Biodiversity Conservation through Cultivation of High-Value Medicinal and Aromatic Plants (A Step towards Commercialization)

Abstract

Medicinal and aromatic plants (MAPs) provide various ecological, economic, and cultural benefits, including food, medicine, clothing, and shelter. However, uncontrolled and unsustainable collection practices are leading to their rapid depletion and eventual extinction. This indiscriminate collection threatens the status of several high-value MAP species, causing habitat damage and biodiversity loss. Over 80% of the world's population still depends on plant-based traditional medicines, making the conservation of MAPs crucial for the sustainability of life on Earth. To address this issue, the chapter suggests utilizing cutting-edge techniques such as in-situ and ex-situ conservation and cultivating medicinal crops in agricultural areas. Cultivating medicinal crops offers several advantages, including high local and international demand, better returns, and fewer resource requirements. This approach can help conserve and sustainably utilize high-value medicinal and aromatic plants while providing economic benefits to farmers. The book chapter aims to raise awareness among researchers, farmers, and other stakeholders about the potential benefits of adopting new crops and addressing issues during the cultivation of medicinal plants. By conserving and sustainably utilizing high-value medicinal and aromatic plants, we can ensure the well-being of the planet and its inhabitants.

Keywords: Biodiversity, Conservation, Medicinal Plant Farming, Commerisilazation

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1. Introduction

Medicinal and aromatic plants (MAPs) have become increasingly popular worldwide as sources of raw materials for pharmaceuticals and traditional healthcare systems, as evidenced by studies such as those conducted by Azaizeh et al. (2003) and Kandari et al. (2012). In fact, over 85% of herbal medicines used in traditional healthcare systems are derived from medicinal plants (Bhattacharya, 2003; Phondani et al., 2014), providing livelihoods for millions of people, especially in the Indian Himalayan region (Phondani et al., 2011)

For developing nations, medicinal plants offer a wealth of opportunities for generating income, employment, and foreign exchange, in addition to providing alternative treatments (Rawat and Uniyal, 2004). Studies have demonstrated the medicinal potential of various traditional healing herbs and their constituent parts, which can be used to prevent, treat, or cure several human ailments (Dhar et al., 1996).

Medicinal and aromatic plants (MAPs) have significant potential as a source of healthcare in underdeveloped countries, where they are used by around 80% of people as their primary form of medicine. Despite this, only a small percentage of the 35,000 (or possibly 70,000) plant species used medicinally worldwide have undergone chemical research. Many bioactive

Comment [DI2]: This paragraph needs reference compounds with therapeutic potential, such as alkaloids, flavonoids, and saponins, have been discovered in these plants.

The cultivation of medicinal crops has numerous benefits over traditional crops, including superior nutrition, substantial domestic and export demand, better prices, minimal resource requirements, and better returns. However, some medicinal crops' prices have recently grown significantly due to a lack of supply, and some species have faced extinction due to overuse.

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Efforts are needed to conserve valuable medicinal plant species, and ex-situ conservation strategies are necessary to cover all activities within a specific time range. Farmers' contributions are crucial in developing a successful long-term conservation strategy, and MAP resources present a feasible alternative for managing natural resources and improving livelihoods from the viewpoint of biodiversity conservation, domestication, and cultivation.

2. **A Historical Look at the Use of MAPs**

The history of medicinal plant use can be traced back to our ancestors, who relied on natural remedies found in nature to alleviate their pain, heal their wounds, and treat their illnesses. Even today, medicinal plants are widely used for both self-care and public health purposes. They are a valuable component of our natural resources and are used as both therapeutic agents and raw materials to create a wide range of products (Lubbe and Verpoorte, 2011). The products derived from medicinal plants are varied, covering a wide range of goods from traditional and contemporary medicines to items used in the medical, food, and cosmetic industries (Kurian and Sankar, 2007).

Medicinal and aromatic plants (MAPs) have a long history spanning from the Doctrine of Signatures and Similitudes to the present-day evidence-based medicine. According to Rajasekharan and Wani (2020), MAPs have become industrial products for global use for the first time, with new concepts such as nutraceuticals, cosmeceuticals, phytotherapy, aromatherapy, and others, broadening their use and leading to new applications in functional foods and animal husbandry. National and international legislative and regulatory bodies appear to be conflicted about the increased use of MAPs in conventional medicine (Hamilton, 2004).

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Here, the term Medicinal and Aromatic Plants (MAP) was repeated many times
Delete all the full names written after abbreviation exhibition
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Numerous valuable medical plant species are becoming rare due to the increased global demand, and some are even in danger of going extinct. So, it's crucial to preserve the widely traded medicinal plants in their native habitat or to grow them in suitable conditions. The cultivation of medicinal crops has numerous benefits over traditional crops. Among them are the following: medicinal crops offer better returns than traditional crops; they have a high domestic and export demand; they fetch better prices on the market; they can be stored for a long time and sold when better prices are high; they are largely drought-tolerant and difficult for animals to graze; they have a low incidence of pest attacks and diseases; and they require the least amount of resources, making cultivation cheaper than with traditional crops. Due to these benefits, certain areas have begun to increase their cultivation of medicinal plants. The spread is

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Some of them are so sensitive like leafy plants which are affected by fungus or can not resist drought
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not, however, sufficient to satisfy the industry's demand. Some medicinal crops' prices have risen significantly in recent years as a result of a shortage in supply. The fact that some of the species have been threatened with extinction by human exploitation is also extremely concerning.

