies for sacred groves. There may be differences in the perceptions, priorities and preferences of various stakeholders regarding the conservation and management of sacred groves. For example, some local communities may prefer to maintain their customary rights and practices over sacred groves, while some conservationists may advocate for stricter protection and regulation of sacred groves. Some local communities may value sacred groves for their cultural and spiritual significance, while some researchers may value them for their ecological and scientific significance. Some local communities may use sacred groves for their subsistence needs, while some outsiders may use them for their commercial or recreational interests.

These conflicts may result in tensions or disputes among various stakeholders over the access and use rights, benefits and costs, roles and responsibilities, and decision making and implementation processes related to sacred groves. These conflicts may also affect the effectiveness and sustainability of forest management interventions in sacred groves.

Opportunities for integrating sacred groves into forest management policies

Despite these challenges, there are also some opportunities and potential solutions for integrating sacred groves into forest management policies in India. Some of them are:

Enhancing biodiversity conservation

One of the opportunities is to enhance biodiversity conservation by incorporating traditional ecological knowledge and

practices into forest management policies and practices. Local communities have accumulated rich and diverse knowledge and practices on the identification, classification, use and management of various species and ecosystems in sacred groves. This knowledge and practice can complement and supplement the scientific knowledge and methods for biodiversity conservation. For example, local communities can help in identifying and documenting the endemic, rare, threatened and endangered species in sacred groves, as well as their uses and values. They can also help in developing and implementing appropriate management practices for the conservation and restoration of these species and their habitats.

Another opportunity is to establish ecological connectivity through sacred groves. Sacred groves can act as corridors or stepping stones for the movement and dispersal of various species across landscapes. They can also act as buffer zones or refugia for various species during environmental disturbances or changes. They can also act as sources or sinks for various species during population fluctuations or migrations. Therefore, sacred groves can enhance the resilience and adaptability of biodiversity to various threats and challenges. For example, sacred groves can help in maintaining the genetic diversity and evolutionary processes of various species. They can also help in mitigating the effects of habitat loss, fragmentation, degradation, invasion, pollution, etc.

Cultural preservation and community engagement

Another opportunity is to preserve cultural identity and heritage by recognizing and



respecting the traditional beliefs and values of local communities associated with sacred groves. Sacred groves are not only ecological assets but also cultural assets that reflect the history, identity, spirituality and worldview of local communities. They are also sources of inspiration, education, recreation and aesthetic pleasure for local people. Therefore, sacred groves can enhance the cultural diversity and richness of India. For example, sacred groves can help in preserving and promoting the languages, arts, crafts, folklore, rituals, ceremonies, festivals, etc., of local communities.

Another opportunity is to promote participatory approaches for community involvement in forest management policies and practices. Local communities have a stake and interest in the conservation and management of sacred groves. They have also demonstrated their capacity and willingness to protect and manage sacred groves for centuries. Therefore, sacred groves can enhance the social capital and empowerment of local communities. For example, sacred groves can help in strengthening the local institutions such as village forest committees, self-help groups, women's groups, youth groups, etc., that can participate in decision making and implementation of forest management activities in sacred groves.

Case studies and examples

There are some examples of successful integration of sacred groves into forest management policies and practices in India. Some of them are:

Orans in Rajasthan

Orans are traditional sacred groves found in Rajasthan. They are community forests, preserved and managed by rural

communities through institutions and codes that mark such forests sacred. Orans have significance for both conservation and livelihood. They harbour a rich diversity of flora and fauna, including many endemic and endangered species. They also sustain various water resources such as johads, nadis, talabs, baoris, etc., that provide water for irrigation, drinking and livestock. Orans also provide various forest products such as honey, herbs, fruits, nuts, medicinal plants, firewood, etc., for domestic consumption and market sale (Mohanty, 2023).

Orans have been integrated into forest management policies and practices through various initiatives by government agencies, NGOs and local communities. For example, the Forest Department of Rajasthan has recognized orans as a category of protected forests under the Indian Forest Act of 1927 and has issued guidelines for their conservation and management (Forest Department of Rajasthan, 2010). The department has also involved local communities in the preparation and implementation of microplans for orans under the Joint Forest Management scheme. Moreover, the department has supported the revival and restoration of orans through plantation, fencing, soil and water conservation measures, etc.

Another example is the work of KRPAVIS (Krishi AvamParisthitiiki Vikas Sansthan), an NGO that works on the revival of orans in Rajasthan. KRPAVIS has facilitated the formation and strengthening of local institutions such as Oran Bachao Samitis (Save Oran Committees) and Mahila Mandals (Women's Groups) that are responsible for



the protection and management of orans. KRPAVIS has also helped in documenting and mapping orans, conducting biodiversity surveys and assessments, organizing awareness campaigns and workshops, providing training and capacity building, mobilizing funds and resources, etc (KRPAVIS, 2020).

Law Kyntang in Meghalaya

Law Kyntang is sacred groves found in Meghalaya. They are protected by the local tribes of Meghalaya, especially the Khasis, who believe that U Basa or goddesses dwell among these thick and virgin forests. They forbid anyone from cutting the trees in these forests, and taking anything out, even a twig or leaf, is not allowed. Law Kyntang is rich in biodiversity, water resources, traditional knowledge and cultural heritage. They harbour many endemic, rare, threatened and endangered species of plants and animals. They also maintain the hydrological cycle and regulate the climate. They also serve as sources of inspiration, education, recreation and aesthetic pleasure for the local people (Dutta, 2023).

Law Kyntang has been integrated into forest management policies and practices through various initiatives by government agencies, NGOs and local communities. For example, the Forest Department of Meghalaya has recognized law kyntang as a category of community reserves under the Wildlife Protection Act of 1972 and has issued guidelines for their conservation and management (Forest Department of Meghalaya, 2019). The department has also involved local communities in the preparation and implementation of

management plans for law kyntang under the Community Reserve Management Committee scheme. Moreover, the department has supported the conservation and restoration of law kyntang through plantation, fencing, soil and water conservation measures, etc.

Another example is the work of NESFAS (North East Slow Food and Agrobiodiversity Society), an NGO that works on the conservation of law kyntang in Meghalaya. NESFAS has facilitated the formation and strengthening of local institutions such as Dorbar Shnong (Village Councils) and Niam Tre (Traditional Religious Institutions) that are responsible for the protection and management of law kyntang. NESFAS has also helped in documenting and mapping law kyntang, conducting biodiversity surveys and assessments, organizing awareness campaigns and workshops, providing training and capacity building, mobilizing funds and resources, etc (NESFAS, 2020).

Recommendations for policy and management

Based on the above discussion, some recommendations for policy and management of sacred groves in India are:

Policy reforms and legal recognition

- Establish legal protection for sacred groves by revising or enacting forest policies and laws that acknowledge the customary tenure and access rights of local communities over sacred groves, as well as their traditional knowledge and practices.
- Integrate sacred groves into national and regional forest policies and plans by identifying and



prioritizing the most important and threatened sacred groves for conservation and management, and by allocating adequate funds and resources for their protection and restoration.

- Develop and implement appropriate indicators and criteria for monitoring and evaluating the effectiveness of forest management interventions in sacred groves, and by reporting and disseminating the results and outcomes

Capacity building and institutional support

- Enhance institutional capacity for managing sacred groves by creating or strengthening local institutions such as village forest committees, self-help groups, women's groups, youth groups, etc., that can participate in decision making and implementation of forest management activities in sacred groves.
- Provide training and resources for effective implementation of forest management activities in sacred groves by developing and disseminating manuals, guidelines, best practices, etc., on various aspects of sacred grove conservation and management, such as biodiversity assessment, restoration techniques, conflict resolution, etc.
- Provide incentives and rewards to local communities for their contribution to forest conservation and restoration in sacred groves by developing and implementing benefit-sharing mechanisms, such

as payments for ecosystem services, eco-tourism, value addition, etc., that can enhance the livelihoods and well-being of local communities.

