BT401 – FINALTERM MERGED PPT
(LECTURE 61 TO 120)
Genetic Resources & Conversation

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Mechanism of cryopreservation in plants

Mechanism of cryopreservation in plants

Leaning objectives

What is the mechanism of cryopreservation in plants?

Mechanism of cryopreservation in plants

The cryopreservation technique followed by the regeneration of plants involves following steps :

1. Selection of material.
2. Addition of cryoprotectant.
3. Freezing.
4. Storage in liquid nitrogen.
5. Thawing.
6. Washing and re-culturing.
7. Measurement of viability.
8. Regeneration of plants.

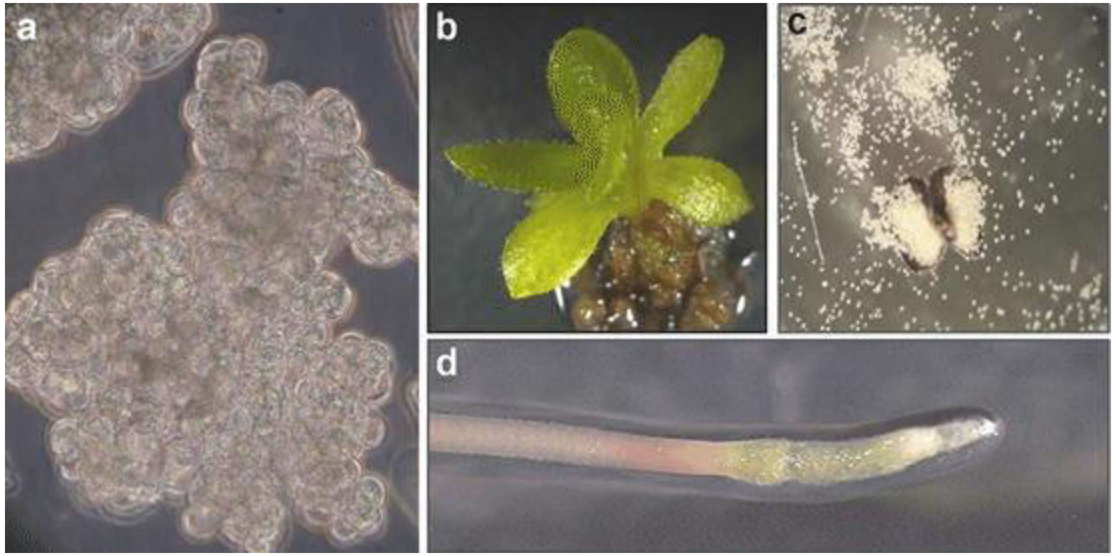
1.Selection of plant material

Selection of proper plant material is important.

Two important factors depend on it such as (a) nature and (b) density.

Any tissue can be selected for this purpose. e.g. meristem, embryo, ovules, seeds etc..

The density should be high.

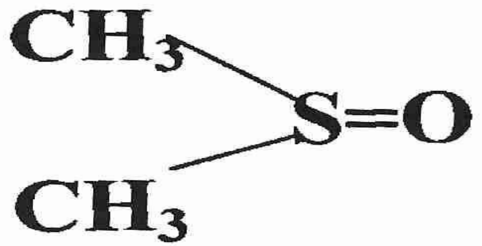


2. Addition of cryoprotectant

They are chemical which prevent cryo-destruction.

These are sucrose, alcohols, glycols, some amino acid (proline), DMSO (dimethyl sulfoxide).

Generally two Cryo protective agents should be used together instead of single one as they are more effective.



dimethylsulfoxide (DMSO)

3. Freezing

The sensitivity of cells to low temperature depends on the plant species. There are four different types of methods :

1. **Slow freezing method** - the tissue or plant material is slowly frozen at slow cooling rate. The advantage is the plant cells are partially dehydrated and survive better.
2. **Rapid freezing method** - it involves plunging the vials in liquid nitrogen. The temperature decreases from -300 to -1000 degree rapidly.
3. **Combined freezing method** - this is combination of both slow and rapid freezing method. The process is carried out in step wise like manner.
4. **Dry freezing method** - in this method dehydrated cells and seeds are stored.

4. Storage

The maintenance of the frozen cells or material at specific temperature is very important.

In general the temperature is kept -70 to -196 degree.

Prolong storage is done at temperature of -196 degree in liquid nitrogen.

To prevent damage, continuous supply of nitrogen is done.

5. Thawing

Usually carried out by plunging the vials into warm water bath with vigorous swirling.

As thawing occurs the vials are transferred to another bath at 0 degree.

6. Washing and re-culturing

The preserved material is washed few times to remove the cryoprotectant.

This material is then re-cultured in a fresh medium

7. Measurement of viability

There is possibility of death of cells due to storage stress.

Thus viability can be found at any stage.

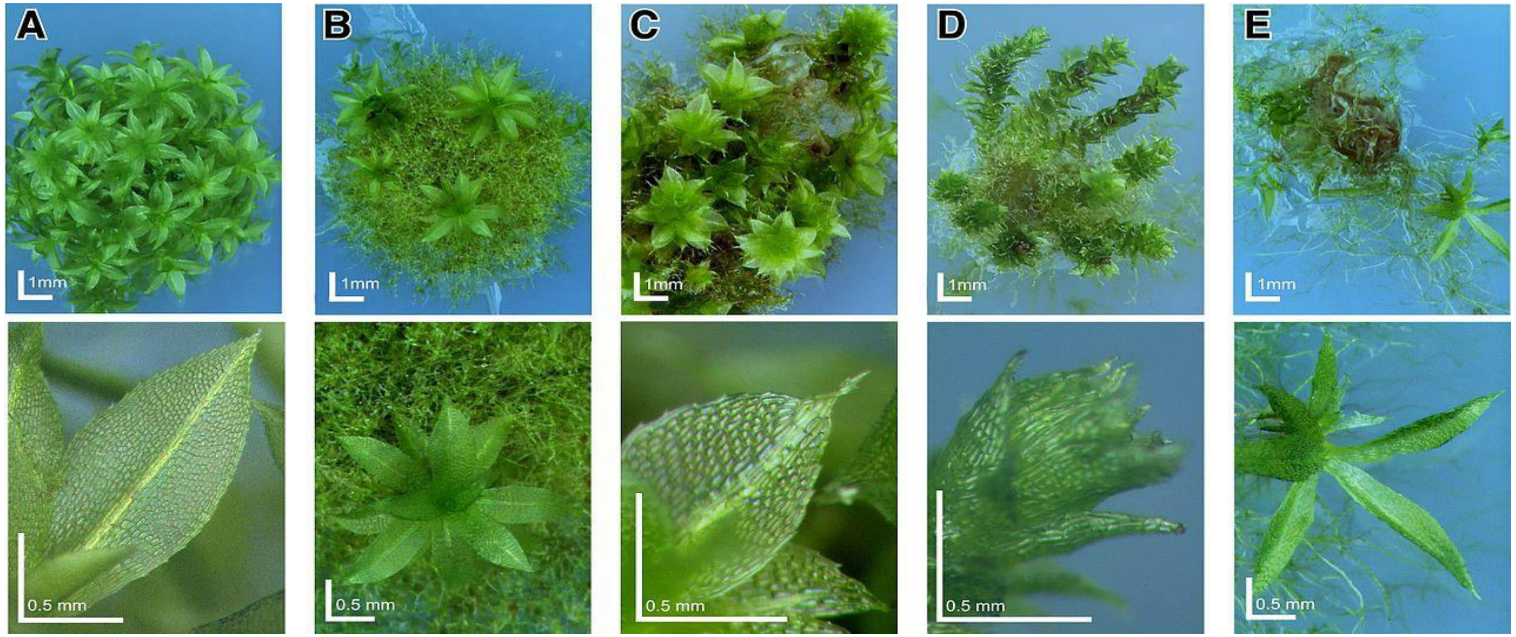
It is calculated by formula :