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Methods for conservation of high-value MAPs

1. By creating awareness

Avoiding the disruption of these plants' native environment is an excellent method to protect these natural riches. It can only be accomplished by drawing attention to the fact that it must not be destroyed and by educating the public on the value of medicinal plants economically. Most people are already aware of how to use wild medicinal plants and must use these resources wisely. However, they are under pressure from poverty and population growth, which leads them to overharvest and destroy natural habitats. This approach is ineffective because the local populace also uses these resources.

If this approach fails and conservation in nature is not an option, other approaches, such as germplasm conservation, may be adopted. Conserving these plants' genetic material can help prevent the extinction of these natural riches.

In-situ and ex-situ conservation of plant germplasm are two different techniques.

2. In-situ conservation

It is the process of conserving threatened plant species on-site in their native habitat by safeguarding the habitat from damage or pollution or defending the species against predators. It can be accomplished by creating biosphere reserves like national parks and gene sanctuaries. By protecting recovered populations in the surroundings where they acquired their distinguishing traits, in-situ conservation works to maintain the environment's continuing processes of evolution and adaptation.

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3. Ex-situ conservation

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Off-site conservation entails preserving an endangered species outside of its native habitat by taking a section of the plant population from the threatened habitat and replanting it in a different place, which could be a wild region or under human care. Ex-situ conservation can be done in several ways: field, gene banks, pollen storage, DNA storage, seed gene banks, and botanical gardens.

Propagation Methods

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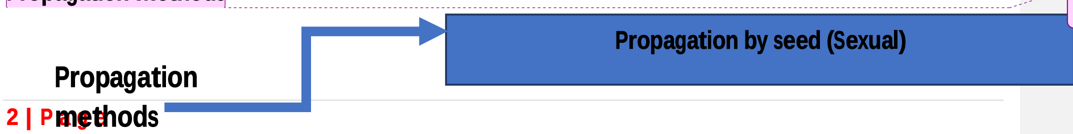

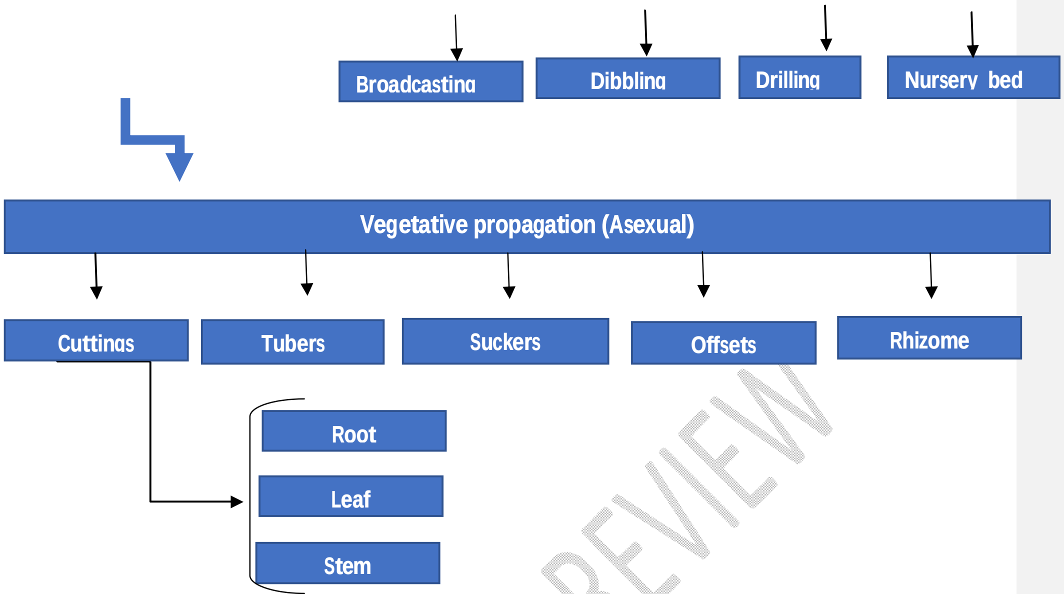

Figure. 1 Layout of MAP propagation methods

Propagation techniques: The main methods used to grow medicinal and aromatic plants are seeds, stem cuttings, root/rhizomes, and slips in nursery beds with a ratio of soil, farmyard manure, and sand of 5:3:1, respectively. Regular weeding and irrigation during dry spells must be assured to maximize seed germination and seedling survival.

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Propagation methods

Add the figure of propagation here.

Propagation by seed (Sexual)

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1. Broadcasting **2. Dibbling** **3. Drilling** **4. Nursery bed**

Broadcasting: The broadcasting method of planting involves manually or mechanically sprinkling seeds on the soil's surface. Seeds may be sown quickly and easily with broadcasting, which can be done in any weather. The seeds must be distributed evenly using this strategy in order for them to have the best chance of germination and growth. This method typically results in an uneven distribution of seeds, some of which are left uncovered by the earth. Uneven densities and depths of the seed cause irregular germination.

Figure. 1.1 Method of the broad casting of seeds

Dibbling:A seed or a few seeds, or seed materials, are placed in a hole, pit, or pocket that has been dug at a predetermined depth and spacing using a dibble or planter, or very frequently by hand or with practical tools like a shovel, hoe, etc. Then, the soil is covered over them. The dibbling method works well for crops planted farther apart and needs a dedicated space to develop their canopies or cultural tasks like weeding, earthing up, and watering in furrows. Seeds may be scattered on flat fields, on ridges or their sides, or in small pits or pockets that form discrete hills, rings, or stations apart from one another. Only the seeding zone needs to be prepared for such a seeding technique.