Stakeholder collaboration and networking

- Promote collaboration among government agencies, communities, NGOs, and researchers involved in forest management by establishing or strengthening platforms, forums, networks, etc., that can facilitate dialogue, exchange, coordination and cooperation among various stakeholders.
- Share knowledge and experiences for better management approaches by conducting or participating in workshops, seminars, conferences, publications, etc., that can disseminate information and knowledge on the ecological, social and cultural value of sacred groves, as well as the challenges and opportunities for their conservation and management.
- Foster partnerships and alliances for advocacy and action by engaging or involving various actors, such as media, policy makers, donors, etc., that can influence or support the conservation and management of sacred groves.

Conclusion

Sacred groves are an ancient and valuable tradition of forest conservation and management in India. They have immense potential to contribute to the conservation of biodiversity, water resources, traditional



knowledge and cultural heritage, as well as to the provision of various ecosystem services. However, they are facing several threats and challenges that require urgent attention and action. Therefore, there is a need to integrate sacred groves into forest management policies and practices by addressing the gaps and barriers in data, legal protection, institutional support, awareness and appreciation of sacred groves. This can help in ensuring the long-term survival and sustainability of sacred groves and the communities that depend on them.

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Melia dubia: A good alternative for wood based industries

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Abstract

The demand for timber and wood products in India far exceeds the country's forest resources, leading to a significant gap between supply and demand. To address this scarcity, the establishment of high-yielding plantations has become crucial. *Melia dubia*, an endemic tree species of Southeast Asia and Australia, has gained attention as an alternative species for timber, plywood, pulpwood, and fuelwood production. This article provides an overview of the distribution, silvicultural characteristics, and wood properties of *Melia dubia*. With its adaptability to various soil types and climates, the species can be effectively grown in several regions of India. *Melia dubia* is known for its rapid growth and commercial value in industries such as plywood, pulpwood, and lumber. Its wood is used for a wide range of applications, including packaging, furniture, interior decoration, and agricultural implements. Moreover, *Melia dubia* plantations offer economic benefits to farmers through buyback agreements and require less maintenance. Additionally, these plantations contribute to climate change mitigation and carbon sequestration. The fast-growing and versatile nature of *Melia dubia* makes it a promising option to bridge the gap between timber supply and demand in India while promoting sustainable agroforestry practices.



Introduction

The poor productivity of Indian forests and the country's small amount of forest land have led to a complete mismatch between supply and demand for home and industrial wood, as well as environmental instability. There is now a huge gap between the supply and demand of raw materials in the nation for businesses, including biomass energy, furniture, plywood, and pulpwood. The country's production in terms of MAI is among the lowest, and its forest wealth is not the only thing that is bad. Indian Forest has a modest MAI of 0.5-0.7 m³ ha⁻¹, compared to the world average of 2.1 m³ ha⁻¹.

India is projected to face a serious scarcity of timber supplies, both domestically and internationally. The global demand for wood is expanding at a 1.7% yearly. In 2020, 153 million cubic metres of wood



was consumed, up from 58 million cubic metres in 2005. Simultaneously, planted forest resources are inadequate to fulfil present demands. The potential for forest extension is restricted.

If supply cannot be increased by the development of high-yielding plantations, this trend leads to economic pressure that encourages commercial exploitation of naturally occurring forests. By using fast growing, quality planting, it allows for an earlier harvest, which helps to increase productivity. However, due to a severe scarcity of required raw materials, industries must establish plantations of required species in order to attain optimum production in a short rotation period. *Melia dubia* is one of the good alternate species that is ideal for plywood, timber, pulpwood, and fuel wood.

Distribution

It is an endemic plant of Southeast Asia and Australia in the Meliaceae family. It grows natively at altitudes of 600-1,800 m in India, particularly in the Sikkim Himalayas, Assam, Khasi hills, northern Bengal, hilly regions of Odisha, the Deccan Plateau, and the Western Ghats. It may be effectively grown throughout the major regions of India because to its wide range of adaptability. With an average yearly rainfall of at least 800 mm, the trees are grown in soil types including red, lateritic, and sandy loam. Maximum and lowest temperatures are, respectively, 30°C and 43°C. It grows naturally in places with 1000 mm of rainfall and 50-90% relative humidity.

Silvicultural characteristics

The *Melia dubia* tree is deciduous to semi-evergreen in nature, growing up to 25

metres tall with broad, spreading branches and attractive leaves. The bark is dark brown and fibrous, peeling off in broad rectangular pieces. Young branches is scurcy-tomentose, while adult branchlets are terete and glabrous. Growing in wastelands and in deciduous woodlands. The new leaves and blooms emerge in February and March after the leaves have shed in December and January. A 12–20 cm long auxiliary panicle with little, honey-scented flowers that arise in bundles with newly emerged leaves is the inflorescence. Fruit ripens in the winter season (October-February), with 3-4 seeds per fruit.

Wood properties

- There is no taste or smell to the wood, which has a dry feel and a polished appearance.
- Its specific gravity is only 0.34, making it incredibly light.
- It is prone to grey stains but ages neatly to a pale brown colour.
- The heartwood initially appears light pink to light red, but ages to become pale brown. The sapwood is greyish white, typically with a yellowish hue.
- 4.9% of the wood is water soluble and contains 0.9% ash.
- It has a solid edge, a straight grain, and a texture that is a little bit uneven.

Importance of *Melia dubia* as timber/wood industry

This tree's wood is mostly used in the plywood industry. It has been evaluated as a pulpwood alternative. The wood is also used for match box sticks, packing cases, pencils (the *Melia dubia* wood is used by the Nataraj pencil company), photo



frames, mini furniture such as benches, stools, wooden tables, windows, doors, interior decoration, musical instruments, wooden racks and packing industries, building purposes, cigar boxes, tea powder boxes, ceiling planks, and agricultural implements etc.

Melia dubia, also known as the money-spinner tree of short rotation, has several uses in the plywood, pulp wood, and lumber industries in addition to its quick growth and tolerance to different agro-climatic conditions across the nation. *Melia dubia*, a promising tree with a rotation of 8 to 12 years that is gaining economic importance in both local and worldwide markets. *Melia dubia* may reach a height of 40 feet within two years of being planted and, on a 10-year-old plantation, has the capacity to produce up to 40 tonnes of biomass per acre annually.

The minimum cultivation duration is six years, but for good economic value, it can be extended up to eight years. Its commercial cultivation is becoming more popular among farmers due to traits such as fast growing, stem straightness with fewer branches, reduced shading impact, and resistance to pest and insect assaults. Due to the numerous factors discussed above, agroforestry plantings are becoming more and more important commercially. Particular tree kinds, like *Melia dubia*, are becoming more and more popular since they generate guaranteed revenue through buyback agreements and require less maintenance.

Additionally, these trees help mitigate the effects of climate change and sequester carbon. In an acre, 400 trees may be

planted, and in 6–8 years, they will be worth 10–12 lakh rupees. It is a feasible source of fuel for biomass power plants due to its high calorific value. Due to a lack of natural resources and an ever-increasing need for timber for a different industrial uses, the fast-growing *Melia dubia* is becoming increasingly important.