$$\left(\frac{No\ of\ cells\ growing}{No\ of\ cells\ thawed}\right) \times 100$$

8.Plant regeneration

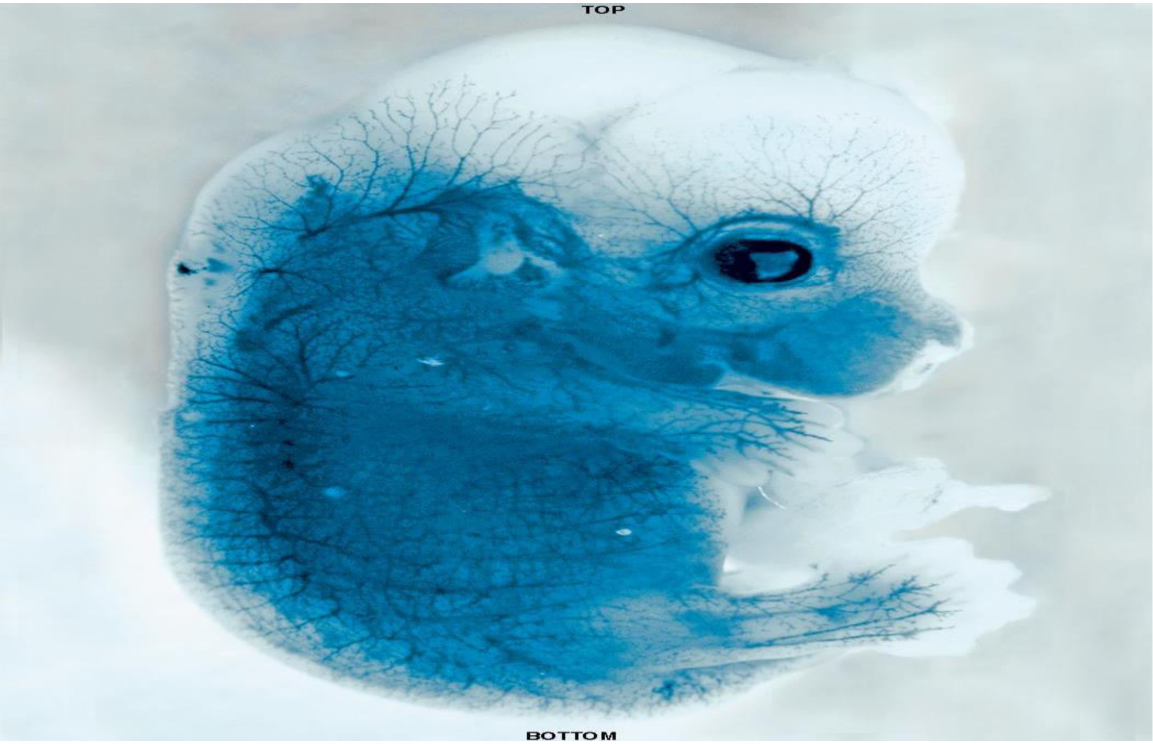
The viable seeds are cultured on non specific growth medium.

Suitable environmental conditions are maintained.



Thank you!

Cryo-conservation of animal genetic resources



Cryo-conservation of animal genetic resources

Learning objectives

- What is mechanism of cryopreservation of animal genetic resources?

Cryo-conservation of animal genetic resources

Cryo-conservation of animal genetic resources is a strategy wherein samples of animal genetic materials are preserved cryogenically.

Animal genetic resources, as defined by the Food and Agriculture Organization of the United Nations, are "those animal species that are used, or may be used, for the production of food and agriculture, and the populations within each of them

Genetic materials that are typically cryogenically preserved include sperm, oocytes, embryos and somatic cells.

Cryogenic facilities are called gene banks and can vary greatly in size usually according to the economic resources available.

They must be able to facilitate germplasm collection, processing, freezing, and long term storage, all in a hygienic and organized manner.

Methodology

Collection

Here are several ways to collect the genetic materials based on which type of germplasm.

Examples

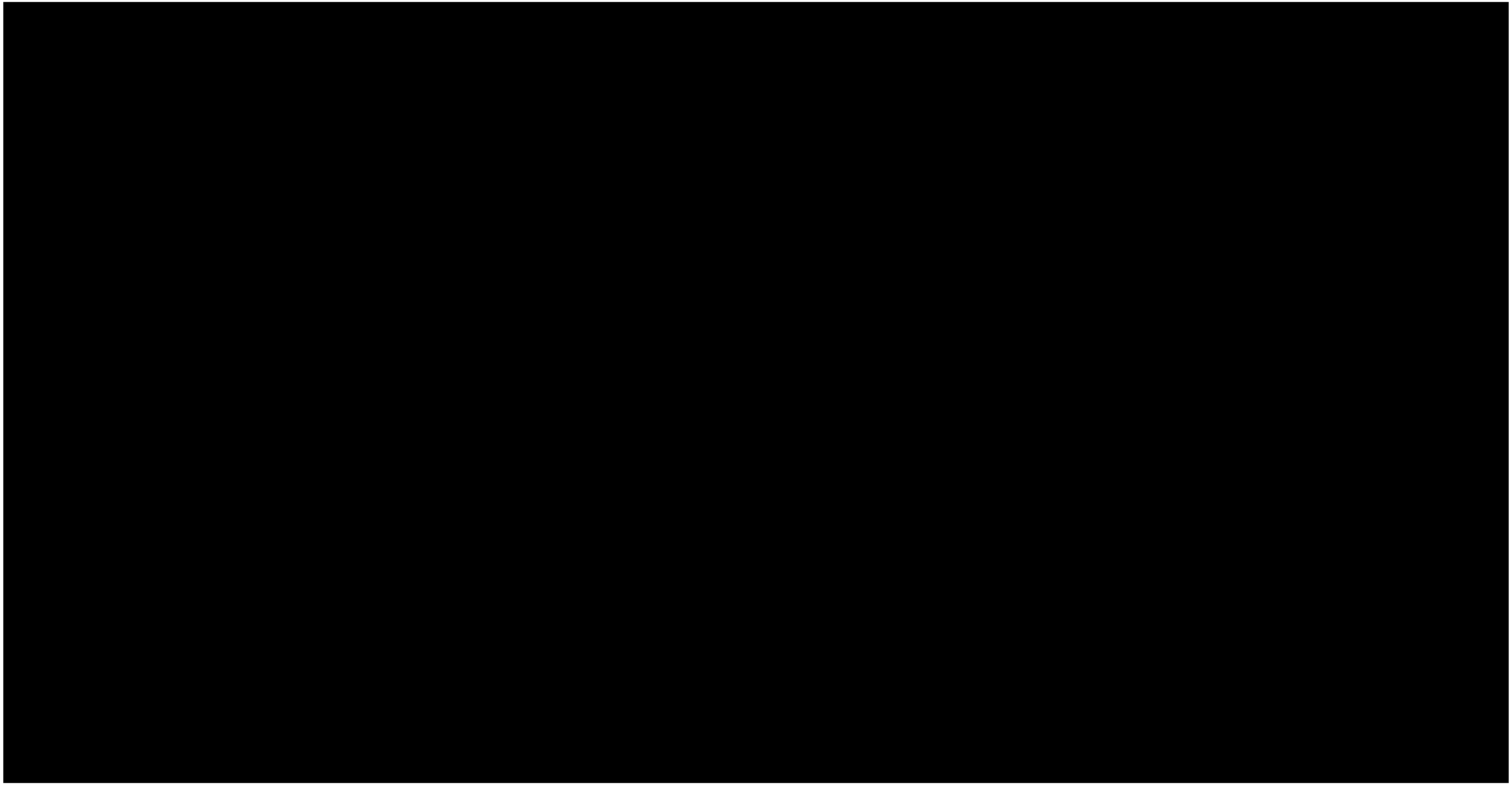
- Embryo
- Somatic cells

Methodology

Freezing

There are two cryopreservation freezing methods

- Slow freezing
- Vitrification



Thank you!

Advantages and disadvantages of Cryopreservation

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Advantages

- Cryopreservation helps in the preservation of biological materials.
- Cryopreservation is used to maintain the biosynthetic properties of plants
- Sperm, gametes, embryos, tissues, bone marrow, organ can be preserved.
- Helps to study the adapting nature of plants and animals under the low temperature.
- Used to preserve the genetic materials of the plants which are on the verge of extinction
- Prevent in breeding
- Reduced risk of microbial contamination
- Reduced risk of cross contamination with other cell lines
- Reduced risk of genetic drift and morphological changes

- Embryo cryopreservation is used most often to store good quality excess embryos resulting from an IVF treatment cycle.
- Embryos can be stored for a patient who elects to have her eggs fertilized with donor sperms. Pregnancies have been reported from embryos stored for 16 years.
- Human sperm cryopreservation is widely used to store donor and partner spermatozoa to preserve sperms
- It also ensure the recovery of a small number of spermatozoa in several male factor infertility17 .
- It is commonly called sperm-banking is a procedure to preserve sperm cells.

Disadvantages

There are few disadvantages to storing eggs.

- During the cycle where the eggs are harvested, patients undergo a traditional IVF protocol.
- There are known side effects with fertility medication including the risk of ovarian hyper stimulation syndrome or OHSS.
- The lengthy process of slow-rate freezing and the subsequent long-term storage of these valuable cells can often be costly, consuming large amounts of energy to accurately maintain such low temperatures.

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Ovarian hyper stimulation syndrome (OHSS)

- Ovarian hyper stimulation syndrome (OHSS) affects women taking injectable hormone medications to stimulate the development of eggs in the ovaries.
- This may occur in women undergoing in vitro fertilization (IVF), ovulation induction or intrauterine insemination.
- Too much hormone medication in system can lead to OHSS, in which ovaries become swollen and painful.
- A small number of women may develop severe OHSS, which can cause rapid weight gain, abdominal pain, vomiting and shortness of breath.
- Less often, OHSS happens during fertility treatments using medications you take by mouth, such as clomiphene (Clomid, Serophene).

Treatment

- Anti-nausea medication, prescription painkillers or both
- Frequent physical exams and ultrasounds
- Daily weigh-ins and waist measurements to check for drastic changes
- Measurements of how much urine you produce each day
- Blood tests to monitor for dehydration, electrolyte imbalance and other problems
- Adequate fluid intake
- Drainage of excess abdominal fluid using a needle inserted in your abdominal cavity
- Support stockings, to help prevent blood clots

Obstacles

- Upto 60% human body is composed of water. What’s the issue then?
- Actually the freezing point of water is 0 degree centigrade while the cryoscopy temperature can be as low as -90 degree centigrade. • Very expensive Technique
- Ice formation can result in the needle shaped crystals resulting in the damage to cell membrane.
- Unequal distribution or over distribution of cryoprotectants.
- Moreover, thermal gradients can induce mechanical stress due to uneven expansion or contraction in the biomaterial.
- The cooling rate required for optimal survival varies by several orders of magnitude between different cell types. • Mass transfer limitations

Thank you!

