CONSERVATION OF MEDICINAL PLANTS

Disclaimer

All the content material provided here is only for teaching purpose.

General introduction

- Medicinal plants are globally valuable sources of new drugs.
- In the United States, about 118 of the top 150 prescription drugs are based on natural sources.
- Furthermore, up to 80 % of people in developing countries are totally dependent on herbal drugs for their primary healthcare, and over 25 % of prescribed medicines in developed countries are derived from wild plant species
- India is floristically rich and is recognized as one of the twelve mega biodiversity centres of the world.
- Ranking 10th among the plant resources rich nations of the world and 4th among the countries of Asia.
- Nation with an area of 3,287,263 sq Km, and is an example of diverse ecosystems.

- According to the International Union for Conservation of Nature and the World Wildlife Fund, there are between 50,000 and 80,000 flowering plant species used for medicinal purposes worldwide.
- Among these, about 15,000 species are threatened with extinction from overharvesting and habitat destruction.

- **Conservation is the process of management of biosphere in order to obtain the greatest benefit for the present generation and maintaining the potential for future.**
- **Conservation of plant resources is of global concern because we don't know what we are losing and what we will need in future.**

Threats to medicinal plants

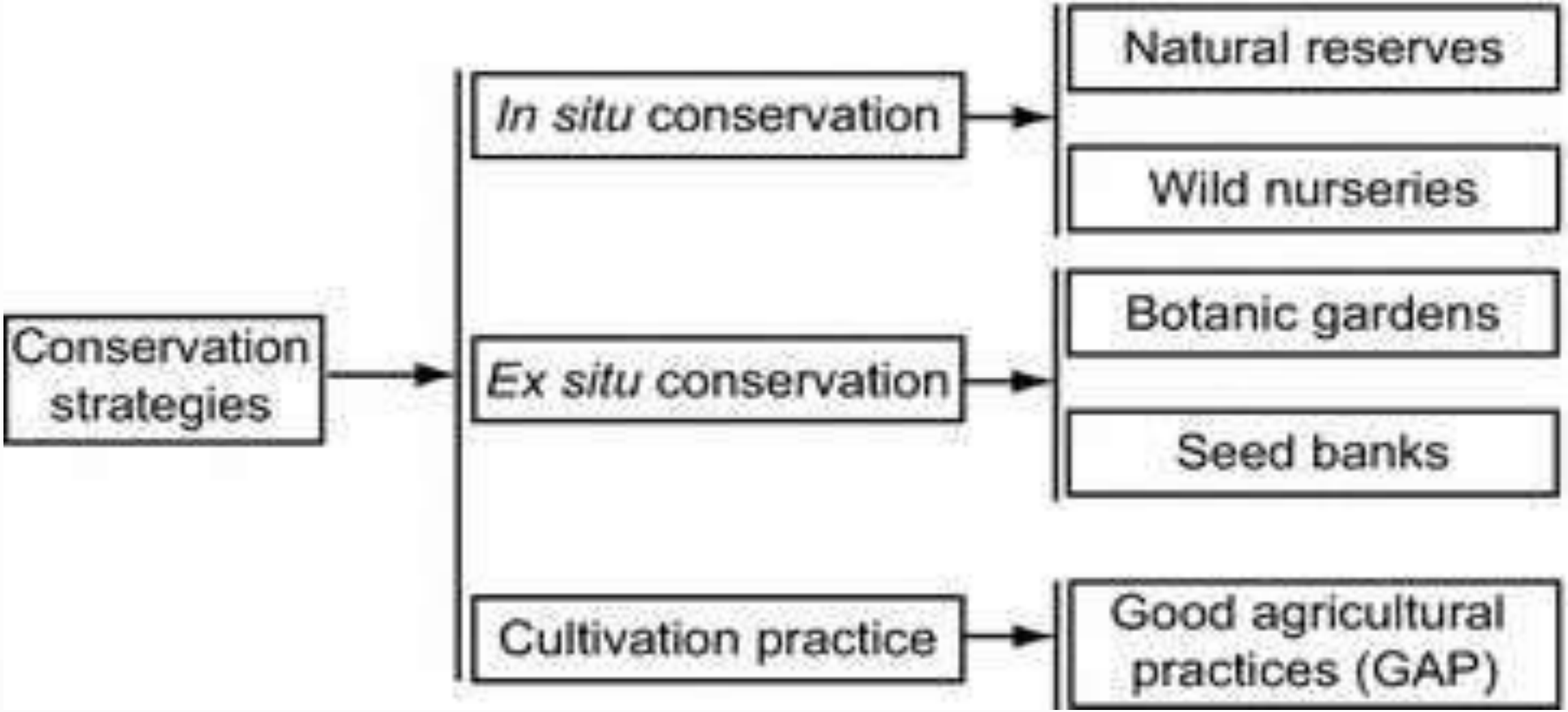
There are different primary and secondary factors that pose threat to many medicinal plants.