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Bone setter plant-A miraculous herb for bone health

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Bone setter plant, botanically known as *Cissus quadrangularis* is a perennial succulent climbing plant belonging to the family of grapes, i.e., Vitaceae. It is commonly called veldt grape, the devil's backbone. There is an ancient quote saying the shape of the herb and its effect on certain parts of the body, i.e., "*Yatra akruthi tatra guna ahavasanthi*" for example stem of *Cissus quadrangularis* resembles the bones and joints in the body and indeed, it is very effective in treating the bone disorders and joint problems. In Sanskrit, it is known as Asthi samharaka, which saves bones from destruction. It is also named *Asthi sandhani*, *Asthi shrunkala*, which describes its peculiar quality of healing bone fractures. Denoting the same property has a few synonyms, like vajravati, vajravalli, asthisrnkhala, vajrangi, granthimala etc. Alternative names of bone setter plant are english- veldt grape, devil's backbone, adamant creeper Hindi-hadjod; Sankrit-Vajravalli, Asthisamharaka, Asthishrunkala; Kannada-Mangaravalli; Malayalam-Cannalamparanta; Tamil-Piranti, pirandai; Telugu-Nalleru; Gujarathi-Hadsankal; Marathi-Kandvel.

A hardy plant can grow in all types of soil and climatic conditions. Though the plant is grown as an ornamental plant along

fences and compound walls, the medicinal value of the plant is not known much. This plant can be grown in pots and is also a part of the terrace garden. It will give the walls and terraces an aesthetic look and serve the medicinal need. Many people hesitate to use this plant because of its itchy nature, but by handling properly, we can prevent itchiness in our hands. Always choose tender stems, as young stems can be easily broken with hands and thicken as it matures. Directly applying crushed stems on hands may lead to an itching sensation; to avoid this, apply some sesame or coconut oil before handling the plant parts.

Origin and botanical description

The species originated in India, Bangladesh and Sri Lanka. It is also found in Africa and Southeast Asia. The plant is described as an evergreen climber growing to 5 m (16 ft) with multiple branching. The stem is quadrangular-branched with 8 to 10cm long internodes. The edges of the stem are leathery. The leaves appear in each node, a trilobed and toothed shape 2-5 cm wide. Every leaf has a tendril emerging from the node's opposite side. The plant's flowers are called Raceme, small white or greenish flowers that bear globose berries upon ripening and become red.





Figure 1: Bone setter stem with leaf

Medicinal Properties / Biomedical

Action

Cissus quadrangularis is a rich source of medicinal value. Therefore, a clear understanding of its medicinal properties will help in better utilization for medicinal purposes. The herb is also called Asthisamharaka in Sanskrit, which means it saves bones from destruction.

- Taste: pungent, sweet
- Action: light, dry, unstable
- Potency: heating
- End taste: pungent
- Effect on dosha: vatahara, kaphahara

Other properties of the plant

- Bone Healing: the stem is a rich source of calcium, phosphorus and phytoestrogen steroids helps in faster regeneration and rapid mineralization during healing process of bone fractures.
- While treating fractures stem of this plant is crushed and its juice is used in bandaging.
- It helps to relieve pain and acts as a pain killer.

- It controls inflammation in the body.
- Herb exhibits intense antioxidant activity by scavenging free radicals.
- It has significant antiulcer properties by decreasing gastric secretions and by enhancing glycoprotein levels.
- The root extract of herb possesses depressant activity of the central nervous system.
- Herb is an essential constituent of 'Laksha Gogglu', an ayurvedic preparation which is highly effective in pain relief and inflammation and promoting the healing of simple fractures.

Soil and climatic conditions

Plants can be grown in any soil type, like sandy, loamy and clay soils. But it prefers well-drained sandy or loam soils with good moisture-holding capacity. It can also grow in poorly structured soil with lower nutrition. It can tolerate drought and does not need irrigation during summer months. But good irrigation improves the sap



content in stem and higher biomass production. The plant cannot grow in shaded condition and may produce weak, tender and poor branching may observe. It prefers warm, dry or moist soil for good growth.

Propagation and planting

Cissus Quadrangularis is a wild plant found in India, South Africa, and hot regions worldwide. This plant also survives and performs well in high-rainfall areas. This plant is not usually cultivated,

but it is now cultivated due to the demand for medicine. The plant is easy to propagate by stem cuttings with two to three nodes, in which one node is planted in the soil. Cutting takes 20-25 days to sprout and grow faster and reaches one foot height in 15 days after sprout initiation. The plant needs support for good and faster growth. This can be trained on fences, trees or modified structures such as RCC poles with top for a better spread.



Figure 2: Bone setter plant trained on concrete poles

Harvesting

Plants will be ready to harvest for medicinal use once they attain the sufficient canopy spread on poles or fences. The matured stems with tip portion may be cut selectively and shade dried for further use. It is also used as fresh in a few preparations. A perennial climber plant can be harvested anytime, depending on the need.

Food recipes

Besides using it for bone health, a few food recipes are popular among consumers in Tamil Nadu.

Chutney

It is prepared using the stem of plant chutney for consumption and is very popular among the people called *Pirandai chutney* in Tamil Nadu. Stem is peeled and boiled in water for 5 minutes. Add the onion, green chilli, salt, coconut and grind to a fine paste. It is the season with curry leaves and mustard. This is a delicious recipe for persons suffering from a cold and cough. People who complain of indigestion at least twice weekly can include this chutney in their diet. A



poultice made of this plant is also used extensively for treating sprains.

Pappad

Another way to consume this plant is by consuming pappads. It can be prepared as regular pappad preparation in the home. Water is added to stone-ground moong dal or rice flour; stem juice, pepper powder,

salt and pickling lime. It is pounded well to make it into soft, pliable dough and then made into pappads. In Tamil Nadu, the *Kallidaikurichi appalams* known for their taste and quality were always made with the stem juice of this plant, giving it a unique taste.



Figure 3: Hadjod (Pirandai) chutney and pappad



Role of agroforestry in organic farming

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Introduction

Ever since the Green revolution happened across the world, agriculture sawed its peak in terms of production. It introduced the usage of fertilizers, herbicides, pesticides, hybrid seeds etc. so as to meet the demands of the increasing population. This led to the practice of present-day agriculture also known as conventional agriculture. Though this practice was able to fulfil the hunger crisis across the world, it led to unsustainability and raised many concerns like that of food security, environmental pollution, climate change, increase in the green-house gases, global warming, soil erosion etc. In conventional agriculture, focus is mostly on a specialised crop / monoculture by increasing the efficiency of inputs like fertilizers etc without changing the structure and functions of the whole system so as to obtain increased yields. In order to tackle this issue, there came a new concept of agriculture into practice *i.e.*, Organic farming. Although organic farming can able to solve some of the constraints arose due to conventional farming but it is unable to eradicate it completely. Thus, agroforestry can be a very good option so as to increase the yields in a sustainable manner without causing any hampering to the basic structure of farming.

Organic farming

Organic farming came into limelight as an alternative to the conventional agriculture. According to Scofield (1986) organic farming doesn't simply means using of living materials, but it focuses on the concept of 'wholeness'. Even though organic farming constitutes for about only 1% of global agricultural land and less than 5% of the sales, it represents one of the fastest growing sectors in the field of agriculture across the globe. According to the modern definition given by Lampkin: "the aim of organic farming is to create integrated, humane, environmentally and economically sustainable production systems, which maximise reliance on farm-derived renewable resources and the management of ecological and biological processes and interactions, so as to provide acceptable levels of crop, livestock and human nutrition, protection from pests and disease and an appropriate return to the human and other resources". Organic farming prohibits the usage of synthetically produced pesticides and fertilizers, antibiotics in livestock feed etc. It emphasises on practices like crop rotation, cover cropping or mulching so as to improve soil quality. Weeds are removed by means of mechanic ways rather than following chemical methodology. Due to all these practices, higher biodiversity sustains than in conventional farming including insects, pests, soil biota, and even large birds and



mammals. Due to higher water holding capacity in the crops grown through organic farming, their yield hasn't shown any decline during drought days compared to that of crops grown by conventional farming which showed reduction in yield.