Applications of Cryopreservation

Applications of Cryopreservation

In Animal Husbandry

The introduction of cryopreservation technology leads a major breakthrough in animal husbandry .Since the 1st successful cryopreservation of bull semen has been used to propagate the rare and endangered species using assisted reproduction techniques.

In fishery science

The 1st report on fish sperm cryopreservation was published by Blaxter (1953). To date milt (semen) of over 200 species of fresh water and marine fish have been cryopreserved and have been adequated for the purpose of cryobanking(10,11,12) . In fish aquaculture the successful cryopreservation of gametes and embryos could offer new commercial possibilities, allowing the unlimited production of fry and potentially healthier and better conditioned fish as required

In medical science

Low temperature have been used in medicine and to prevent food spoilage since ancient time. Now- a- days it is used in fertility treatment the transport of human organs and the long- term storage of biological specimens, either for future or simply as a record of biodiversity.

Cryopreservation of oocyte

Human oocyte cryopreservation is a new technology in which a woman's eggs are extracted, frozen or stored. Egg freezing benefits two groups of women. One those who are diagnosed with a medical condition whereby the necessary treatments for cure may render them sterile or unable to produce viable eggs. The second who are delaying their childbearing for personal reasons. Eggs frozen at the age of 35 are more usable than fresh oocytes produced at age 43 years of age

Cryopreservation of testicular tissue

Cryopreservation of immature testicular tissue is a developing method to avail reproduction to young boys who need to have gonado toxic therapy

Embryo cryopreservation

Embryo cryopreservation is used most often to store goodquality excess embryos resulting from an IVF treatment cycle. Embryos can be stored for a patient who elects to have her eggs fertilized with donar sperms. Pregnancies have been reported from embryos stored for 16 years

Cryopreservation of ovarian tissue

Ovarian tissue cryopreservation is considered to be an experimental technique for fertility preservation. This procedure is an option for patients who require immediate gonadotoxic treatment of aggressive malignancies when there is insufficient time to allow the woman to undergo ovulation induction, oocyte retrieval and crypreservation oocytes and/or embryos.

Cryopreservation of stem cell

An important application of cryopreservation is in the freezing and storage of hematopoietic stem cell, which are found in the bone marrow rescue, hematopoietic stem cells are collected from a patient's bone marrow prior to treatment with high-dose chemotherapy. Following treatment, the patient's cryopreserved cells are thawed and infuse back into the body. This procedure is necessary, since high dose chemotherapy is extremely toxic to the bone marrow

Preservation of micro-biology cultures

Bacteria and fungi can be kept short term refrigerated however, cell division and metabolism is not completely arrested and thus is not an optimal option for long term storage or to preserve cultures genetically or phenotypically as cell divisions can led to mutations.

To conserve plant biodiversity

conservation of plant biodiversity is an important issue concerning the human population worldwide. Conservation of plant biodiversity can be performed in situ and ex situ. These two methods are complementary and are not exclusive. They offer different alternatives for conservation, but selection of the appropriate strategy should be based on a number of criteria, including the biological nature of the species and the feasibility of applying the chosen methods22 . At present biotechnological methods have been used to conserve endangered, rare crop ornamental, medicinal and forest species for short-,medium-, and long- term

Future of cryopreservation

Vitrification method of cryopreservation may bring new opportunities to research protocols. It is still an experimental procedure. There are two major concern about vitrification - toxicity of high concentration of cryoprotectants used and microbial contamination of liquid nitrogen. Several IVF programs have adopted the vitrification method as the sole procedure for day-3 human embryos and for human blastocysts, with excellent survival and pregnancy rates. The challenge now is to find a protocol to successfully vitrify human oocytes for which the slow freezing method has yet to produce acceptable.

Cryopreservation of sperm

Today human sperm cryopreservation is widely used to store donor and partner spermatozoa before assisted reproduction treatments to preserve spermatozoa before therapy for malignant diseases, vasectomy or surgical in fertility treatments and to ensure the recovery of a small number of spermatozoa in several male factor infertility

Thank you!

Categories of Protected areas

Category Ia: Strict Nature Reserve

Primary objective

To conserve

- Regionally
- Nationally
- Globally outstanding ecosystems
- Species (occurrences or aggregations)
- Geo diversity features

Category Ia: Strict Nature Reserve

Other Objectives

- To preserve ecosystems.
- To secure examples of the natural environment for scientific studies.
- To minimize disturbance through careful planning.
- To conserve cultural and spiritual values associated with nature.

Category Ia: Strict Nature Reserve

Distinguishing features

The area should generally:

- Have a largely complete set of expected native species.
- Be capable of being managed to ensure minimal disturbance.
- Be free of significant direct intervention by modern humans.

Category Ia: Strict Nature Reserve

- Have a full set of expected native ecosystems, largely intact with intact ecological processes, or processes capable of being restored with minimal management intervention.
- Be managed for relatively low visitation by humans.

Category Ia: Strict Nature Reserve

Definition:

- Protected areas that are strictly set aside to protect biodiversity where human visitation, use and impacts are strictly controlled to ensure protection of the conservation values.

Category Ia: Strict Nature Reserve

Role in the landscape/seascape

- Protecting some of the earth's richness that will not survive outside.
- Protecting additional ecosystem services.
- Providing areas where ecosystems can be studied in as pristine an environment as possible.

Category Ia: Strict Nature Reserve

- Protecting natural sites that are also of religious and cultural significance.

Issues for consideration

- There are few areas not under some kind of legal or at least traditional ownership, so that finding places that exclude human activity is often problematic.

Category Ia: Strict Nature Reserve

- Most apparent problem is with climate and air pollution
- New and emerging diseases.
- In an increasingly modified ecology, it may become increasingly difficult to maintain pristine areas through non-intervention.

Thank you!

IUCN Categories of Protected Areas

Definition:

- Large natural or near natural areas set aside to protect large-scale ecological processes, which also provide a foundation for environmentally scientific, educational, recreational and visitor opportunities.

Category II: Category II: National Park

Category II: Category II: National Park

Primary objective

- To protect natural biodiversity along with its underlying ecological structure.

Other objectives

- To manage the area in order to perpetuate, in as natural a state as possible.

Category II: Category II: National Park

- To maintain viable and ecologically functional populations.
- To contribute to local economies through tourism.
- To manage visitor use for inspirational, educational recreational purposes.

Category II: Category II: National Park

Distinguishing features

- The area should contain representative examples of major natural regions, and biological and environmental features or scenery.
- It should be of sufficient size to maintain ecological processes.

Category II: Category II: National Park

- The composition, structure and function of biodiversity should be to a great degree in a “natural” state.

Role in the landscape/seascape

- Protecting larger-scale ecological processes.
- Protecting compatible ecosystem services.

Category II: Category II: National Park

- Protecting particular species and communities that require relatively large areas of undisturbed habitat.
- To inform and excite visitors about the need for and potential of conservation programmes.

To support compatible economic development, mostly through recreation and tourism, that can contribute to local and national economies and in particular to local communities.

Category II: Category II: National Park

Issues for consideration

- Commercialization of land and water in category II is creating challenges in many parts of the world.

Category III: National Monument-Feature

Category III: National Monument-Feature

Definition:

- Protected areas set aside to protect a specific natural monument.
- They are generally quite small protected areas and often have high visitor value.

Category III: National Monument-Feature

Primary objective

- To protect specific outstanding natural features
- Their associated biodiversity and habitats.

Category III: National Monument-Feature

Other objectives

- To provide biodiversity protection in landscapes or seascapes that have otherwise undergone major changes
- To conserve traditional spiritual and cultural values of the site.

Category III: National Monument-Feature

Distinguishing features

- Category III protected areas are usually relatively small sites that focus on one or more prominent natural features and the associated ecology, rather than on a broader ecosystem.

Criteria

Natural geological and geomorphological features:

- Waterfalls, cliffs, craters, caves etc.

Culturally-influenced natural features:

- Cave dwellings

Natural-cultural sites:

Forms of sacred natural sites (sacred groves, springs, waterfalls, mountains, sea coves etc.) of importance to one or more faith groups

Category III: National Monument-Feature

Cultural sites with associated ecology:

- Where protection of a cultural site also protects significant and important biodiversity, such as archaeological or historical sites that are inseparably linked to a natural area.

Category III: National Monument-Feature

Role in the landscape/seascape

- Important natural monuments can sometimes provide an incentive for protection and an opportunity for environmental/cultural education even in areas where other forms of protection are resisted due to population or development pressure, such as important sacred or cultural sites and in these cases category III can preserve samples of natural habitat in otherwise cultural or fragmented landscapes.

Thank you!

Category III: National Monument-Feature_2

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Management

These areas are managed to maintain certain natural features, and this can be carried out by a range of actions depending on the governance type of the area

Legal and compliance

The classification of a Category III protected area requires that such areas are managed for conservation by legal or other effective means, and therefore legal recognition and protection at the national or sub-national level is likely to be present in these sites. The level of legal protection will however vary between countries, and will depend on the governance type of the area, as they receive differing levels of recognition by government in different countries. Nonetheless a number of national laws are likely to apply to these sites that deter large-scale economic activities in order to maintain the conservation values of these areas.