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Figure. 1.2 Method of the dibbling of seeds

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Drilling: Drilling involves forcing seeds into the ground mechanically. Seed is metered out of a hopper into tubes that are part of a soil-opening tool (such as disc openers or chisels) that plants the seed at a pre-determined depth while a seed drill moves across a field. Drilling makes it easier to rough up and thin out weak and diseased plants. Wheel hoes, Japanese rice weeders, and other tools can weed rice fields profitably and quickly. The adverse effects of cross-cultural activities like manuring, irrigating, spraying, etc. more time commitment, labor-intensive and expensive.

Figure. 1.3 Method of the drilling of seeds

Nursery Bed: In general, cuttings placed in the ground are rooted in the nursery bed, or sowed seeds are germinated there. Along with nutrition, adequate moisture and aeration are crucial elements that influence seedling growth. Planting seedlings are cultivated for planting purposes in nurseries. Young seedlings are cared for in the nursery from the time they are sown until they are ready to withstand harsh field conditions. Whether native or alien, nursery seedlings are reported to have higher survival rates than seeds placed directly in the ground or through spontaneous regeneration. Therefore, nursery seedlings become their planting material whether these plantations are for production, protection, or amenity.

Nurseries are of two types:

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Temporary nurseries These have been set up at or close to the planting location. The nursery becomes a component of the planted site after the seedlings are raised for planting. Sometimes they are referred to as "flying nurseries."

Permanent nurseries Depending on the goal and the volume of seedlings raised yearly, these facilities might be big or small. Large nurseries house more than this number, while small nurseries house less than 100,000 seedlings at a time. Permanent nurseries must always have an adequate water supply, be well-designed, and be situated.

The production of seedlings is a significant expenditure associated with afforestation, so every effort should be made to produce high-quality seedlings at a fair price. It is crucial to becoming proficient in nursery operating skills.

Figure. 1.4 Method of the nursery bed of seeds

Vegetative propagation (Asexual)

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The process of reproducing by using any vegetative parts of the plant or a component of the plant fragment to serve as propagation and grow into new plants is known as vegetative propagation.

Cuttings: To regenerate the entire plant, the vegetative portion of the plant—the leaf, stem, and root—is cut and replanted. The three different kinds of cutting are called for the plant portion being cut or separated.

Root cutting: These can be removed without harming the main plant. Cut a stem piece that is the index finger in length and thickness. The use of growth hormones must be avoided since they will prevent root growth. Lay the rooted cutting horizontally in the nursery beds or a polythene bag filled with compost. Firmly press down after lightly covering with soil, and watering is carried out as needed. Roots start to grow between 4 and 8 weeks after planting.

Leaf cutting: The most common way to take a leaf cutting is to snip off a healthy leaf along with a small portion of the stalk. The stalk of the leaf-cutting is then inserted into a moist propagation medium after being bathed in a rooting hormone. If possible, bottom heat of roughly 75°C should be provided***.***

Stem cutting: The stem is usually the vegetative component of a plant that is used for propagation. Gather little branches that proliferate and are unaffected by pests or diseases. Avoid gathering the cutting materials during the hottest part of the day to prevent the plant from losing a significant amount of moisture or wilting.

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The material should not be kept in a polythene bag because it can quickly get too hot. Once inside the nursery, find a protected area and prepare the cuttings. Place the trimmed cuttings in a nearby container of cold water. Trim a comparatively vigorous sprout to a length of 2.5 to 12 cm.

Tubers: Take these cuttings when the plant is not actively growing. The required stem depends on the internode length (the space between the leaves). A node is a point at which the leaf meets the stem, and the number of nodes measures a cutting. For example, a single node cutting is suitable for plants where the internode space is less than 1.5cm. In this case, cut just above the node and insert that end into the compost. Two-node cuttings are taken from plants with a shorter distance between the nodes. Cut just under a node, as this is a good place for roots to be formed. Several noded cuttings are employed with species having few leaves and extremely short internodes. Taken at a distance of 5 to 15 cm, they work best. That is usually classified as a softwood cutting if the stem is leafy. The majority of tropical trees can be multiplied using softwood cuttings. Using a clean knife, remove all but the top two leaves of the cutting. Trim each leaf down by half. Dipping the stem base into a hormone solution or powder is preferable to encourage rooting. However, this is not necessary. Insert two-thirds of the stem into the prepared cuttings bed or a polythene bag of compost and gently press the compost to firm it in. Water and keep shaded when it is dormant. Cut a small piece of the tuber, which should include a bud. Do not use any growth hormone. Like yam, it will be desirable to plant this cutting onto a raised bed or individual mound because it will allow for the eventual harvest of some of the plant's tubers without harming the entire plant.

Suckers: These are the shoots that are produced from the roots. Treat these as either unrooted cuttings or separate them from the main plant keeping a piece of root attached. Avoid these suckers drying out by preparing the planting ground in advance and watering them after planting.

Offsets: These are the little clumps of new shoots that form clumps or sets of buds at the base of some species, e.g., banana and plantain. Separate these from the main plant and divide them into individual plants or small clumps. Do not allow these to dry out or be left in the sun. Plant these clumps into the nursery beds or their final planting position and water them well. It is a helpful technique when growing young plants in the nursery to help them develop a fibrous root system. That results in good plant establishment when transplanted to their final planting site.

Undercutting promotes strong fibrous roots and prevents the roots from penetrating too far into the nursery bed. Undercutting can only be done on a raised bed twice the width of a machete.

Rhizomes: Cutting a rhizome Cutting the rhizome into sections for propagation is done while making sure that each segment includes at least one lateral bud, or "Eye," which is effectively a stem cutting. The leptomorph rhizome, which has a dormant lateral growth point at the majority of nodes, responded well to this general approach. Rhizomes are split or fractured into pieces, and new roots and shoots emerge as a result. To propagate a plant, cuttings are made from the vegetative part of the plant, such as the rhizome, which is essentially a modified stem. From the nodes, the rhizome is divided into small, horizontally scattered pieces that range in length from 25 to 50 mm.