Criticisms faced by organic farming

- Despite of several advantages obtained from organic farming it showed many of the negative consequences. One of the major criticisms faced by organic farming is its lower yield compared to conventional farming. On an average, 20% to 25% reduction of yield was observed in organic farming (Kirchmann *et al*, 2009).
- In order to produce same yield as compared to conventional agriculture it requires more land to grow crops which in turn leads to more destruction of forests. Even though it is thought that organic farming is carried out in a sustainable manner it uses the same basic methodology as conventional farming.
- The issue of nitrogen leaching is not eradicated completely in organic farming. Even some studies showed that there was increase in the levels of nitrogen in the groundwater near the crops grown by organic farming. During the initial sowing of the cropfarmers undertake the practice of tillage in both the methodologies whether it is in conventional farming or it is organic farming. Though tillage helps in better water seepage into the ground as well the root growth, it causes the problem

of soil erosion, lowering of biological activity in the soil etc (Amundson *et al*, 2015).

- In order to tackle this issue the concept of zero tillage was adopted in organic farming. However it is not majorly practiced by the below margin farmers as it hasn't shown any impact in the increase in the yield of the crop. When the emission of green house gases per unit area basis was studied it showed less emission from the organic farms however when the yield gap in organic farming is taken into account, emissions per unit of output were higher in organic farms compared to conventional agriculture.

Advantages of integrating organic farming with agroforestry

- Agroforestry is one such approach where in trees are combined with crops or livestock. It is an age-old practice of cultivating trees on farm lands. In some of the tropical countries, crops of coffee and cocoa are cultivated in organic manner and are grown along with trees as these crops require shade to grow. Organic farming in many of the developed nations is usually getting monocultured and thus agroforestry will play a very important role in the crop diversification and intensification of agro-ecological relationships.
- Integrating agroforestry with organic agriculture will help to reduce the yield gap, as there will be a year-round supply of goods from trees as well as crops. Trees



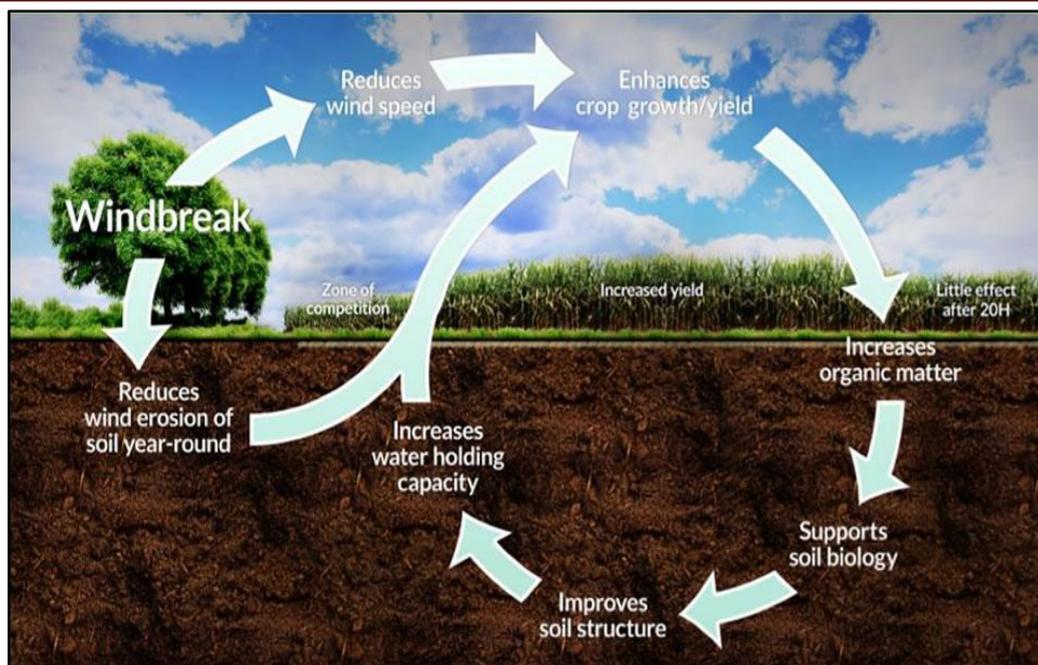
growing on the farm lands will become a source of fodder for the livestock and add nutrients to the soil. They play an important role in binding the soil particles, thus reducing the risk of soil erosion and leaching of the nutrients.

- Agroforestry also protect the crops from the extreme climatic conditions. They become the life line for the farmers of the harsh climatic regions. Windbreaks and shelterwood agroforestry systems act as a strong barrier towards high-speed winds, hot air etc. Livestock also gets protection from the trees during the period of scorching heat.
- The leaves of the trees growing on the farm lands can be used as mulch for the organic crops which will protect them from excessive evapotranspiration and also add nutrients to the soil. Agroforestry is also thought to improve the product quality of the organic crops. For e.g., protein content in wheat (Lin *et al*, 2001).
- Planting of Nitrogen fixing trees on the hedges while growing organic crops in the alleys cater the nitrogen requirement of these crops thus, reducing the dependency on

the chemical fertilizers. Trees also help in fixation of the soil organic carbon, nitrogen, phosphorous and many other nutrients along with improving many of the soil characteristics like soil porosity, acidic nature of the soils etc.

- Agroforestry can serve as natural controller for some of the crop pests, as trees harbour many birds, insects etc which will feed on these pests thus reducing their impact on the crops yield. E.g.: Trees harbour many of the birds like owls, eagles etc which will feed on the rodents destroying the crops.
- Organic farming paves a way for the new employment generation as it requires additional labour to take care of the crop growth. This will lead the farmers to additional investment which will be compensated by the agroforestry. Practising agroforestry will also provide aesthetic and recreational benefits to the farmers and also play an important role in preserving the local culture.
- Thus, integrating agroforestry with organic farming will pave a way for the development in the field of organic agriculture and increasing sustainability.





Source: <https://www.fs.usda.gov/nac/topics/soil-health.php>

Challenges of integrating organic farming with agroforestry

Though there have been found many advantages of integrating trees with organic crops still it is not practised in a wide manner. There have been many constraints regarding this issue such as high expenses for initial establishment, requirement of land agricultural lands, skilled and trained labour, lack of research etc.

Conclusion

It is sure that growing trees along with organic crops will ensure sustainability along with improving the quality of the yield. Thus, modern agroforestry systems should be developed which will ensure environmental benefits along with improving the economic status of the farmers.

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औषधीय और सुगंधित पौधे (हिमाचल प्रदेश)

चंद्रेश गुलेरिया और आरुशी मंड्याल

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परिचय

भारत में हिमालयी राज्यों विशेष रूप से हिमाचल प्रदेश में जैविक विविधता की एक विस्तृत श्रृंखला है। हिमाचल प्रदेश प्राकृतिक संसाधनों के साथ-साथ नृजातीय वनस्पतियों के व्यापक इतिहास का घर है। हिमाचल प्रदेश राज्य, जिसका कुल क्षेत्रफल 55.673 वर्ग किलोमीटर (आर्थिक और सांख्यिकी विभाग , हिमाचल प्रदेश) है, एक वनस्पति-भौगोलिक रूप से महत्वपूर्ण क्षेत्र है , क्योंकि राज्य के एक उष्णकटिबंधीय से एक अल्पाइन स्थलाकृति में अचानक परिवर्तन होता है , जो दृढ़ता से परिलक्षित होता है। राज्य के सामान्य वनस्पति पैटर्न, विशेष रूप से औषधीय और सुगंधित पौधों की विविधता और उनकी प्रचुरता के संदर्भ में , अपनी विविध जलवायु के साथ , राज्य औषधीय पौधों की लगभग 640 प्रजातियों का घर है जो इसके चार कृषि-जलवायु क्षेत्रों में फैले हुए हैं। 2,500 मीटर से अधिक की ऊंचाई पर , किन्नौर, लाहौल-स्पीति, कुल्लू, कांगड़ा के कुछ हिस्सों और शिमला जैसे आदिवासी क्षेत्रों में भारी मात्रा में औषधीय पौधे पैदा होते हैं। इन क्षेत्रों में कुछ महत्वपूर्ण औषधीय पौधे पाटीस , बतस्ताभ,