- Degradation of habitat due to expanding human activity,
- Forest decline
- Destructive collection of plant species,
- Invasion of exotic species that compete with native species,
- Increased spread of diseases,
- Industrialization,
- Over exploitation,
- Human socioeconomic change and upheaval,
- Changes in agricultural practices,
- Excessive use of agrochemicals, natural and manmade calamities, genetic erosion etc.

Need for conservation of medicinal plants

- To meet the requirements of expanding regional and international markets healthcare products and needs of growing populations
- To meet the increasing demand for raw material needed for domestic consumption and for export
- Over one and a half million practitioners of the Indian systems of medicine, in the oral and codified streams, use medicinal plants in preventive, promotive and curative applications.
- Several medicinal plants have been assessed as endangered, vulnerable and threatened due to over harvesting in the wild.
- While the demand for medicinal plants is increasing, their survival in their natural habitats is under growing threat.
- Hence there is a need for conservation, cultivation, maintenance and assessment of M. plants for future use.

Conservation strategies



Conservation strategies

The two main strategies are

1. ***In situ (in their natural surroundings) conservation.***

Examples:

- BIO SPHERE RESERVES: https://en.wikipedia.org/wiki/Biosphere_reserves_of_India
- NATIONAL PARKS: https://en.wikipedia.org/wiki/List_of_national_parks_of_India
- WILD LIFE SANCTUARIES: http://www.thrillophilia.com/blog/top-10-wildlife-sanctuaries-in-india/

1. ***Ex situ (protection of species outside their natural* habitats)**

Examples:

- SELECTION OF SUPERIOR GERM PLASM:
- FIELD GENE BANKS:https://www.business-standard.com/article/news-_ians/india-s-first-field-gene-bank-for-litchis-set-up-in-bihar-_115082600563_1.html
- BOTANICAL GARDENS: https://sikkimadventuretourism.com/jawaharlal-_nehru-botanical-garden
- EXPERIMENTAL GARDEN: https://bsi.gov.in/Center/209_7_Botanic-_Gardens-Under-The-Botanical-Survey-of-Indi.aspx

In-situ Vs Ex-situ

FIG :- IN SITU CONSERVATION(NATIONAL PARK , ETC.)

Captive Breeding
Great Plains Zoo *(America)*

Botanical Gardens
Kirstenbosch *(South Africa)*

Seed Banks
Svalbard *(Norway)*

In situ conservation

- *In situ or on site conservation involves maintaining genetic resources in their* natural habitats i.e., within the ecosystem to which it is adapted, whether as wild or crop cultivar in farmer's field as components of the traditional agricultural systems.
- The key operational steps for establishing *in situ gene* banks for conservation of prioritized medicinal plants include: Threat assessment, establishment of a network of medicinal plant forest reserves, involving local stakeholders, botanical, ecological, trade and ethno-medical surveys, assessing intraspecific variability of prioritized species, designing species recovery programmes, establishment of a medicinal plant seed centre, etc.
- Conclusively, no *in situ* conservation project can succeed without the complete cooperation and involvement of local people.