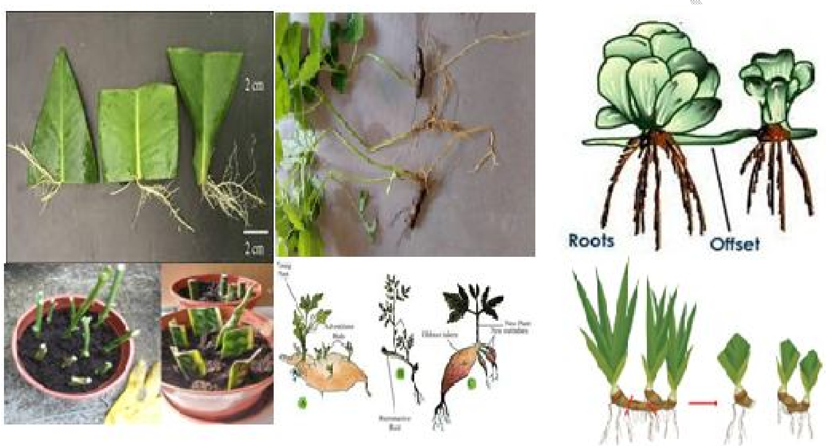

Figure. 2. Pictorial atlas of vegetative propagation

Treatment of Cuttings with Fungicides

The cutting of medicinal plants may be affected by the presence of nematodes, a number of fungi, and bacteria in the soil. For the purpose of preventing soil-borne disease, it is desirable to treat the soil mixture with formaldehyde, chloropicrin, dexon (P-dimethyl amino benzamide sodium), and pentachloronitrobenzene prior to planting or cutting.

Treatment of Cutting with Growth Regulators

In this process, the cutting was treated with indole-3-butyric acid (IBA**)**, indole acetic acid (IAA) and Naphthalene acetic acid (NAA) growth regulators using at different concentration (PPM) applied by dip methods for growth production of plants.

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Propagation Structure

In the multiplication process, cuttings are sometimes placed in pots or plastic bags or directly in the soil. Cuttings were planted in clay pots that had been filled with a pre-planting soil mixture that had been treated. Sand and some organic material, such as sawdust, shredded bark, or cow dung manure, are frequently added to create a potting mixture and better textures. The moisture in the mixture will usually tend to equalize during the next 24 hours.

Table: 1. Develop an appropriate cultivation calendar/plan for medicinal and aromatic plant species agro techniques in the study area

Name of plant **Species**	**Propagation method**	**Sowing time**	**Harvesting period**	**Irrigation schedule**
*Asparagus racemosus*Wild.	Seeds	May June	October November	Three times weekly
*Cinnamomum tam*ala Bach. -Ham. Nees &Ebermaeir	Seeds	March April	October November	-do-
*Cymbopogon flexuosus*Nees ex Steudel	Slips	February March	October February	Weekly
Hedychium spicatum Bach.-Hum. Ex J.E. Smith	Seeds, rhizomes	February March	October December	Weekly
Matricaria chamomilla L. Linn	Seeds	March-April	September October	Two times weekly
Ocimumbasilicum L.	Seeds	March -April	September October	Two times weekly
Origanum vulgare L.	Seeds	March -May	October December	Two times weekly
Rosmarinus officinalis L. Linn	Stem cuttings	March-May	October December	Two times weekly
*Sapindusmukorossi*Gaertner	Seeds	February March	March April	Three times weekly
Valeriana jatamansi Jones	Rhizome	March April	October November	Two times weekly
Withaniasomnifera L.	Seeds	March April	September October	Two times weekly
Source:	Prakash C. P, Indra D. B, Vikram S. N, Bhagwati P. K, Arvind B, Rakesh K. M. 2016. Promoting medicinal plants cultivation as a tool for biodiversity conservation and livelihood enhancement in Indian Himalaya. Journal of Asia-Pacific Biodiversity 9 (2016) 39-46			

Table: 2. Propagation guide of selected medicinal plants

Name	Habitat	Part used for medicinal purposes	Propagation
Adenia cissampeloides	Forest	Stem-bark mild hypertension and numbness	Stem cutting: Cut a piece of stem with 2-3 nodes
Aframomummelegueta	Forest	The fruit is used to treat boils, rheumatism, and bone fractures. Roots are used for	Rhizomes: Select and cut rhizomes with buds

		chest pains. Seeds are used to treat wounds, numbness and anemia. The whole plant is used for coughs	
Azadirachta indica	Cultivated	Leaves, root-bark, stem-bark, seed, bark	Stem cuttings: Cut stems 6 cm long with 2-3 nodes on each
Cryptolepissanguinolenta	Forest and thickets	Root	Propagated by either seed or by root cuttings.
Clausenaanisata	Coastal	Leaves, bark, and roots	Seeds
Hyptissuavuolens, Hyptispectinata	Weed of roadside and cultivated land	Leaves.	Vegetative cuttings
Zingiber officinale	Cultivated in tropical zones	Rhizome and rhizome-bark	Rhizomes: Select and cut rhizomes with buds. Plant directly into beds

Source:Amponsah, K., Crensil, O'R., Odamtten, G.T., Ofusohene-Djan 2002. Manual for the propagation and cultivation of medicinal plants of Ghana.

Seed Germination The fundamental process by which many plant species develop from a single seed into a plant is known as seed germination. This procedure affects crop output and quality. Rapid water uptake by the seeds during the early stages of germination causes swelling and optimal temperature-induced softening of the seed coat. Imbibition is the name given to this phase. Enzymes are activated to begin the growth process. The seed starts to create proteins, respire, and metabolize the food stored after activating its internal physiology. It is called the seed germination lag phase.