Biodiversity importance

The main emphasis of protection in category III areas is on the natural features found in these sites. Their role in the conservation of species and habitats, hence, varies. In some cases their contribution to biodiversity conservation may be indirect result of protection of natural features. In other cases (e.g. natural cave system) they may play a key role in the wider conservation strategy of an area.

Socio-cultural values

Category III areas are likely to hold socio-cultural values as they may have features such as sacred groves, springs, waterfalls, mountains, sea coves etc. of importance to one or more faith groups. These areas are often of significant tourism value and can be managed with the objective of promoting sustainable tourism.

Issues for consideration

It will sometimes be difficult to ascertain the conservation attributes of category III sites, particularly in cases where there may be pressure to accept sites within a protected area system to help protect cultural or spiritual values.

Not all natural monuments are permanent

It is sometimes difficult to draw the boundaries between a natural monument and cultural site, particularly where archaeological remains are included within category III.

Some apparent “monuments” may require protection of a larger ecosystem to survive.

ategory III differs from the other categories in the following ways:	
Category Ia	Category III is not confined to natural and pristine landscapes but could be established in areas that are otherwise cultural or fragmented landscapes. Visitation and recreation is often encouraged and research and monitoring limited to the understanding and maintenance of a particular natural feature.
Category II	The emphasis of category III management is not on protection of the whole ecosystem, but of particular natural features; otherwise category III is similar to category II and managed in much the same way but at a rather smaller scale in both size and complexity of management.
Category IV	The emphasis of category III management is not on protection of the key species or habitats, but of particular natural features.
Category V	Category III is not confined to cultural landscapes and management practices will probably focus more on stricter protection of the particular feature than in the case of category V.
Category VI	Category III is not aimed at sustainable resource use.

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Thank you!

Category IV: Habitat-Species Management Area

Habitat-Species Management Area

Definition:

IUCN Management Category IV (Habitat/Species Management Area) refers to areas that are managed to protect particular species or habitats. They are defined by IUCN as *"protected areas aiming to protect particular species or habitats and management reflect this priority.*

Habitat-Species Management Area

Primary objective

- To maintain, conserve and restore species and habitats.

Other objectives

1. To protect vegetation patterns.
2. To protect fragments of habitats as components of landscape or seascape-scale conservation strategies.
3. To develop public education and appreciation of the species or habitat

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Habitat-Species Management Area

Distinguishing features

- Protection of particular species
- Protection of habitats
- Active management to maintain target species
- Active management of culturally-defined ecosystems

Habitat-Species Management Area

Role in the landscape/seascape

- Protect critically endangered populations of species.
- Protect rare or threatened habitats.
- Provide flexible management strategies and options in buffer zones around, or connectivity conservation corridors between, more strictly protected areas that are more acceptable to local communities and other stakeholders;
- Maintain species that have become dependent on cultural landscapes where their original habitats have disappeared or been altered.

Thank You!

Category IV: habitat-species management area

Management

These areas are managed to maintain or restore certain species and/or habitats, and this can be carried out by a range of actors depending on the governance type of the area (see IUCN Protected Area Management Categories for information on governance types). These are often areas that have already undergone substantial modification, where a high degree of human pressure often exists, and significant management intervention is necessary. Category IV areas will generally be publically accessible.

Legal and compliance

The classification of a category IV protected area requires that such areas are managed for conservation by legal or other effective means, and therefore legal recognition and protection at the national or sub-national level is likely to be present in these sites. The level of legal protection will however vary between countries, and will depend on the governance type of the area, as they receive differing levels of recognition by government in different countries. Nonetheless a number of national laws are likely to apply to these sites that deter large-scale economic activities in order to maintain the conservation values of these areas.

Biodiversity importance

Category IV areas are important for their role in ‘plugging the gaps’ in conservation strategies by protecting key species or habitats in ecosystems. It provides a management approach for areas that have already undergone substantial modification, necessitating protection of remaining fragments for identified target species with or without intervention.

Socio-cultural values

While Category IV areas are not necessarily associated with human presence and intervention, many exist in crowded landscapes and seascapes where human pressure is comparatively greater, both in terms of potential illegal use and visitor pressure.

Issues for consideration

Many category IV protected areas exist in crowded landscapes and seascapes.

The category IV protected areas that rely on regular management intervention need appropriate resources from the management authority.

Because they usually protect part of an ecosystem, successful long-term management of category IV protected areas necessitates careful monitoring and an even greater-than-usual emphasis on overall ecosystem approaches and compatible management in other parts of the landscape or seascape.

Category IV differs from the other categories in the following ways:

Category Ia	Category IV protected areas are not strictly protected from human use; scientific research may take place but generally as a secondary objective.
Category II	Category IV protected areas aim their conservation at particular species or habitats and may in consequence have to pay less attention to other elements of the ecosystem in consequence, whereas category II protected areas aim to conserve fully functional ecosystems.
Category III	The objective of category IV areas is of a more biological nature whereas category III is site-specific and more morphologically or culturally oriented.
Category V	Category IV protected areas aim to protect identified target species and habitats whereas category V aims to protect overall landscapes/seascapes with value for nature conservation
Category VI	Management interventions in category IV protected areas are primarily aimed at maintaining species or habitats while in category VI protected areas they are aimed at linking nature conservation with the sustainable use of resources

Thank you!

Category V: Protected Landscape-Seascape

Protected Landscape-Seascape

Definition:

- A protected area where the interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic value.

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Protected Landscape-Seascape

- Where safeguarding the integrity of this interaction is vital to protect and sustain the area and its associated nature conservation and other values.

Primary objective

- To protect and sustain important landscapes/seascaps and the associated nature conservation.

Protected Landscape-Seascape

Other objectives

- To maintain a balanced interaction of nature and culture.
- To contribute to broad-scale conservation by maintaining species associated with cultural landscapes and/or by providing conservation opportunities in heavily used landscapes;
- To provide opportunities for enjoyment, well-being and socio-economic activity through recreation and tourism;
- To provide natural products and environmental services;
- To provide a framework to underpin active involvement by the community in the management of valued landscapes or seascapes and the natural and cultural heritage that they contain;
- To encourage the conservation of agrobiodiversity and aquatic biodiversity;
- To act as models of sustainability so that lessons can be learnt for wider application.

Protected Landscape-Seascape

Distinguishing features

- Landscape and/or coastal and island seascape of high and/or distinct scenic quality and with significant associated habitats, flora and fauna and associated cultural features
- A balanced interaction between people and nature
- Unique or traditional land-use patterns

Desirable characteristics:

- Opportunities for recreation and tourism consistent with life style and economic activities;
- Unique or traditional social organizations, as evidenced in local customs, livelihoods and beliefs;
- Recognition by artists of all kinds and in cultural traditions (now and in the past);
- Potential for ecological and/or landscape restoration.

Protected Landscape-Seascape

Role in the landscape/seascape

- Some category V protected areas act as a buffer around a core of one or more strictly protected areas
- Category V protected areas may also act as linking habitat between several other protected areas.
- Category V offers unique contributions to conservation of biological diversity. In particular:
- Species or habitats that have evolved in association with cultural management systems and can only survive if those management systems are maintained
- To provide a framework when conservation objectives need to be met over a large

Thank you!

Category V: Protected Landscape-Seascape_2

Management

Management of these areas can be carried out by a range of actors depending on the governance type of the area .A high degree of human intervention is to be expected within these areas, including agriculture and forestry, although these practices should be traditional and sustainable systems of land-use.

Legal and compliance

The classification of a category V protected area requires that such areas are managed for conservation by legal or other effective means, and therefore legal recognition and protection at the national or sub-national level is likely to be present in these sites. The level of legal protection will however vary between countries, and will depend on the governance type of the area, as they receive differing levels of recognition by government in different countries.

As designated protected areas, these sites receive international attention and have been incorporated into a number of environmental safeguard standards.

Biodiversity importance

The biodiversity importance of category V areas is due to the important role they play in conservation at the landscape/seascape scale, particularly as part of a mosaic of management patterns, protected area designations and other conservation mechanisms.

Socio-cultural values

Evidence of traditional land use patterns is a key criterion for category V areas, and therefore these areas will hold certain socio-cultural values, largely that of resource use by local people such as sustainable forestry and agriculture. Human settlements are very likely to be present as a key characteristic of these areas is a long-history of interaction between people and their environment.

Issues for consideration

- Being a relatively flexible model, category V may sometimes offer conservation options where more strictly protected areas are not feasible.
- Category V protected areas can seek to maintain current practices, restore historical management systems or, perhaps most commonly, maintain key landscape values whilst accommodating contemporary development and change: decisions about this need to be made in management plans.
- The emphasis on interactions of people and nature over time raises the conceptual question for any individual category V protected area: at what point on the temporal continuum should management focus?
- Since social, economic and conservation considerations are all integral to the category V concept, defining measures of performance for all of these values is important in measuring success.

Category V differs from the other categories in the following ways:

Category Ia	Human intervention is expected. Category V does not prioritize research, though it can offer opportunities to study interactions between people and nature.
Category Ib	Category V protected areas are not “wilderness” as defined by IUCN. Many will be subject to management intervention inimical to the concept of category Ib.
Category II	Category II seeks to minimize human activity in order to allow for “as natural a state as possible”. Category V includes an option of continuous human interaction.
Category III	Category III focuses on specific features and single values and emphasises the monumentality, uniqueness and/or rarity of individual features, whereas these are not required for category V protected areas, which encompasses broader landscapes and multiple values.
Category IV	Category V aims to protect overall landscapes and seascapes that have value to biodiversity, whereas category IV aims often quite specifically to protect identified target species and habitats. Category V protected areas will often be larger than category IV.
Category VI	Category VI emphasises the need to link nature conservation in natural areas whilst supporting sustainable livelihoods: conversely category V emphasises values from long-term interactions of people and nature in modified conditions. In category VI the emphasis is on sustainable use of environmental products and services (typically hunting, grazing, management of natural resources), whereas in category V the emphasis is on more intensive uses (typically agriculture, forestry, tourism). Category VI will usually be more “natural” than category V.