STATE WISE DETAILS OF THE PROTECTED AREA NETWORK OF INDIA

State-wise details of the Protected Area Network of the country

S.No.	State/UT	No. of National Parks	No. of Wildlife Sanctuaries	No. of Conservation Reserves	No. of Community Reserves
1	Andhra Pradesh	6	21	0	0
2	Arunachal Pradesh	2	11	0	0
3	Assam	5	18	0	0
4	Bihar	1	12	0	0
5	Chhatisgarh	3	11	0	0
6	Goa	1	6	0	0
7	Gujarat	4	23	1	0
8	Haryana	2	8	2	0
9	Himachal Pradesh	5	32	0	0
10	Jammu &Kashmir	4	15	34	0
11	Jharkhand	1	11	0	0
12	Karnataka	5	22	2	1
13	Kerala	6	16	0	1
14	Madhya Pradesh	9	25	0	0
15	Maharashtra	6	35	1	0
16	Manipur	1	1	0	0
17	Meghalaya	2	3	0	0
18	Mizoram	2	8	0	0
19	Nagaland	1	3	0	0
20	Orissa	2	18	0	0
21	Punjab	0	12	1	2
22	Rajasthan	5	25	3	0
23	Sikkim	1	7	0	0
24	Tamil Nadu	5	21	1	0
25	Tripura	2	4	0	0
26	Uttar Pradesh	1	23	0	0
27	Uttaranchal	6	6	2	0
28	West Bengal	5	15	0	0
29	Andaman & Nicobar	9	96	0	0
30	Chandigarh	0	2	0	0

Advantages of in-situ conservation

- Animals are still being utilized
- The performance characteristics can be properly recorded and evaluated
- Breeds have the opportunity to evolve

Disadvantages

- Animals are at risk from diseases and other natural disasters.
- Genetic drift may result in unfavourable genetic changes if the population is small,
- There is a risk of increasing inbreeding and hence homozygosity, which is associated with reduced fitness.
- The animals may be less productive and so more costly to maintain.

Ex situ conservation

- *Ex situ conservation, involves conservation of biodiversity outside the native* or natural habitat where the genetic variation is maintained away from its original location
- The *ex situ genetic conservation fulfils the requirement of present* or future economic, social and environmental needs.
- Conservation also includes propagation and assessment of molecular diversity
- Conservation of medicinal plants include a combination of methods, depending on factors such as geographic sites, biological characteristics of plants, available infrastructure, and network having an access to different geographical areas, human resources and number of accessions in a given collection

IN SITU VERSUS *EX SITU*

IN SITU	*EX SITU*
Means "in the original place"	Means "outside the original place"
*In situ*methods are carried out on-site such as in the wild	*Ex situ*methods are carried out off-site such as in a laboratory, botanical garden, zoo, or aquarium
Methods are applicable for large populations	Methods are applicable for small populations
Experimental conditions are difficult to maintain	Experimental conditions can be easily maintained
Less expensive	More expensive
Do not require much equipment and it is less labour intensive	Require specific equipment and it is labour-intensive
Require a large area	Require a small area

Advantages and disadvantages of ex-situ conservation methods

Conservation strategy	Advantages	Disadvantages
• Seed Banks:	- Propagules readily available for use, - Minimum work, little space is required, - Provenance (clinical, geographical) variation can be conserved provided species range adequately sampled.	- Recalcitrant seed can not be conserved, - Large seed preservation is problematic - Dose not conserve associated species.
• Pollen Banks:	- Minimum space required - Applicable for plants with recalcitrant or orthodox seed	- Only half of the genome conserved, - Tricellular pollen storage is problematic
• Tissue Culture Banks:	- Minimum space required - Genetic erosion reduced - Short time required to produce propagules	- Sometime sampling is problematic - Problem some clonal variation
• DNA Banks or Gene Banks:	- Minimum space is required, - Species with high extinction potential can be conserved, - Applicable to all kinds of plants & animals,	- Very costly to maintain the system - Not a easy method, which required skilled persons.
• Cryopreservation of ovum, sperm or embryo	- Minimum space is required, - All kinds of plants/animals components can be preserved	- Involves freezing, with liquid nitrogen, very costly method - Viability of healthy clone is sometime questionable

In vitro regeneration

- *In vitro regeneration include plant/explant growth, maintenance under* disease free condition, retention of regenerative potential, genetic stability, and ensuring that there is no damage to the live material.
- It offers a number of advantages over the *in vivo method:*

➢ Great savings in storage space and time

➢ Possibility of maintaining species for which seed preservation is impossible or unsuitable and

➢ Disease-free transport and exchange of germplasm, since cultures are maintained under phytosanitary conditions.