Extrinsic factors for seed germination

Here are a few important conditions that must be met for a seed to grow into a seedling and eventually into a plant.

Water: It is essential for seed germination. Some seeds are so dry that they require to absorb much water in comparison to their dry weight. For seeds to germinate, water is crucial. It aids by giving protoplasm the essential moisture it needs to function, gives developing embryos dissolved oxygen, softens seed coatings, and enhances seed permeability. Additionally, it aids in seed rupturing and transforms insoluble food into a soluble form for transfer to the embryo.

Oxygen: Oxygen is a vital and necessary energy source for germinating seeds. The seed uses aerobic respiration to carry out its metabolic functions during germination until it can produce its green leaves. The pores of soil particles contain oxygen, but if the seed is buried too deeply, it will be depleted of this gas.

Temperature: A seed needs a temperature between 25 to 30 °C to germinate. The ideal temperature for various seeds varies. Some seeds have specific requirements for higher or lower temperatures between 5 and 40 °C.

Light or darkness: Light and darkness might serve as environmental triggers. Many seeds do not begin to grow until they are exposed to sunshine.

Under favorable circumstances, the seed germination process begins. The embryo quickly grows and expands inside the seeds before the covering layers rupture and the radicle emerges. This radicle emergence is regarded as the point at which germination is complete.

Intrinsic factors for seed germination

Seed vitality: When given the best conditions, a seed's capacity to germinate is said to have vitality. It is reliant on its food reserves, size, health, etc.

Seed viability/longevity: Over time, a seed loses its ability to germinate. Each seed thus has a lifespan or a time frame during which it can demonstrate regrowth or germination. Within two to five years, most crop plants lose their viability. Even in favorable circumstances, the seeds cannot germinate due to the condition of dormancy. The seed's internal circumstances are to blame. As a result, it is often known as the internal circumstances in an otherwise viable seed inhibiting germination. Before dormant seeds can germinate, these inherent limitations need to be removed.

Seed dormancy: Seed dormancy is the state or condition in which seeds cannot germinate even in environments that are favorable for germination, such as those with the right temperature, water, light, gas, seed coats, and other mechanical constraints. These conditions are caused mainly by the fact that the seeds need time to relax in order to germinate. These circumstances can change over days, months, or even years. These circumstances include heat, light, water, gases, seed coverings, and hormone structures.

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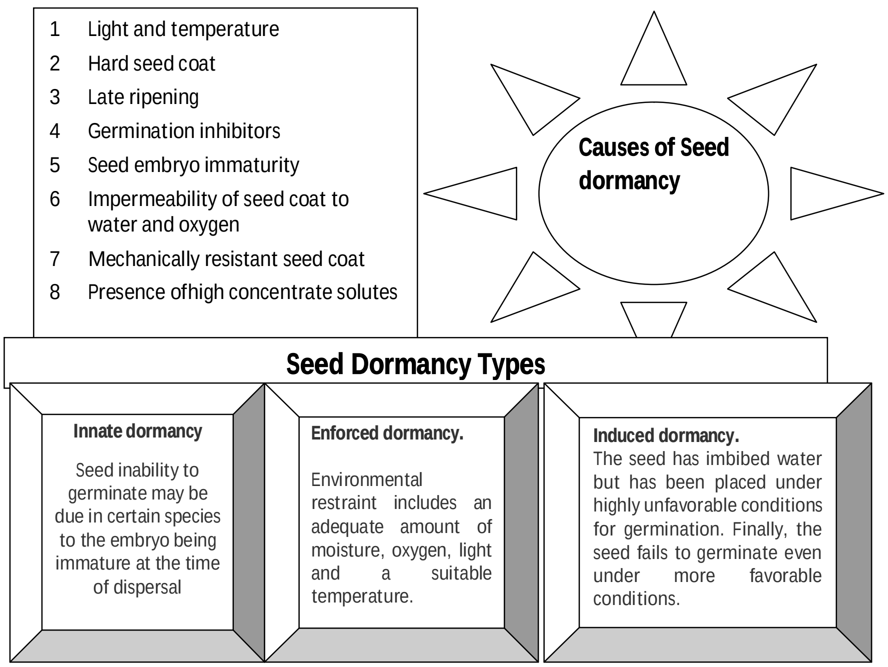

Treatment to break dormancy in seeds.

Seed coat treatment: These treatments make a hard seed coat permeable to water or gases by softening or cracking. This process is called scarification. The treatment can be either chemical or physical.

Embryo treatments can be done in two ways:

Moist stratification The incubation of seeds at an appropriate low temperature over a moist layer before transferring to a temperature suitable for germination.

Warm stratification: Incubation at 40-50°C for a few hours to a few days may affect overcoming dormancy in some species. For instance, rice seeds are treated with hot water at 40°C for at least 4 hours.

Chemical treatments: Plant growth regulators or other chemicals can be used in induced germination growth regulators.

Seed priming techniques to enhance germination

Priming is frequently applied to commercial seed lots to improve seed vigor regarding germination potential and greater stress tolerance. Additionally, priming can be helpful for seed bank managers who need to find innovative ways for ex-situ conservation of germplasm collections (crop and native species). Seed vigor is described by the International Seed Testing Association (ISTA) as "the sum of those qualities of the seed which govern the level of activity and performance of the seed or seed lot during germination and seedling emergence." (ISTA, 1995). The demand for higher standards in the plant sector has made the need for improved seed quality a priority. Since slow germination rates expose plantlets to unfavorable climatic conditions and soil-borne pathogens, achieving rapid and uniform seedling emergence is essential for crop performance (Osburn and Schroth, 1989). The practice of "priming" has long been used to improve the quality of seeds. Priming causes seeds to germinate more quickly, which increases agricultural yields and biotic/abiotic stress resistance to high levels. These characteristics that increase product competitiveness are directly related to seed vigor, an intricate agronomic attribute governed by numerous genetic and environmental factors (Rajjou et al., 2012; Jisha et al., 2013).