Thank you!

Protected Area with Sustainable Use of Natural Resources

Category VI

Protected Area with Sustainable Use of Natural Resources

Definition:

Protected areas that conserve ecosystems and habitats, together with associated cultural values and traditional natural resource management systems.
Generally large, with most of the area in a natural condition
Where a proportion is under sustainable natural resource management

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Category VI

Primary objective

- To protect natural ecosystems
- Use natural resources sustainably, when conservation and sustainable use can be mutually beneficial.

Category VI

Other objectives

- To promote sustainable use of natural resources, considering ecological, economic and social dimensions;
- To promote social and economic benefits to local communities where relevant;
- To facilitate inter-generational security for local communities' livelihoods – therefore ensuring that such livelihoods are sustainable;
- To integrate other cultural approaches, belief systems and world-views within a range of social and economic approaches to nature conservation;
- To contribute to developing and/or maintaining a more balanced relationship between humans and the rest of nature;

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Criteria

- These areas aim to conserve ecosystems and habitats, together with associated cultural values and natural resource management systems
- They are unique in that they have the sustainable use of natural resources as a means to achieve nature conservation, together and in synergy with other actions more common to the other categories, such as protection.
- The category is not designed to accommodate large-scale industrial harvest.
- In general, IUCN recommends that a proportion of the area is retained in a natural condition, which in some cases might imply its definition as a no-take management zone.

Category VI

Role in the landscape/seascape

- Protected areas are particularly adapted to the application of landscape approaches.
- This is an appropriate category for large natural areas.
- It is particularly appropriate to the conservation of natural ecosystems when there are few or no areas without use or occupation.

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Thank you !

Protected Area with Sustainable Use of Natural Resources

Management

Management of these areas can be carried out by a range of actions depending on the governance type of the area. Human occupation and intervention is to be expected in these areas, although most practices will be traditional and low-impact as sustainable use is actively promoted.

Legal and compliance

The classification of a category VI protected area requires that such areas are managed for conservation by legal or other effective means, and therefore legal recognition and protection at the national or sub-national level is likely to be present for these sites. The level of legal protection will however vary between countries, and will depend on the governance type of the area, as they receive differing levels of recognition by government in different countries. Nonetheless a number of national laws are likely to apply to these sites that restrict large-scale economic activities in order to maintain the conservation values of these areas.

As designated protected areas, these sites receive international attention and have been incorporated into a number of environmental safeguard standards. These include those of multilateral financial institutions such as but not limited to the World Bank [2] and the International Finance Corporation .

Biodiversity importance

Category VI areas are unique among the IUCN Categories as they seek to achieve biodiversity conservation through a synergy between the sustainable uses of natural resources together with protection. These areas tend to be relatively large and are particularly relevant for the application of landscape approaches to conservation. As intervention within these areas is aimed at maintaining or restoring natural ecosystems, they can be anticipated to have high biodiversity values, and may include no-take areas as an integral part of maintaining these values.

Socio-cultural values

These areas can be expected to hold significant socio-cultural value. While industrial use is not expected, sustainable use by local and traditional communities is a key criterion, and the maintenance of these sustainable practices is as important as the maintenance of the natural resources on which people rely.

Issues for consideration

- Protection of natural ecosystems and promotion of sustainable use must be integrated and mutually beneficial.

- New skills and tools need to be developed by management authorities to address the new challenges that emerge from planning, monitoring and managing sustainable use areas.

- There is also need for development of appropriate forms of governance suitable for category VI protected areas and the multiple stakeholders that are often involved.

Category VI differs from the other categories in the following ways:

Category Ia	Category VI protected areas do conserve biodiversity, particularly at ecosystem and landscape scale, but the aim would not be to protect them strictly from human interference. Although scientific research may be important, it would be considered a priority only when applied to sustainable uses of natural resources, either in order to improve them, or to understand how to minimize the risks to ecological sustainability.
Category II	Category VI protected areas aim to conserve ecosystems, as complete and functional as possible, and their species and genetic diversity and associated environmental services, but differ from category II in the role they play in the promotion of sustainable use of natural resources. Tourism can be developed in category VI protected areas, but only as a very secondary activity or when they are part of the local communities' socio-economic strategies (e.g., in relation to ecotourism development).
Category III	Category VI protected areas might include the protection of specific natural or cultural features, including species and genetic diversity, among their objectives, whenever the sustainable use of natural resources is also part of the objectives, but they are more oriented to the protection of ecosystems, ecological processes, and maintenance of environmental services through nature protection and promotion of management approaches that lead to the sustainable use of natural resources.
Category IV	Category VI protected areas are more oriented to the protection of ecosystems, ecological processes, and maintenance of environmental services through nature protection and promotion of the sustainable use of natural resources. While category IV protected areas tend to prioritize active management, category VI promotes the sustainable use of natural resources.
Category V	Category V applies to areas where landscapes have been transformed as a result of long-term interactions with humans; category VI areas remain as predominantly natural ecosystems. The emphasis in category VI is therefore more on the protection of natural ecosystems and ecological processes, through nature protection and promotion of the sustainable use of natural resources.

Thank you!

Virtual University

Thank you!

Protected Area with Sustainable Use of Natural Resources

Management

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Thank you!

Thank you!

National Parks of Pakistan

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National Parks of Pakistan

Learning Objectives

- What are National Parks?
- Important National Parks of Pakistan

National Park

"National park is an area which is strictly reserved for the betterment of the wildlife & biodiversity, and where activities like developmental, forestry, poaching, hunting and grazing on cultivation are not permitted"

- In these parks private ownership rights are not allowed.
- Their boundaries are well marked and circumscribed.
- They are usually small reserves spreading in an area of 100 sq. km. to 500 sq. km.
- In national parks, the emphasis is on the preservation of a single floral or faunal species.

National Parks of Pakistan

Major National parks in Pakistan are as follow;

- Hingol National Park
- Hazarganji Chiltan National Park
- Kirthar National Park
- Lal Suhanra National Park
- Margalla Hills National Park

National Parks of Pakistan

- Ayubia National Park
- Deosai National Park
- Chitral Gol National Park
- Khunjerab National Park
- Machiara National Park

1) Hingol National Park

- Hingol National Park spread over an area of about 1,650 square km along the Makran Coast, Balochistan
- It is the largest of National Parks of Pakistan
- The area was for the first time declared reserved in 1988.
- Hingol is known to support threatened invertebrates in addition to a variety of bird species
- The park is an excellent habitat to wild animals including over 3000 ibexes, and 1500 Urials and more than 1200 Chinkara
- A number of resident and migratory birds are supported by this park

Hingol National Park

2) Kirthar National Park

- Kirthar National Park is the the second largest national park of Pakistan spread over an area of 3000 square kilometres.
- Kirthar was designated a national park by the Sindh Wildlife Department in 1974,
- This is the first of Pakistan's parks to be included in the UN's listing of National Parks of 1975
- This is natural haven for Urial sheep, Ibex, Chinkara gazelle,
- Jungle cats, desert cats, occasional leopard, desert wolf also prowl the park.

Kirthar National Park

Thank You!

National parks-2

National parks-2

Learning objectives

- Lal Suhanra National Park
- Hazarganji Chiltan National Park
- 5) Margalla Hills National Park

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4) Lal Suhanra National Park

- Blackbuck became virtually extinct in the Cholistan Desert but the species has been re-introduced in Lal Suhanra
- There is big lake in the center of the park called Patisar Lake, which is ideal for bird watching.
- Patisar Lake regularly holds between 10,000 and 30,000 ducks and common coot in mid-winter.
- The park supports a large population of birds of prey.
- Nilgai antelope is also being bred in the Park

Lal Suhanra National Park

Hazarganji Chiltan National Park

5) Margalla Hills National Park

- Margalla hills national park, is located in the foothills of the himalayan range.
- Area is drained by the river kurang and its tributaries, which flow into the river soan
- Park is the most accessible park in pakistan due to its close proximity to the national capital, islamabad.
- Asiatic leopard, wild boar, golden jackal, rhesus macaque, leopard cat, are some of the mammals found in the park.
- Birds in the park include Himalayan Griffon vulture, Laggar falcon

Margalla Hills National Park

Thank you!

Zoological Parks in Pakistan

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Zoological Parks in Pakistan

Learning Objectives

- What are zoological parks?
- Importance of Zoological parks
- Pakistan’s famous zoological parks

Zoological Parks in Pakistan

"A zoological park is a location where animals are kept in captivity for study and viewing."

- ➢ The zoo originally evolved from the menageries of the ancient world, in which royalty would exhibit their collection of exotic pets.
- ➢ Unfortunately not all zoos are scientific in nature, and extreme controversy has arisen regarding how the animals are treated.
- ➢ Suffice to say, regulation is necessary to ensure proper care.
- ➢ Conservation (not exploitation) should always be the central goal behind any legitimate zoo.