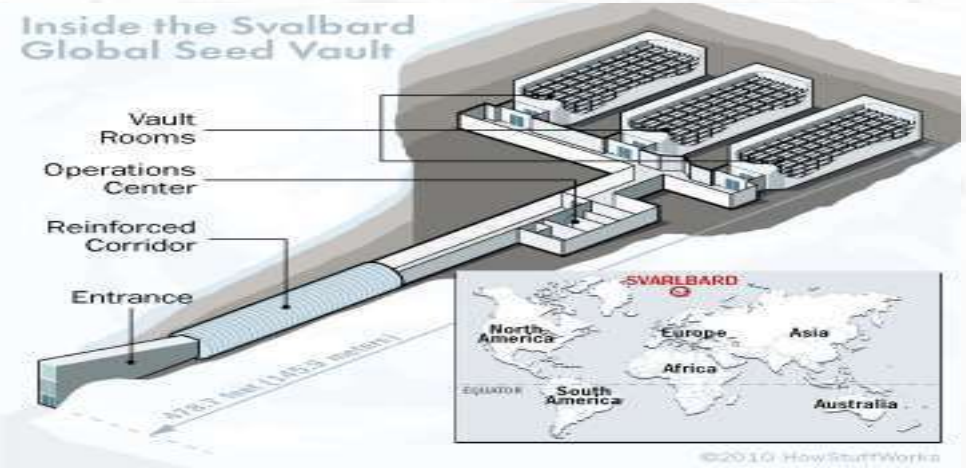
Cryobanks for conservation

- Cryopreservation of plant cells and meristems is an important tool for longterm storage of germplasm or experimental material without genetic alteration using a minimum space and maintenance.
- The development of methods to store apical meristems in liquid nitrogen successfully is needed to aid in the conservation of genetic resources.
- Cryobanks are basically meant for storage of germplasm.
- For longterm preservation, cryogenic storage at ultra low temperatures under **liquid nitrogen (-150 to -196°C) is the method of choice.**
- Relatively new to plants, cryopreservation has followed advances made in the mammalian systems is achieved either through slow cooling or vitrification.
- Encapsulation/dehydration is another new technique that offers practical advantages.
- It is based on the technology originally developed for production of synthetic seeds, i.e., somatic embryos encapsulated in a hydrosoluble gel.
- Several types of *in-vitro* raised materials such as meristems/shoot tips, cell suspensions, protoplasts, somatic embryos and pollen embryos of medicinal and aromatic species have been studied from the cryopreservation perspective.