According to Everari (1984), attempts to increase seed germination go back to the ancient Greeks in the historical account. Theophrastus (B.C., 371-287), studied the germination of seeds and found that cucumber (Cucumis sativus L.) seeds treated in water before planting grew more quickly (Theophrastus, Enquiry into Plants, Book VII, I.6). The majority of the information on seed physiology was compiled in the Naturalis Historia, an encyclopedia by the Roman naturalist Gaius Plinius Secundus (A.D., 23-79), generally known as Pliny, the Elder. He discusses the value of soaking cucumber seeds in water and honey before planting them in his work to promote germination (Gaius 1949-1954).

The French agronomist and botanist Oliver de Serres (1539-1619) later discussed the efficacy of the treatment farmers used on cereals (Triticum, Secale, and Ordeumspp), in which seeds were soaked for two days in manure water and then dried in the shade before to sowing.

Nano-priming technology for enhancing seed germination.

Nano-priming is a cutting-edge seed priming technique that increases seed germination, seed growth, and yield by giving plants resilience to various problems. Nano-priming outperforms all other seed priming strategies in terms of efficiency. The development of electron exchange and enhanced surface reaction capabilities linked to various components of plant cells are the primary roles of nanoparticles (NPs) in seed priming.

Nano-materials have recently been used in plant science, primarily to enhance seed germination, compared to their use in the healthcare and industrial sectors. Priming is frequently applied to commercial seed lots to improve seed vigor regarding germination potential and greater stress tolerance. Additionally, priming can be helpful for seed bank managers who need better procedures for ex situ preservation of germplasm collections (crop and native species). Depending on the plant type, seed morphology, and physiology, many priming treatments may be applied; all of them activate the so-called "pre-germinative metabolism." Tens of thousands of wild plant species are threatened or extinct in various habitats because they are currently rare or endangered (Weinig et al., 2014). Biodiversity conservation is a challenge made more difficult by climate change and land use change (Thuiller, 2007; Jackson and Kennedy, 2009). Since environmental constraints are severe in many places, it is not always possible to keep plants in their natural environments; in situ seed conservation is thought to be a crucial method of preventing plant extinction. In these circumstances, ex situ seed conservation serves as a safety net for species that may be imperiled or extinct in the wild (Li and Pritchard, 2009). Even in the best-protected nature reserve, we cannot always ensure the protection of a plant (in-situ conservation), but seeds can be stored safely for hundreds of years in a seed bank (Van Slageren, 2003). Therefore, it is an effective technique to protect species and supply propagation materials to re-establish wild plant populations to collect and store seeds under seed bank conditions. In order to gather and preserve the seeds of wild species, several seed banks, like the Millennium Seed Bank (http://www.kew.org/science-conservation/millennium-seed-bank) (Van Slageren, 2003), have been established in recent years.

The difficulty in managing seed banks and restoration is mainly due to the long-term storage of seeds, lack of information about storage conditions, and scarcity of seeds from native wild species. In order to assist and expand the capacity building in local seed enterprises for large-scale native seed production, there is an urgent need for innovation in native seed research to strengthen the current understanding of seed conservation and use. In this context, innovative tools will be created to track and lengthen the lives of native plants that are most likely to be useful for commercial production.

A targeted investigation will be conducted on methods to monitor and lengthen the life of short seeds, such as those of alpine plants (Mondoni et al., 2011). All seeds eventually decay to some extent, even those stored in low-temperature, airtight storage, but if the damage is not too severe, it could be possible to repair it with the correct equipment (Butler et al., 2009).

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However, research on wild species has indicated that priming may have rejuvenating effects on aged seeds, as seen in *Digitalis purpurea* L. (Butler et al., 2009) and *Ranunculus sceleratus* L. Most priming research has been done thus far on crop types and species (Probert et al., 1991). Priming's effects on seed survival in wild species have not been thoroughly studied up to this point, and its effectiveness may vary between plant populations and be highly species dependent.