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Importance of Zoological Parks in Pakistan

- Zoos provide the opportunity for people to see a glimpse of this side of nature.
- Zoo plays important role in conservation of many threatened/endangered species
- Wild animals in captivity help us manage and conserve them in the wild.
- Zoos raise money for conservation efforts.
- Zoo provides area for recreational purposes

List of Zoological Parks in Pakistan

Some of famous zoological parks in Pakistan are listed bellow;

- Bahawalpur Zoo
- Changa Manga Wildlife Park
- Clifton Fish Aquarium
- Hyderabad Zoo
- Islamabad Zoo
- Jallo Wildlife Park
- Jungle World

Zoological Parks in Pakistan

- Karachi Municipal Aquarium
- Karachi Safari Park
- Karachi Zoo
- Lahore Walkthrough Aviary
- Lahore Zoo
- Lahore Zoo Safari
- Landhi Korangi Aquarium
- Landhi Korangi Zoo

Thank you!

Zoological Parks in Pakistan

Zoological Parks in Pakistan

Learning Objectives

- Pakistan’s famous zoological parks

Bahawalpur Zoo

- Nawab of former state Bahawalpur, Sir Sadiq Muhammad Khan Abbasi, established Bahawalpur Zoo in 1942
- It covers an area of 25 acres .
- The Bahawalpur Zoo came under administration of Wildlife Department in 1982.
- The lion, black tiger, fish, watch, crocodile and many other animals which were mummified during 1942 and 1974 are kept in museum
- Domestic cats, jackals, an Indian civet cat, Crocodiles, lions, tigers and hyenas etc are present in zoo

Bahawalpur Zoo

Lahore Safari Zoo

- A Safari Zoo is established since 1996-2001 for public recreation within the suitable environmental location,
- It is just 13 KM away from motorway link Thokar Niazbaig, Multan Road, Lahore.
- The Safari Zoo is offering stunning display of the animals and birds unique in this region.
- In 2004, the largest walkthrough aviary of Pakistan was constructed in the facility and was opened for visitors
- Amazing fact is that In July 2016, a record 34,340 tourists visited Lahore’s Safari Zoo and an income of Rs0.93 million was generated by wildlife and parks department

Lahore Safari Zoo

Thank you!

Botanical Garden

What is a botanical gardens?

It is a garden dedicated to the collection, cultivation and display of a wide range of plants labeled with their botanical names. It may contain specialist plant collections such as tropical plants, or other species of plants.

Types of plants in botanical gardens

1- cacti and succulent plants.
2- herb gardens.
3- greenhouses, shade houses.
4- tropical plants.
5-Medicinal Plants.
6- aromatic or textile plants
7- other exotic plants.

who is responsible for a botanical gardens?

Botanical gardens are often run by universities or other scientific research organizations, and often have associated herbaria and research programmers in plant taxonomy or some other aspect of botanical science.

Importance of Botanical garden

1- Enjoyment

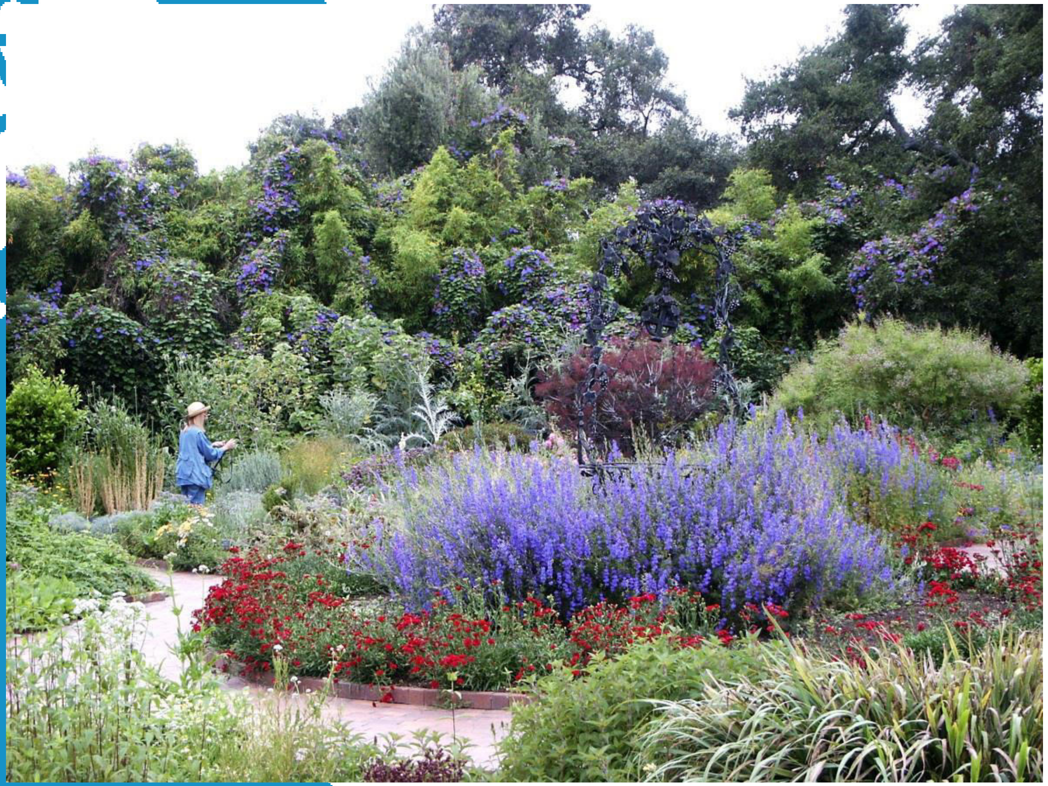
2-Economic

3- Scientific research

Botanic gardens contain collections of plants for education, scientific purposes and display; they can be: taxonomically-based - collections of a particular family, genus or group of cultivars; or collections of native plants; or useful species such as medicinal, aromatic or textile plants.

4- conservation

conservation of rare and threatened plants. The conservation of plant diversity is critical for sustainable development and botanic gardens are playing a key role as centers of conservation action. * Botanical gardens can promote diversity. Because they include many species of plant.



5- Climate Change

plants can alter the temperature of the Earth's atmosphere. Through the process of photosynthesis, plants use energy from the sun to draw down carbon dioxide from the atmosphere and then use it to create the carbohydrates they need to grow. Since carbon dioxide is one of the most abundant greenhouse gases, the removal of the gas from the atmosphere may temper the warming of our planet as a whole. *transpiration in plants can increase water vapor in the atmosphere, causing more precipitation and cloud cover in an area. The additional cloud cover often reinforces the cooling by blocking sunlight. *Contribute to soil fertility and prevent soil erosion

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Thank You!

Botanical Garden in Pakistan

List of botanical garden in Pakistan

Research botanical gardens

- Abdul Wali Khan University Botanical Garden, Mardan
- Botanical Garden, Governor's House, Lahore
- Botanical Garden, Govt Zamindar College, Gujrat
- Danishmandan Botanic Garden, Lahore
- Botanical Garden, University of the Punjab, Quaid-e-Azam Campus, Lahore
- Faisalabad Botanical Gardens (part of Gatwala Wildlife Park), Faisalabad
- Forman Christian College Botanic Garden, Lahore
- Government College University Botanic Garden of GCU, Lahore
- Karachi University Botanic Garden of Karachi University, Karachi

- Lahore Botanical Gardens, Lahore
- National Herbarium, Islamabad
- Pakistan Forest Institute Botanical Garden of Pakistan Forest Institute, Peshawar
- Quaid-i-Azam University Botanical Garden, Islamabad
- Shah Abdul Latif Herbarium and Botanical Garden of Shah Abdul Latif University, Khairpur
- University of Peshawar Botanical Garden of University of Peshawar, Peshawar
- living plants museum of medicinal plants, Pakistan Forest Institute, Peshawar

Public botanical gardens

- Bagh-e-Jinnah, Lahore
- Rani Bagh Arboretum, Hyderabad
- Sukh Chayn Gardens, Lahore

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Thank You!

Ramsar Convention

History & Concept

History

- Ramsar is one of the global inter-governmental environmental agreements.
- The treaty was negotiated in1960s by countries and NGOs

History & Concept

History

- To avoid the increasing loss and degradation of wetland habitat for migratory water birds
- In a 18 nations meeting it was adopted in the Iranian city of Ramsar On 2nd February 1971
- Came into force in 21^{st} December 1975

History & Concept

Mission

The Convention’s mission is

“the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world”

History & Concept

The Convention uses a broad definition of wetlands which includes

- All lakes and rivers
- Underground Aquifers
- Swamps and Marshes
- Wet Grasslands
- Peatlands
- Oases
- Estuaries
- Deltas
- Tidal flats
- Mangroves etc.

History & Concept

Concept

- Wetlands are among the most diverse and productive ecosystems.
- They provide essential services and supply all our fresh water.
- Wetlands continue to be degraded and converted to other uses.

History & Concept

The “three pillars” of the convention

The Contracting Parties(160)commit to:

- Work towards the wise use of all their wetlands.
- Designate suitable wetlands for the list of Wetlands of International Importance.
- Cooperate internationally on transboundary wetlands, shared wetland systems and shared species

Thank You!