अतिस, ट्रेजेन, किरमाला, रतनजोत, काला जीरा, केसर, सोमलता, जंगली हींग , चार्मा, खुर्सानी अजवाइन, पुष्कर मूल , हौवर, धोप, धामनी, नेचनी, नेरी, धोप चेरेलू , शरगर, गग्गर और बुरांश, केजावो पाए जाते हैं।। वर्ष 2020-21 में औषधीय जड़ी-बूटियों का आऊट टर्न एवं मूल्य क्रमशः 2088 एवं 244950 (मूल्य '000 में) (वन विभाग हिमाचल प्रदेश) था। हिमाचल प्रदेश को औषधीय पौधों के हब के रूप में विकसित करने के लिए राज्य सरकार विभिन्न कृषि-जलवायु क्षेत्रों में औषधीय पौधों की खेती के लिए विभिन्न योजनाएं, नीतियां और किसानों को वित्तीय सहायता प्रदान कर रही है और औषधीय पौधों के संरक्षण को बढ़ावा दे रही है अतः किसानों को उनकी खेती के लिए प्रोत्साहित कर रही है। इसके अलावा, राज्य सरकार ने स्वस्थानी परिस्थितियों में प्रजातियों के आवास की नियमित निगरानी , स्थापना और संरक्षण को लागू किया है , और भारतीय हिमालयी क्षेत्र के अन्य क्षेत्रों में इस रणनीति को दोहराने की सलाह दी है। निवासियों के बीच जैव विविधता मूल्यों के प्रति जागरूकता पैदा की जा रही है और जैविक संसाधनों के संरक्षण और प्रबंधन में निवासियों की भागीदारी सुनिश्चित की जा रही है। उद्योगों के संगठित क्षेत्र



में वृद्धि के कारण औषधीय और सुगंधित पौधों की मांग बढ़ रही है। आयुर्वेदिक फार्माकोपिया समिति, भारत सरकार के अनुसार, भारत में स्वदेशी दवाओं के अवयवों के रूप में उपयोग की जाने वाली लगभग 1100 एकल दवाओं में से 350 पौधे आमतौर पर आयुर्वेदिक तैयारियों में उपयोग किए जाते हैं। इन 350 पौधों में से, हिमाचल प्रदेश में केवल 225 से अधिक प्रजातियां बढ़ रही हैं, जो वाणिज्यिक निष्कर्षण और बाहरी बाजारों में निर्यात के लिए उपलब्ध हैं। इसलिए, अच्छी आय बनाने के लिए औषधीय और सुगंधित पौधों का उचित मूल्य निकालना, औषधीय और सुगंधित पौधों की मांग को पूरा करना और लोगों को खेती करने के लिए प्रोत्साहित करना, ग्रामीण अर्थव्यवस्था के उत्थान के लिए अपनी आय को पूरक बनाना महत्वपूर्ण है, ताकि किसानों को नुकसान से बचाया जा सके और औषधीय और सुगंधित पौधों की खेती बढ़ाई जा सके।

औषधीय और सुगंधित पौधों के तहत योजनाएं मेहक योजना

हिमाचल प्रदेश सरकार ने वर्ष 2020-21 के दौरान सुगंधित पौधों (जंगली गेंदा कैमोमाइल, मुश्कबाला, चोरा, रोजमैरी, रोज जेरेनियम, लेमन ग्रास, तुलसी, पुदीना, साजेते) की खेती और उनके प्रसंस्करण को बढ़ावा देने के लिए मेहक योजना शुरू की है। हिमाचल प्रदेश के किसानों के लिए इस योजना का उद्देश्य ग्रामीण अर्थव्यवस्था का उत्थान करना है, खेती, प्रशिक्षण और मूल्य को बढ़ावा देना है, किसानों को मौसम की घटनाओं जैसे ओलावृष्टि और ठंड और बड़े

पैमाने पर जानवरों के हमलों से होने वाले नुकसान से बचाना है और सबसे महत्वपूर्ण औषधीय और सुगंधित पौधों की इत्र, स्वाद और मसाला उद्योगों के रूप में भारी मांग को पूरा करना है।

योजना के लक्ष्य और उद्देश्य:

- जंगली/आवारा पशुओं से प्रभावित क्षेत्रों में पारंपरिक फसलों के विकल्प के रूप में सुगंधित फसलों का विकास करना।
- उच्च मूल्य कम मात्रा वाले आवश्यक तेलों का उत्पादन करके किसानों की अर्थव्यवस्था को बढ़ाना।
- सुगंध उद्योग को आवश्यक तेलों और सुगंधित रसायनों की आपूर्ति के लिए सुगंधित पौधों की खेती और मूल्यवर्धन को बढ़ावा देना।
- बेरोजगार युवाओं के लिए किसानों का कौशल उन्नयन और रोजगार के स्रोत

राष्ट्रीय आयुष मिशन

राष्ट्रीय औषधीय पादप बोर्ड, आयुष मंत्रालय देश भर में किसान की भूमि पर औषधीय पौधों की खेती का समर्थन कर रहा है, उपलब्धता और बाजार की स्थिति और इसकी खेती की लागत के आधार पर 30%, 50% और 75% की दर से 140 औषधीय पौधों के लिए सब्सिडी प्रदान कर रहा है। राष्ट्रीय आयुष मिशन (NAM) कार्यक्रम में, आयुष मंत्रालय ने 56396 हेक्टेयर भूमि पर औषधीय पौधों के उत्पादन को प्रायोजित किया है।

योजना के दिशानिर्देशों के अनुसार, निम्नलिखित के लिए सहायता प्रदान की जाती है:

- किसान की भूमि पर प्राथमिकता के आधार पर औषधीय पौधों की खेती।



- गुणवत्तापूर्ण पौध सामग्री को बढ़ाने और आपूर्ति करने के लिए बैकवर्ड लिंकेज वाली नर्सरियों की स्थापना।
- फारवर्ड लिंकेज के साथ फसल कटाई के बाद का प्रबंधन।
- प्राथमिक प्रसंस्करण, विपणन बुनियादी ढांचा आदि।

हिमाचल प्रदेश में, राष्ट्रीय आयुष मिशन (NAM) ने वर्ष 2019-20 में औषधीय पौधों के लिए लगभग 128.94 लाख रु. की वित्तीय सहायता प्रदान की है। 25 लाख रुपये एक मॉडल नर्सरी (4 हेक्टेयर) के लिए और 12.5 लाख रु. दो छोटी नर्सरी (1 हेक्टेयर) के लिए, अतिस, कुटकी, कुठ, शतावरी, स्टीविया और सर्पगंधा की खेती के लिए 54.44 लाख रु. , और पोस्ट हार्वेस्ट मैनेजमेंट (ड्राइंग शेड और स्टोरेज गोदाम का निर्माण) के लिए 20 लाख रु. , लचीले घटक के लिए 17 लाख (राज्य में औषधीय पौधों की खेती पर सर्वेक्षण / अध्ययन और उनकी विपणन स्थिति, विपणन और आईईसी , क्रेता-विक्रेता बैठक (राज्य स्तर), गतिशीलता समर्थन) के लिए दिया है।