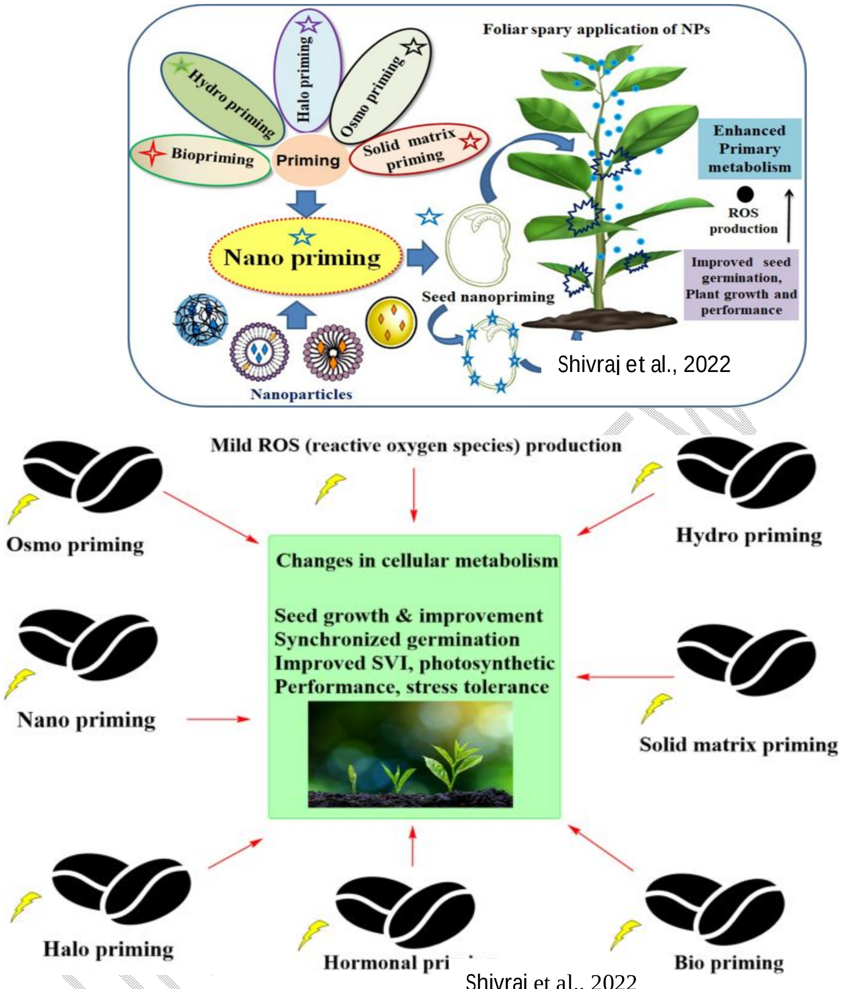


Figure. 3 Impact of different types of seed priming on the growth and physiological changes in plant

Role of seed bank for biodiversity conservation

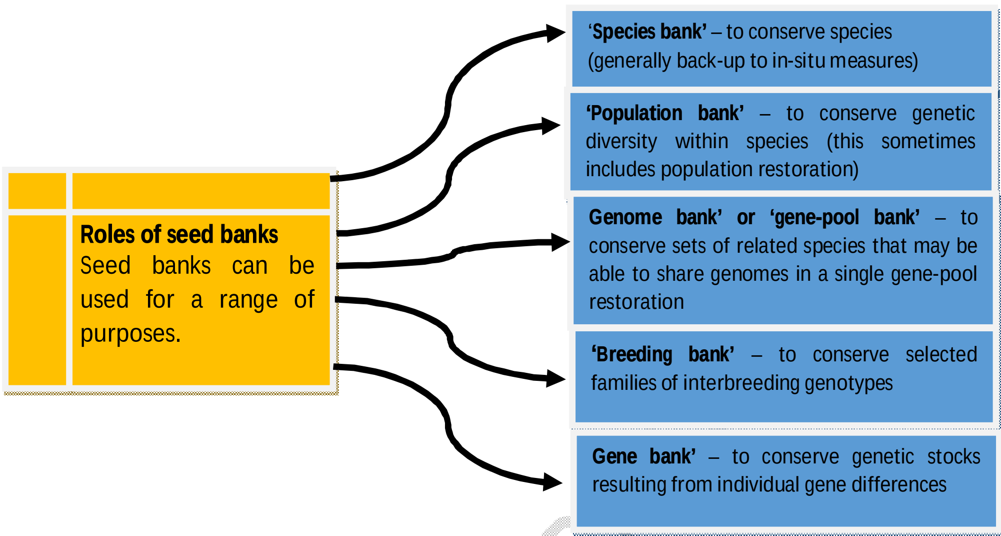
According to a very conservative estimate, the frequency of plant extinction is now between 100 and 1000 times greater than that expected by natural extinction. The planet loses at least one critical therapeutic candidate every two years (Pimm et al., 1995).

The World Wildlife Fund and the International Union for Conservation of Nature estimated that between 50,000 and 80,000 flowering plants are used as medicines globally. One-fifth of them, or 15,000 species, are in danger of going extinct due to habitat loss and overharvesting (Bentley, 2010), and 20% of their wild resources are already almost depleted due to the growing human population and plant consumption (Ross, 2005).

Even though this issue has been known for years, the rapid extinction of species and degradation of habitats worldwide has raised the possibility of the extinction of medicinal plants, particularly in emerging nations. Much research is on medicinal plants' preservation and sustainable usage (Uprety et al., 2012, Larsen and Olsen et al., 2016). Several suggestions have been made about their protection, including the necessity for integrated conservation measures based on both in situ and ex situ tactics and the construction of mechanisms for species inventorying and status monitoring (Hamilton, 2004). The sustainable use of wild resources could be a conservation strategy for medicinal plants with declining stocks. Seed banks are more efficient in preserving aromatic and therapeutic plants.

Keeping significant genetic variation ex-situ in one space is possible because of seed banks. The benefits include the ability to conserve multiple collections in a small space, the fact that 90% of seed plants have orthodox seeds, which can be stored for an extended period at low temperatures under refrigeration, and the ability to record a variety of eco-geographic information on each seed population using database systems. Plant populations can be conserved and restored using seeds from seed banks. Ex-situ systems should ideally only be used as backups for in situ conservation systems, which conserve biodiversity in living environments.