Significant Ramsar sites of Pakistan

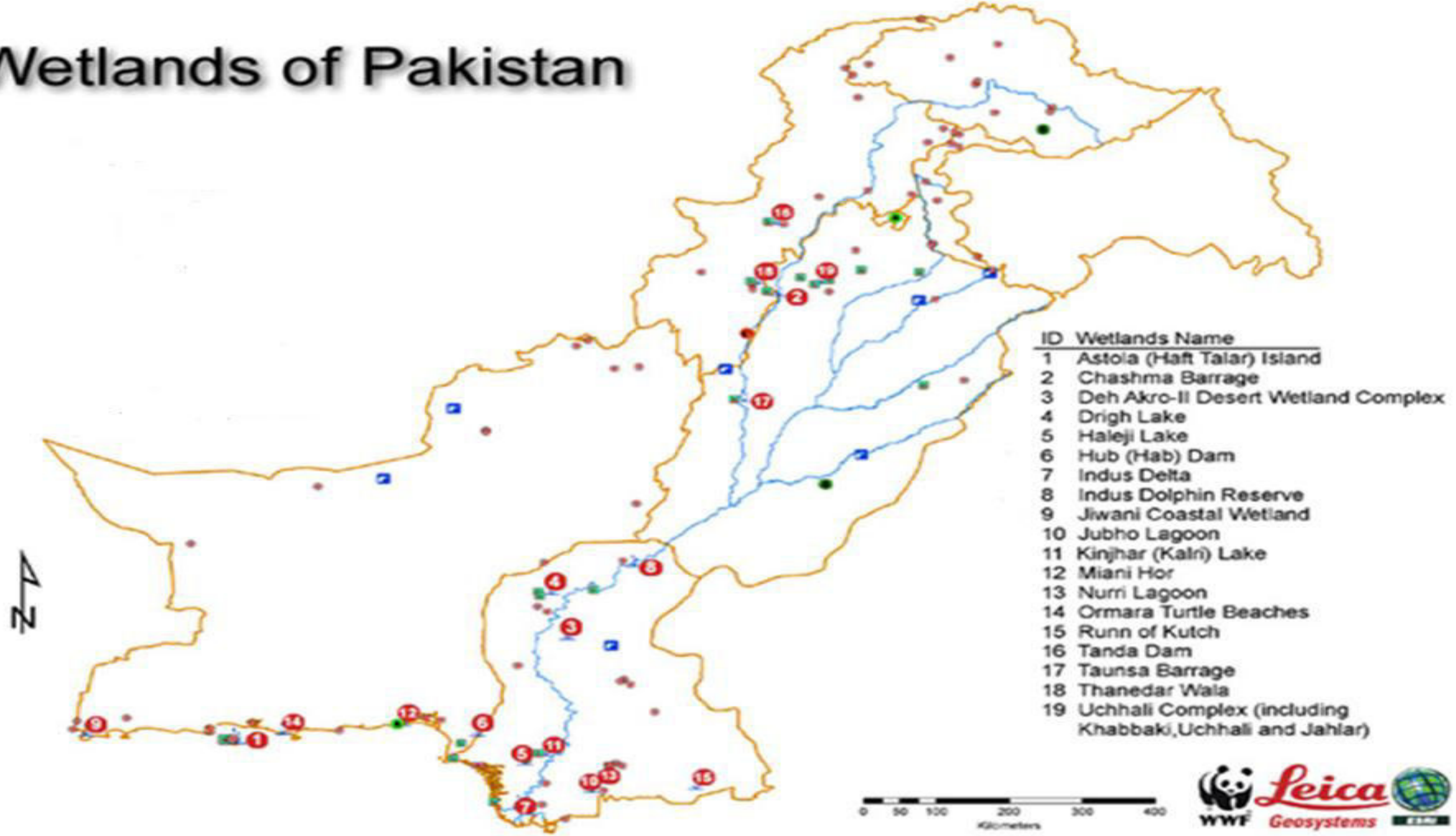
Significant Ramsar sites of Pakistan

In 2013, 19 (nineteen) Ramsar sites has been declared in Pakistan.

Area

- Covering an area of 1,343,627 hectares (3,320,170 acres)

Wetlands of Pakistan



Significant Ramsar sites of Pakistan

Religion wise significant ramsar sites of Pakistan

Baluchistan

- Astola Island
- Hub Dam
- Jiwani Costal Wetland
- Miani Hor
- Ormara Turtle beach

Significant Ramsar sites of Pakistan

Sindh

- Keenjhar (Kalri) Lake
- Haleji Lake
- Drigh Lake
- Indus Dolphin reserve
- Jubho lagoon
- Nurri Lagoon
- Deh Akro-II
- Indus Delta
- Runn of Kutch

Significant Ramsar sites of Pakistan

Punjab

- Uchhali Complex
- Taunsa Barrage
- Chashma Barrage

Khyber Pakhtunkhwa

- Tanda Dam
- Thanedar Wala

Thank You!

Threats to Wetlands

Threats to Wetlands

Half of the world's wetland have disappeared since long.

- Continued development in all aspects is the need of hour with proper management
- Unmanaged activities pose major threats to wetlands, despite their value and importance.

Threats to Wetlands

Industrial Development:

The rapid industrial development at the beginning of 19^{th} century led to present-day situation of wetland being affected by human activities.

Invasive species

Alien invasive species have had severe impacts on local aquatic flora and fauna, and can upset the natural balance of an ecosytem. For example, the introduction of Nile perch to Lake Victoria has pushed many of the lake's native cichlid species to extinction.

Pollution

Pollution in wetlands is a growing concern, affecting drinking water sources and biological diversity. Drainage and run-off from fertilized crops and pesticides used in industry introduce nitrogen and phosphorous nutrients and other toxins like mercury to water sources. These chemicals can affect the health and reproduction of species, posing a serious threat to biological diversity.

Climate change

Climate change is also taking its toll. Increases in temperature are causing polar ice to melt and sea levels to rise. This in turn is leading to shallow wetlands being swamped and some species of mangrove trees being submerged and drowned.

Dams

Worldwide there are now over 40,000 dams which alter the natural flow of water and impact on existing ecosystems.

Thank You!

Wildlife Sanctuaries in Pakistan

Wildlife Sanctuaries in Pakistan

Learning Objectives

- What is Wildlife Sanctuary?
- Importance of wildlife sanctuary.
- list of wildlife sanctuaries in Pakistan

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Wildlife Sanctuaries in Pakistan

"Sanctuary is an area which is of adequate ecological, faunal, floral, Geo-morphological, natural or zoological significance."

- The Sanctuary is declared for the purpose of protecting, propagating or developing wildlife or its environment
- A sanctuary is a protected area which is reserved for the conservation of only animal and human activities like harvesting of timber, collecting minor forest products and private ownership rights are allowed as long as they do not interfere with well-being of animals
- Boundaries of sanctuaries are not well defined and controlled biotic interference is permitted

Importance of Wildlife Sanctuaries

- Sanctuary is created for the purpose of protecting endangered species with a limited territorial range
- Endangered species in wildlife sanctuaries are typically closely monitored
- Wildlife sanctuaries offer wildlife rehabilitation
- Wildlife sanctuaries help to preserve and bring back endangered species by giving them a natural environment to live in while they are in no danger of predetors or humans.
- Wildlife sanctuaries also educate people about the creatures sothat they can maybe help in preserving them

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Wildlife Sanctuaries in Pakistan

Wildlife Sanctuaries of Pakistan are;

1) Astor Wildlife Sanctuary
2) Baltistan Wildlife Sanctuary
3) Chasma and Taunsa Barrage Dolphin Sanctuary
4) Cholistan Wildlife Sanctuary
5) Hab Dam Wildlife Sanctuary
6) Kargah Wildlife Sanctuary

Wildlife Sanctuaries in Pakistan

7) Mahal Kohistan Wildlife Sanctuary
8) Naltar Wildlife Sanctuary
9) Nara Desert wildlife Sanctuary
10) Rann of Kutch Wildlife Sanctuary

Thank you!

Wildlife Sanctuaries in Pakistan

Virtual University

Wildlife Sanctuaries in Pakistan

Learning Objectives

- list of wildlife sanctuaries in Pakistan

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Wildlife Sanctuaries in Pakistan

7) Mahal Kohistan Wildlife Sanctuary
8) Naltar Wildlife Sanctuary
9) Nara Desert wildlife Sanctuary
10) Rann of Kutch Wildlife Sanctuary

Rann of Kutch Wildlife Sanctuary

- **Runn of Kutch Wildlife Sanctuary**, spread over 566,375 ha is part of the great Thar desert and comprises
- Rann of Kutch across the frontier with India, which includes permanent saline marshes, coastal brackish lagoons, tidal mudflats, and estuarine habitats.
- The site supports many locally and globally threatened species,
- Threatened species include the Great Indian bustard, Houbara bustard, Sarus crane
- This area used to have the only population of the Indian Wild Ass or Onager in Pakistan.

Rann of Kutch Wildlife Sanctuary

Chasma and Taunsa Barrage Dolphin Sanctuary

- Chashma and Taunsa Barrage are declared Wildlife Sanctuaries by the Punjab government.
- A very important breeding, staging and wintering area for a wide variety of waterfowl, including at least one threatened species (Marmaronetta angustirostris).
- Mid-winter waterfowl counts in recent years have regularly exceeded 20,000 birds.
- The endangered Indus Dolphin (Platanista indi) occurs in the river both upstream and downstream of the barrage.
- Since the 1970s, the population of the Indus Dolphin has significantly increased here

Chasma and Taunsa Barrage Dolphin Sanctuary

Cholistan Wildlife Sanctuary

- Cholistan Wildlife Sanctuary is part of the Cholistan desert in the south eastern portion of the province of Punjab

- It contains some of the most rare and interesting wildlife in Pakistan.