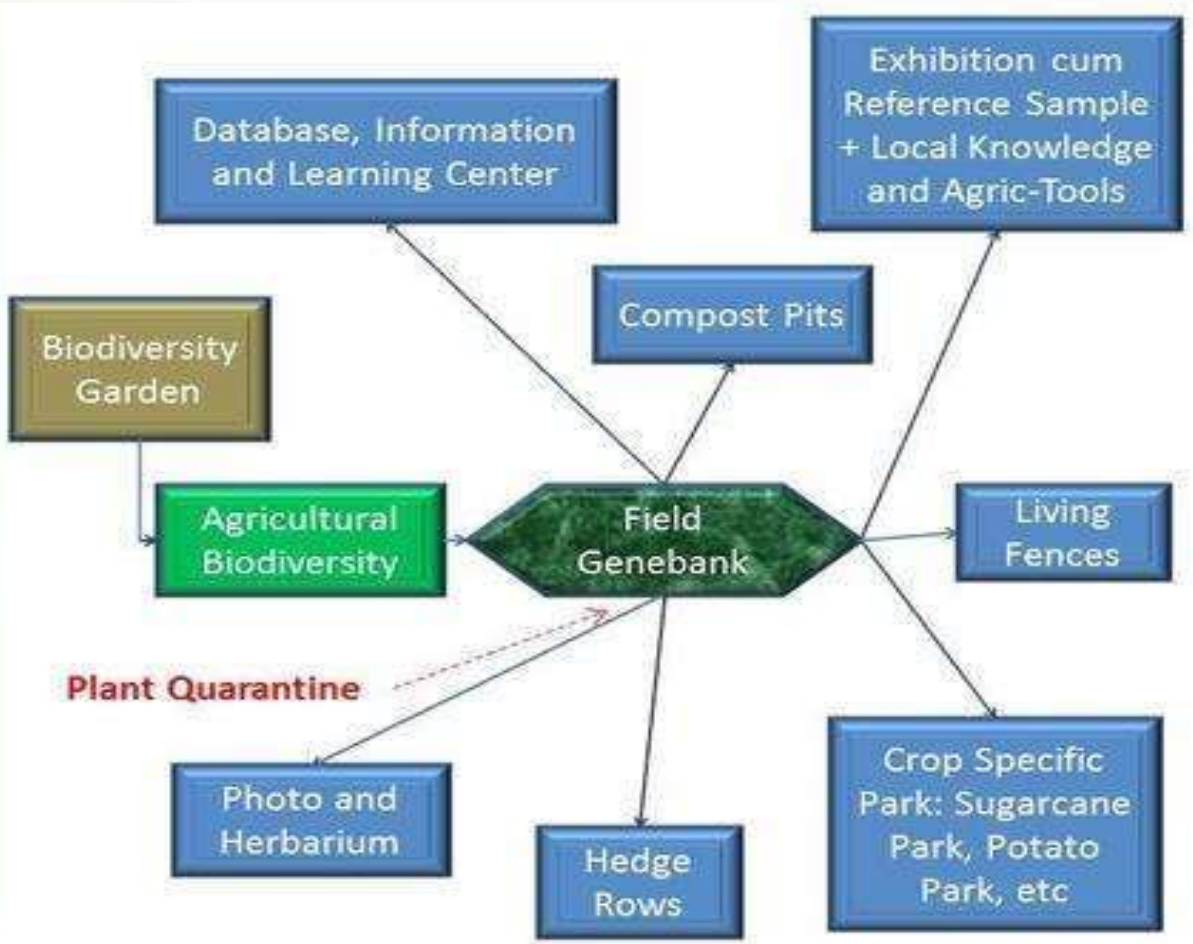
SEED BANK

- A seed bank preserves dried seeds, by storing them at a very low temperature.
- Spores and pteridophytes are conserves in seed banks, but other seedless plants such as tubercrops can not be preserved this way.
- A place where germplasm is conserved in the form of seed is called seed gene bank.

The arctic seed bank- Svalbard seed vault exterior




Collections and storage
Learning center
Diversity fair
Database management
Resources management
CSB
Characterization / evaluation/ enhancement
Diversity blocks
Regeneration/ multiplication
Linkage and collaboration
Management of germplasm flow


Database, Information and Learning Center
Exhibition cum Reference Sample + Local Knowledge and Agric-Tools
Compost Pits
Biodiversity Garden
Agricultural Biodiversity
Field Genebank
Living Fences
Plant Quarantine
Photo and Herbarium
Hedge Rows
Crop Specific Park: Sugarcane Park, Potato Park, etc

Seed Bank Advantages

1. Readily Available to geneticists and crop breeders

Seed Bank Disadvantages

1. Storage and grow-out costs are high so that only the most useful food, forage, and forestry crops are maintained
2. USDA has had 160,000 samples stored since 1898 but only 5-10% are still alive today
   - National Center for Genetic Resources Preservation is using tubes filled with liquid nitrogen in deep freezes that will only have a 1% loss in germination over a hundred billion years
3. Evolution is stopped. As pests evolve new virulence, the stored crops are not co-evolving with them

References:

1. "WHO Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants". World Health Organization. 2003. Retrieved 26 February 2017
2. Shah Biren ,Seth A.K. Text book of Pharmacognosy and Phytochemistry, second edition , CBS publishers pvt. Ltd, pg 69-78.
3. C.K. Kokate, A.P. purohit ,S.B. Gokhale Pharmacognosy Golden Jubilee 50 Edition, Nirali Prakashan Page-04.01-04.12
4. Jarald E.D., Jarald S.E.(2007), Test book of pharmacognosy & Phytochemistry, 1st edition, CBSPublishers & distributors, New Delhi, p.no. 2213-259
5. T.E.Walis, Textbook of pharmacognosy, 5th edition, published by CBS Publisher & Distributor,p.no. 242-296