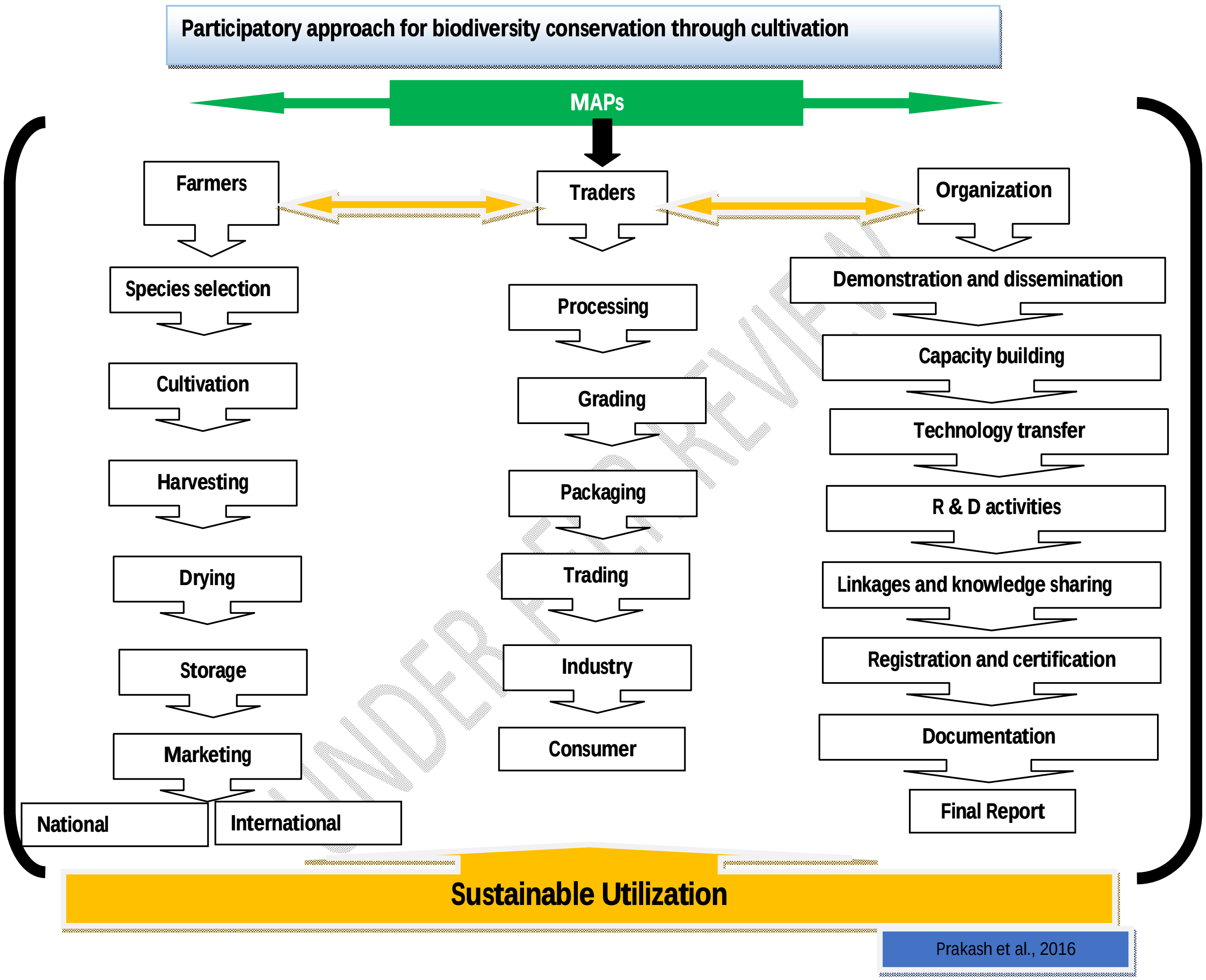
To preserve plant biodiversity for the future, seed banks are essential. They offer the local (vulnerable, endangered, and severely endangered) seed plant biodiversity the necessary protection and ongoing access to the foreign biodiversity needed for the economic growth of the biological export sector.



Supply chain of medicinal and aromatic plants

The economic potential and research on MAPs are presented in the current chapter as a practical example that policymakers at the national and international levels might use to connect socio-economic development and natural resource conservation. Poor rural people can find work and generate income by relying on livelihood systems based on medicinal and aromatic plants, which are generally mediated by market demand.

To ensure a consistent and regular supply of medicinal plants for the pharmaceutical sector and to stop the depletion of the natural resource base, developing the proper framework and technology for the cultivation of MAPs is essential. The farmers, traders, scientists, and policy planners would benefit from the participatory action research framework method in the context of socio-economic development for the sustainable lives of rural subsistence communities.


Participatory approach for biodiversity conservation through cultivation
MAPs
Farmers
Traders
Organization
Species selection
Cultivation
Harvesting
Drying
Storage
Marketing
National
International
Processing
Grading
Packaging
Trading
Industry
Consumer
Demonstration and dissemination
Capacity building
Technology transfer
R & D activities
Linkages and knowledge sharing
Registration and certification
Documentation
Final Report
Sustainable Utilization
Prakash et al., 2016

Conclusion

With the increased realization that many wild medicinal and aromatic plant (MAP) species are being over-exploited, a number of agencies are recommending that wild species be brought into cultivation systems. The market demand for these natural resources, which have been used since the beginning of human civilizations, has significantly increased as a result of the resurgence of interest in MAPs in industrialized nations. The utilization of MAP species is varied, just like their adaptability. However, it is possible to distinguish between industrial and therapeutic uses. While herbal medicines (CAM) have gained popularity in the developed world, traditional medicine has remained a top priority in the healthcare systems of low-income nations. Production, i.e., wild-crafting and cultivation of high-quality MAPs that can be used safely and effectively in a variety of applications and for the preservation of our endangered natural resources, have become prerequisites. For the survival of these ancient natural resources, sustainable utilization has also become essential.

The cultivation of medicinal and aromatic crops is becoming a new industry. To replace some of the traditional low profitable crops, it is important to either adopt the MAP intensive cropping concept or popularize medicinal and aromatic crops. It is essential to provide details regarding the key medicinal crops' uses and methods of cultivation. Because it is difficult to obtain seeds and samples of medicinal and aromatic plants, a seed bank must be established in order to supply farmers with seed stock.

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