राष्ट्रीय औषधीय पादप बोर्ड , आयुष मंत्रालय , भारत सरकार ने भारतीय चिकित्सा पद्धति , जोगिंदर नगर, जिला मंडी में अनुसंधान संस्थान में उत्तरी क्षेत्र के क्षेत्रीय-सह-सुविधा केंद्र की स्थापना की है और छह पड़ोसी उत्तर राज्य पंजाब, हरियाणा, उत्तराखंड, उत्तर प्रदेश , चंडीगढ़ और हिमाचल प्रदेश में राष्ट्रीय औषधीय पादप बोर्ड के जनादेश का प्रचार और औषधीय पौधों की खेती और संरक्षण को बढ़ावा दिया है।



राज्य के लोगों को औषधीय पौधों के प्रति जागरूक करने के लिए आयुष विभाग द्वारा दो सप्ताह वृक्षारोपण अभियान 'चरक वाटिका ' चलाया गया जिसके अंतर्गत चरण-1, जिसमें 1167 आयुर्वेदिक चरक संस्थान और लगभग 11,526 पौधे लगाए गए और चरण- 2 (7 जून, 2021 में शुरू किया गया), शुरू किया गया।

वन समृद्धि जन समृद्धि योजना

हिमाचल प्रदेश सरकार ने जंगली जड़ी-बूटियों को बेचकर और निजी भूमि से उनके उत्पादन को बढ़ावा देकर रोजगार के अवसर पैदा करने के उद्देश्य से वन समृद्धि जन समृद्धि योजना (वीएसजेएसवाई) शुरू की है। अब प्रदेश के जंगलों से बिना वन विभाग की अनुमति के कोई भी औषधीय पौधे नहीं ले सकता और न ही बेच सकता है। गांव के निवासी जो भूमि के मालिक हैं और औषधीय पौधों की खेती करते हैं , योजना के लिए पात्र हैं। सरकार अपनी भूमि पर औषधीय पौधे उगाने वाले किसानों को 25% अनुदान प्रदान करती है। योजना के तहत सरकार रुपये की वित्तीय सहायता के साथ अनुमति देती है। औषधीय पौधों को इकट्ठा करने और उन्हें सरकार द्वारा निर्धारित मानक कीमतों पर बेचने के लिए गांवों में स्वयं सहायता समूहों को 10,000 रुपये राशि प्रदान करती है।

उद्देश्य:

- वनों, औषधीय पौधों और जड़ी-बूटियों की रक्षा और संरक्षण करना
- ग्रामीणों के लिए रोजगार के अवसर सृजित करना
- ग्रामीणों को सशक्त बनाना और उनके जीवन स्तर में सुधार करना

- ग्रामीणों और गांवों को आत्मनिर्भर बनाना
- JICA परियोजना के तहत, वन विभाग ने औषधीय पौधों और जड़ी-बूटियों के लिए एक हर्बल औषधीय सेल बनाया है और स्वयं सहायता समूहों को तकनीकी जानकारी और बाजार मूल्य (दैनिक मूल्य) प्रदान करता है।

औषधीय और सुगंधित पौधों के विपणन में समस्याएं

हिमाचल प्रदेश में औषधीय और सुगंधित प्रजातियों (एमएपी) पर प्रतिकूल प्रभाव डालने वाले प्रमुख मुद्दे हैं, जिनमें औषधीय और सुगंधित पौधों (एमएपी) की अवैध/अधिक/समय से पहले/असंगठित कटाई, उच्च मांग और गैर-पारदर्शी शामिल हैं। इन समस्याओं के अलावा, औषधीय और सुगंधित पौधों के उपलब्ध स्टॉक पर ज्ञान, प्रमुख एमएपी (MAP) प्रजातियों की खेती और कटाई के तरीकों के बारे में जानकारी की कमी, अंतिम उपयोगकर्ताओं और बिचौलियों के बारे में जानकारी की कमी और कच्चे माल की मात्रा पर अपर्याप्त जानकारी जैसे कुछ अंतराल हैं। औषधीय और सुगंधित पौधों के विपणन में प्रसंस्करण सुविधाओं की कमी, न्यूनतम समर्थन मूल्य का अभाव, विनियमित बाजारों की कमी, ग्रेडिंग के बारे में तकनीकी ज्ञान की कमी और परिवहन की उच्च लागत भी प्रमुख समस्याएं हैं। औषधीय और सुगंधित पौधों पादप उत्पादकों के लिए अवसर किसानों के लिए औषधीय पौधों की खेती के मुख्य लाभों में क्षेत्रीय बाजारों तक बेहतर पहुंच, गारंटीकृत बाजार और मूल्य (कम जोखिम), विशेष रूप से गैर-पारंपरिक फसलों के लिए,

सुनिश्चित और अक्सर उच्च रिटर्न, और उत्पादन इनपुट, मशीनीकरण और परिवहन सेवाओं तक बेहतर पहुंच शामिल है। औषधीय और सुगंधित पौधों की खेती, मौसम की घटनाओं जैसे ओलावृष्टि और पाला और बड़े पैमाने पर जानवरों के हमलों के कारण किसान के लिए जोखिम को कम करने में उपयोगी है। औषधीय पौधों के संसाधनों की कमी को रोकने और अंततः उनके विलुप्त होने को रोकने के लिए, हिमाचल प्रदेश सरकार कार्रवाई कर रही है और स्थानीय समुदायों की भागीदारी के साथ सहयोग कर रही है। गेहूं और धान जैसी फसलों के साथ-साथ इन औषधीय और सुगंधित फसलों की खेती करने का एक सबसे बड़ा फायदा यह है कि यह कीटनाशकों पर होने वाले खर्च को काफी कम कर देता है। महक योजना के तहत (मार्च, 2023) पहाड़ी क्षेत्रों में औषधीय और सुगंधित पौधों की खेती और प्रसंस्करण के लिए चंबा जिले के भटियात विकास खंड के 30 बागवानों के एक समूह के साथ 6 दिवसीय आवासीय प्रशिक्षण, CSIR-Central Institute of Medicinal and Aromatic Plants (CSIR-CIMAP), (सीएसआईआर-सेंट्रल इंस्टीट्यूट ऑफ मेडिसिनल एंड एरोमैटिक) लखनऊ में आयोजित किया गया था। सीएसआईआर-इंस्टीट्यूट ऑफ हिमालयन बायो रिसोर्स टेक्नोलॉजी (सीएसआईआर-आईएचबीटी), पालमपुर (CSIR-Institute of Himalayan Bioresource Technology (CSIR-IHBT), Palampur से तकनीकी सहायता और मार्गदर्शन के साथ, किसान सफलतापूर्वक ब्लॉक में 1100



मीटर से अधिक ऊंचाई पर जंगली गेंदा की खेती कर रहे हैं। इसके परिणामस्वरूप जंगली गेंदे से निकाले गए तेल की मांग बढ़ गई है। 300 से अधिक किसान जंगली गेंदे की खेती कर रहे हैं और लगभग 300 किलोग्राम तेल का उत्पादन कर रहे हैं , अधिकारियों के अनुसार , वे तेल से 12000 से 14,000 रुपये प्रति किलोग्राम की कीमत कमा रहे हैं जो उन्हें अन्य फसलों की तुलना में अधिक मुनाफा दे रहा है।
निष्कर्ष

औषधीय और सुगंधित पौधे (एम एंड एपी) न केवल स्थानीय स्वास्थ्य देखभाल प्रणालियों में योगदान करते हैं बल्कि लोगों की निर्वाह अर्थव्यवस्था में भी महत्वपूर्ण भूमिका निभाते हैं (विशेष रूप से पहाड़ियों , पहाड़ों और ग्रामीण इलाकों में रहने वाले)। एमएंडएपी (M & AP) के महत्व को समझते हुए राज्य सरकार हिमाचल को देश का 'हर्बल राज्य' बनाने के लिए औषधीय पौधों की खेती को प्रोत्साहन दे रही है। उन पहलों के परिणामस्वरूप , औषधीय और सुगंधित पौधों (MAPs) की खेती राज्य में बढ़ रही है।



Forest trees seed certification: Need of the hour

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In past few decades greater emphasis is being given to raise large scale plantation under various schemes which entails use of large quantity of seeds. Many national and multi-national programs have established commitments for restoration, conservation, sustainability, and biodiversity. Social forestry, community forestry, National Forest Policy 1988, Mahatma Gandhi National Rural Employment Guarantee Act 2005, National Agroforestry Policy 2014, Green Highways (Plantation & Maintenance) Policy-2015, Green Skill Development Programme, 2018, etc. emphasize massive plantation efforts especially focusing on areas outside the forest. India has only 24.62 % (ISFR, 2021) forest cover, which is far below the recommended 33% of our National Forest Policy, 1988. Increasing the area under natural forest has negligible scope, while Trees Outside Forests (TOFs) offer tremendous opportunity for productivity augmentation and sustainability. Certified Forest Reproductive Material (FRM) is intended for use in a variety of forestry and agroforestry functions, including the production of timber and other goods (e.g. fruit, gum, and resin cork), soil protection, biodiversity, climate change mitigation and environmental restoration. In addition, Forests will play an important role in both climate change adaptation and mitigation strategies. FRM can have a considerable

impact on a forests health and productivity, but also their ability to adapt and survive shocks such as changes in climate or pests and disease. In the Union budget of 2022, Indian Government looks at agroforestry and private forests as tools to decarbonise economy. Promotion of agroforestry through legislative changes and financial support is part of the government's larger goal to gradually move towards a carbon neutral economy. Besides supporting sustainable farming, the agroforestry also provides ecological services and acts as a carbon sink. However, one of the major constraints to scaling up of agroforestry has been cited as unavailability of high quality planting material and its availability and accessibility to the growers. Unavailability of quality tree germplasm is a consequence of absence of control systems (standards, certification, policies, regulations and enforcement) to guarantee its production and supply. Quality seed control systems are therefore required to ensure that the high quality planting material, once identified is bulked and availed to farmers without destroying its integrity. At present, most of the genetic material (seed/planting stock material) used in forestry sector in India is obtained from unspecified sources, from stands, natural or planted, which are neither classified nor managed specifically for seed or planting stock material



production and lesser importance has been given to quality of seed being used in plantation work, however most of the developed countries great emphasis is laid on the use of quality seeds. The "green revolution" in agriculture has been possible mainly because of use of quality seeds. So if we want to increase the productivity from our planted forests, we will have to use quality seeds. In order to ensure that only seeds of best quality available are used for raising plantations, it is necessary to introduce seed certification.

Concept of forest tree seed certification

Certification of seed means verification of origin and quality, and is likened to a guarantee for manufactured goods. The purpose of certification of forest tree seed is to maintain and make available to the public, high quality forest tree seeds and propagating materials of superior provenances and varieties resulting from natural selection or systematic breeding, so grown and distributed as to insure the genetic identity and genetic purity. For agricultural seed, certification implies genetic improvement; its aim is to maintain and make available to the public high-quality seeds and propagation materials of superior crop plant varieties grown and distributed in order to insure genetic identity and genetic purity. In "Forestry Terminology": Seed certification is "the guarantee of seed character and quality by an officially recognized organization, usually evidenced by a certificate including such information as certification category, genuineness of species and variety, year of collection, origin, purity, soundness, and germinative capacity."

Forestry has been slow to follow agriculture's lead in seed certification for three main reasons:

1. the lack of appreciation of the importance of seed origin,
2. seed certification is based on breeding, and tree breeding is slower than agricultural breeding, and
3. the volume of forest tree seed traded is small.
4. tree seed is commonly collected by unsupervised and unskilled labour.

However, as tree breeding programmes become productive, seed certification is becoming more urgent, particularly in tropical regions with their fast growth, early flowering and short commercial and breeding rotations. Naturally we want plantations that will produce the maximum amounts of the most desirable products per acre. We want to obtain seed that has produced such results. Conversely, we want to avoid reaccessions of seed that has given poor or indifferent results. Unless we can control the necessary seed collections, there is no certainty that good seed accessions will be repeated and poor ones avoided. Seed must be collected under certain recognized standards and so verified by a reputable agency or authority, i.e., seed certification.

Forest tree seed certification schemes

Many countries have established seed zone systems for their indigenous species and various schemes of seed certification have been or are being designed in which better and essential information on seed is provided both nationally and in relation to international trade (Table:1) Clearly it is important, even though difficult, to create internationally acceptable systems of seed



certification. As more countries become involved in seed exchange, plantation work and tree improvement, such a system can be considered essential. In fact an international scheme does now exist. There is the scheme which sets minimum standards for the control of forest reproductive material moving in international trade, prepared by the Organization for Economic Cooperation and Development (O.E.C.D.). First accepted in 1967 after several years' preparatory work and meetings. In a broader picture four classes of forest tree seed and propagating materials are recognized in national and international trade. This scheme is very similar to the standards established in the USA except for materials from untested seed orchards in the qualified category. The major difference however between the EU and the OECD schemes is that the latter is optional and countries participate and use the scheme on a voluntary basis while the former is compulsory. The OECD Scheme for the Certification of Forest Reproductive Material seeks to encourage the production and use of forest tree seeds or plants that have been collected, processed, raised, labelled and distributed in a manner that ensures their trueness to name. The OECD Forest Scheme defines four broad categories of forest reproductive material that are recognised for certification:

1. Source-identified material is collected from a forest area within a delineated region of provenance.
2. Material from selected stands is collected from a delineated population of trees possessing sufficient uniformity.

3. Qualified material is from untested seed orchards.
4. Tested material is from tested seed orchards or stands, which have been proven to produce seed of improved quality.

The OECD Scheme for the Certification of Forest Reproductive Material seeks to encourage the production and use of forest tree seeds or plants that have been collected, processed, raised, labelled and distributed in a manner that ensures their trueness to name. This certified material is intended for use in a variety of forestry functions, including timber production, soil protection, and environmental criteria. The OECD Scheme for the Control of Forest Reproductive Material Moving in International Trade is open to OECD members as well as to other states. To date, 29 participating countries implement the Scheme (including tropical countries developing their seed exchange for reforestation purposes). Seeds and plants are produced and officially controlled according to harmonised procedures. OECD labels are used according to the category of the forest reproductive material they fall under. The labelled material is recognised internationally as "QUALITY GUARANTEED" and "OF CONTROLLED ORIGIN". To date, the participating countries have approved 402 tree species that are eligible for OECD certification of reproductive material (<https://www.oecd.org/agriculture/forest/>)

Outlook for certification

The best potential for future certification of tree or other native plant seeds is in restoration or reclamation planting programs. These programs require relatively small seed lots from an



extraordinarily large number of species, many of which have not been grown in nurseries before. There is also a trend toward wanting only local ecotypes for restoration planting and source-identified certification to provide the assurance that proper seed sources are being used. From this perspective, there appears to be a promising future for certification of seeds and other materials from trees and other native plants. Certification of forest tree seed is just starting. The volume of activity can be expected to increase gradually. OECD standards will likely permit coordinated international tree seed certification activities. Among many

foresters engaged in tree seed work, there is also the hope that standards developed for tree seed certification will be used as guides even by those seed producers who do not sell seed. Such a practice cannot but help them and their respective communities upgrade their forests and the production resulting from them. Finally, I should like to stress that the future of tree seed certification rests with the seed user. Certification cannot become truly effective until the man who uses the seed knows what seed he wants, and is willing to pay the extra price certified seed will have to bear to meet the special cost of high-quality seed production and

A comparison of forest reproductive materials certification schemes around the globe

Name of region	USA- Northwest Forest Tree Seed Certifiers Association (NWFTSCA)	OECD (Organization for Economic Cooperation and Development)	European Union (EU)	India
Name of Scheme	'Forest Reproductive Material Certification Standards: Oregon— Washington Interagency.'	Control of Forest Reproductive Material Moving in International Trade.	Council Directive 1999/105/EC of 22 December 1999 Later on EU 2000: Directive 199/105/CE	At present no legal framework exist
General overview	<ul style="list-style-type: none"> ❖ Formed in 1966 ❖ The NWFTSCA standards provide certification for a range 	<ul style="list-style-type: none"> ❖ first published in 1967 and amended in 1974 (Hoekstra 1976). ❖ Additional revision is currently 	<ul style="list-style-type: none"> ❖ The was first enacted in 1966, and has been substantially amended several 	<ul style="list-style-type: none"> ❖ The first attempt to certify tree germplasm in India began in 1979 under an Indo-Danish project on seed procurement and tree improvement ❖ Recently, the Indian



	of forest reproductive materials (FRM) that include seed, scions, cuttings, seedlings and pollen; and also for the certification of FRM sources such as seed orchards, seed production areas, and plantations and evaluation tests. The NWFTSCA recognizes four classes or categories of reproductive material sources.	underway. The unit of approval for reproductive material is 1 of 7 kinds of “basic material”: ❖ seed source, stand, seed plantation, seed orchard, parents of family(ies), clonal mixtures, and clone. ❖ All materials are tagged and accompanied by a certificate of provenance.	times to incorporate advances in tree improvement	Council of Forest Research and Education (ICFRE) lobbied for the certification of tree germplasm and the Indian government reinitiated the process of developing a certification scheme for forest and agroforestry tree germplasm. ❖ The objective of certification of tree germplasm as set out in the bill is similar to other schemes such as that of the OECD, which is to encourage the production and use of seed, plants or other planting stock ensuring that the same have been collected, transported, processed, sampled, labeled, sealed, and distributed in a manner to represent their trueness to the name and quality
Classes of FRM	1. Audit Class	Source-identified material	Source-identified material	
	2. Source-identified class.	Selected material	Selected material	
	3. Selected class	Materials from untested seed orchards (Qualified)	Materials from untested seed orchards (Qualified)	
	4. Tested class	Tested materials.	Tested materials.	



From waste to fertilizer: Utilizing waste mica with potassium solubilizing bacteria for improved soil health

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Introduction

Potassium (K) is an essential macronutrient for plants that is needed in significant quantities to support their growth and development. It plays a vital role in various physiological processes, including cell metabolism, enzyme activation and starch synthesis. The continuous use of K fertilizers over a prolonged period of time is becoming increasingly expensive due to the fact that all of the K fertilizer currently used in India is imported from foreign countries such as Canada, Russia, Belarus, Germany, Israel, and Jordan. As per Fertilizer Association of India (FAI) in 2021-2022, India consumed approximately 2.5 million tonnes of potash. Developing countries such as India, which lack mineral deposits, have limited opportunities to achieve self-sufficiency in K nutrition by relying solely on conventional fertilizer sources such as muriate of potash and sulphate of potash. It is crucial to identify and explore alternative sources for K fertilizers. Fortunately, certain Indian states possess vast deposits of low-grade K-bearing minerals, such as mica, containing approximately 5-10% total K. These mineral deposits remain untapped and unutilized; presenting an unrealized

source of K that could significantly enhance soil fertility and reduce the heavy reliance on conventional K fertilizers, if modified by suitable means.

Availability of mica in India

Mica deposits are abundant in various parts of India, particularly in Andhra Pradesh, Bihar, Jharkhand, Maharashtra, Odisha, Rajasthan, and Telangana. Minor deposits can also be found in certain areas of Gujarat, Haryana, Karnataka, Kerala, Tamil Nadu, and West Bengal. According to the National Mineral Inventory (2015) database based on UNFC system, India has around 6,35,302 tonnes of mica mineral deposits. As per the Indian Minerals Year Book (2021), Andhra Pradesh accounts for the largest share (41%) of the country's total mica deposits, followed by Rajasthan (28%), Odisha (17%), Maharashtra (13%), Bihar (2%), and minor quantities in Jharkhand and Telangana. Mica minerals such as muscovite (white mica) and phlogopite contain high levels of potassium, researchers are currently investigating their potential to be used as an alternative and sustainable source of potassic fertilizer.

Potassium solubilizing microbes to enhance K availability from waste mica



Mica waste generated after cleaning and processing mica ore contains about 8-10% potassium. Plant Growth Promoting Rhizobacteria (PGPR) are a specialized group of bacteria that can colonize the rhizosphere and improve various processes related to plant growth and nutrient uptake, especially under conditions of unbalanced nutrition. One of the ways these microbes can promote plant growth is by solubilizing insoluble mineral K into soluble forms. There are many different groups of microbes that have been identified as K solubilizing microorganisms, with bacteria and fungi being the most prominent members. Researchers have identified important K solubilizing bacteria (KSB) or silicate dissolving bacteria (SDB) such as *Bacillus edaphicus*, *B. circulans*, *B. mucilaginosus*, *Paenibacillus* sp., *Pseudomonas*, and *Burkholderia* sp. (Basak *et al.*, 2017). Potassium solubilizing bacteria employ various mechanisms to solubilize K, such as direct solubilization (through production of low molecular weight organic acids) and indirect solubilization (chelation of cations of the minerals) of K minerals, polysaccharide secretion (production of capsular exo-polysaccharides) and production of biofilm.

Success stories

The combination of potassium solubilizing bacteria and waste mica has been the subject of investigation and documentation by researchers worldwide. Higher K recovery was observed with the application of *Bacillus* sp. and crop residues (2 g kg⁻¹ soil) along with waste mica compared to mica alone (Rani *et al.*, 2022). Ahmad *et al.* (2020) found that application of 50% K through MOP + 50%

K through waste mica + *Fraturia aurantia* + *Bacillus edaphicus* showed significant effect on K uptake and recoveries by maize due to higher solubilization of K. Pramanik *et al.* (2019) reported that application of *Bacillus pseudomycooides* along with waste mica increased K availability after 105 days of incubation. Higher K (37%) was observed to be released from biotite over muscovite (Sarikhani *et al.*, 2016).

Singh *et al.* (2010) concluded that PGPRs namely, *Bacillus mucilaginosus*, *Azotobacter chroococcum* and *Rhizobium* spp. could be used to mobilize potassium from waste mica, which in turn could be used as a source of potassium for plant growth. Higher amount of available K was recorded in soils of Alfisol with the application of waste mica along with *Bacillus mucillaginosus* (Basak and Biswas, 2009). According to Nishanth and Biswas (2008), composting waste mica with rice straw and rock phosphate inoculated with *Aspergillus awamori* offers a viable alternative technology for managing waste mica.

Conclusion

Combining K solubilizing bacteria with waste mica as a potential source of potassium fertilizer is a promising opportunity to reduce reliance on commercial fertilizers. Laboratory studies have extensively examined K extraction from waste mica, there is still a significant knowledge gap regarding its efficacy in detailed field experiments and trials. Therefore, researchers must dedicate their efforts to developing efficient and effective fertilizer materials that utilize indigenous minerals like waste mica, in



line with India's vision of achieving an "Atma Nirbhar Bharat".

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