- Some of the rare animals of this region are Desert wolf (rare), Indian fox, Red fox, Jackal, Small Indian civet, Small Indian mongoose, Indian grey mongoose, Indian desert cat, Jungle cat, Caracal cat, Saker falcon, Black backed vulture, Indian cobra, Monitor lizard, Saw scaled viper and Russells viper

Cholistan Wildlife Sanctuary

Thank you!

Concept of Game Reserve

Concept of Game Reserve

Definition:

"A game reserve is an area wherein controlled hunting and shooting is permitted on permit basis"

A game reserve (wildlife preserve) is a large area of land where wild animals live safely or are hunted in a controlled way for sport.

Concept of Game Reserve

- In the game reserves the major focus is specifically the animals.
- If hunting is prohibited, a game reserve may be considered a ”Nature Reserve”
- Wherein all aspects of naturally-occurring life in the area are considered.

Concept of Game Reserve

- Most of the areas in game reserves have created to provide habitat protection for animal species commonly referred to as game (huntable species for sport or meat)

Concept of Game Reserve

Game Count:

- Game count to be conducted as it provides an estimation of the game population
- It is to ascertain the number of female animals, as this indicates the production potential.

Concept of Game Reserve

- It is an estimate that walking 6km to water isn’t unnatural for an animal.
- Some of the Reserve’s water points will be done away or moved to more suitable locations.

Thank You!

In Vitro Germplasm Conservation

In Vitro Germplasm Conservation

In 1972, conservation of habitats rich in genetic diversity was recommended in the UN conference. Then an International Board for Plant Genetic Resource (IBPGR) was established.

This board has objectives to provide necessary support for collection, conservation and utilization of plant genetic resources from anywhere in the world.

Modes of Conservation

(a) In situ Conservation:

Since 1980, in situ conservation has received high priority in the world conservation strategy. The method of conservation is to preserve land races with wild relatives in which genetic diversity exists.

1. Modes of Conservation

(b) Ex situ Conservation

It is the chief mode of conservation of genetic resources including both cultivated and wild ones. Under suitable conditions genetic resources are conserved for a long term as gene bank. Such gene bank is of two types:

(i) In vivo Gene Bank

(ii) In vitro Gene Bank

Modes of Conservation

(i) In vivo Gene Bank:

Generally plant seeds, vegetative propagules are used for storage for long time. The whole plants are preserved. This type of conservation strategy is called in vivo gene bank. In this approach, conservation method of storage is used for preservation of plant genetic resources

Modes of Conservation

(ii) In vitro Gene Bank:

This approach includes the conservation of genetic resources by non-conventional methods. In this approach explants are grown on medium.

Thank you!

In vitro Germplasm conservation

Methods of Preservation

Free Preservation or Cryopreservation:

Cryopreservation (Latin Kuos means frost) means storage of materials at very low temperature. Plant cells and tissue cultures are brought to zero state of metabolism by subjecting them to ultra-low temperature i.e. -I96°C.

It is done by using liquid nitrogen which provides approximately -496°C. Cryo-protectants (e.g. glycerol, proline, mannitol, dimethylsulfoxide, sorbitol) are also used to protect the viable cells from the damage during freezing and thawing (to become unfrozen or warm).

Cold Storage

Germplasm of some plants (in the form of shoot tips, nodal or meristem explant culture) are stored at low and non-freezing temperature (1-9°C). At low temperature, growth of plant material is slow down but not completely stopped as in cryo-preservation. In cold storage there is no risk of cold injuries.

Low-pressure and Low-oxygen Storage:

For conservation of cultured plant materials low-pressure storage (LPS) and low-oxygen storage (LOS) have been developed. These are alternative methods of cryopreservation and cold storage.

Thank you!

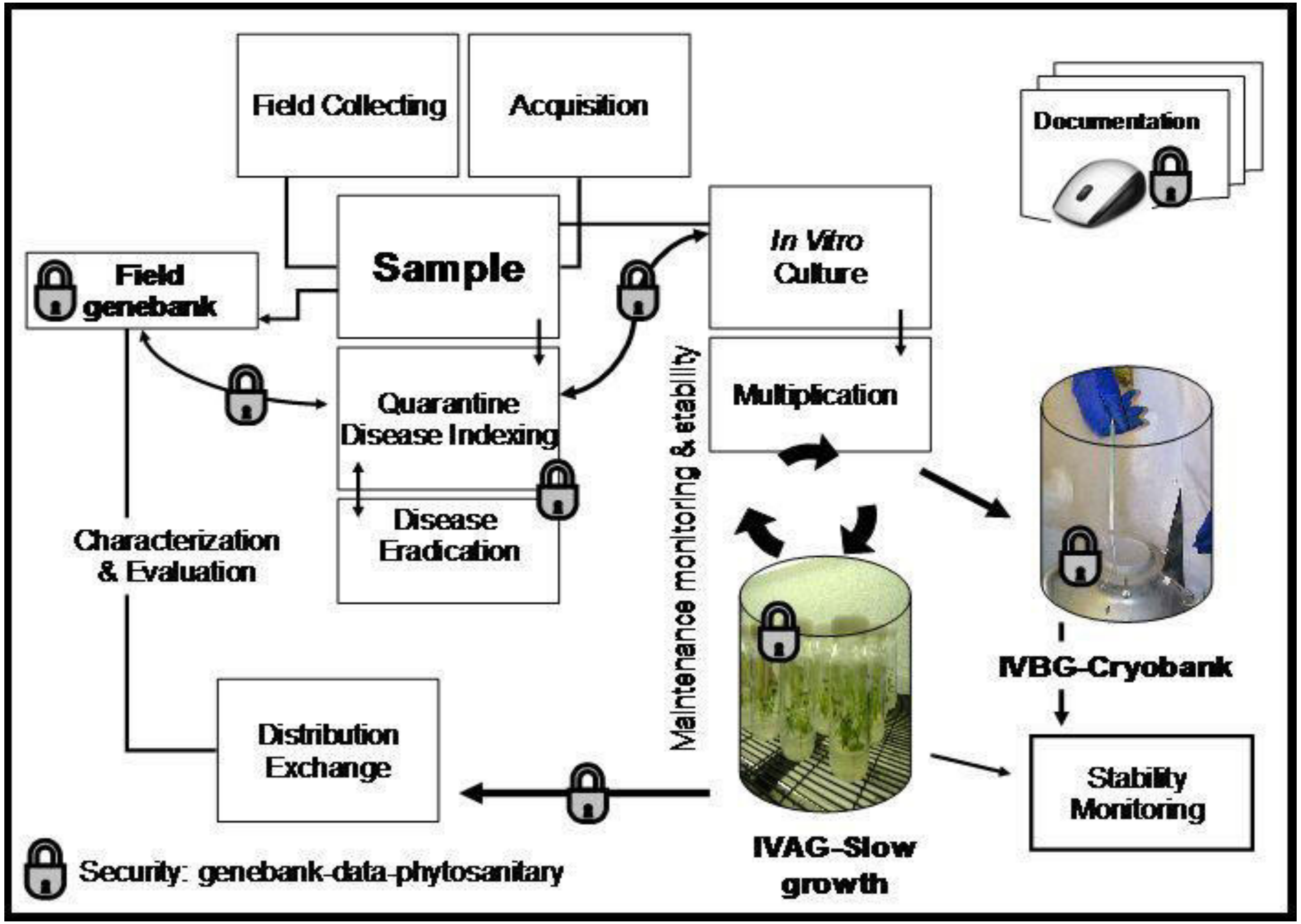
Tissue Culture Conservation

Tissue Culture Conservation

Using this method, millions of genetically identical plants can be obtained from a single bud. This method has, therefore, become an alternative to vegetative propagation. Shoot tip propagation is exploited intensively in horticulture and the nurseries for rapid clonal propagation of many dicots, monocots and gymnosperms.

Tissue Culture Conservation

Conservation in tissue culture in *in vitro* genebanks is often combined with cryopreservation. Cultures in the active genebank are maintained by successive subculturing allowing culture renewal and distribution. For medium term storage, sub-culture intervals are extended, reducing processing costs by arresting growth using cold treatments, adapted light conditions, culture medium modifications (osmotic active compounds, growth retardants). This increases efficient use of resources and staff time and offsets selection risks and contamination


Field Collecting
Acquisition
Documentation
Sample
In Vitro Culture
Field genebank
Multiplication
Quarantine Disease Indexing
Disease Eradication
Maintenance monitoring & stability
Characterization & Evaluation
IVBG-Cryobank
Distribution Exchange
Stability Monitoring
IVAG-Slow growth
Security: genebank-data-phytosanitary

Advantages of tissue culture conservation

source of disease-free material.

It is most appropriate for rapid multiplication purposes, dissemination and active collections.

Tissue Culture Conservation

- labour intensive
- risk of losing valuable germplasm
- genetic instability

Practical considerations

Security

Purity: freedom from contaminating organisms.

Authenticity: correct identity.

Stability: fit-for-purpose and trueness-to-type.

Culture facilities

- Use culture growth rooms with temperature control, lighting and shelving.
- Aim for a room where the humidity is 40–50%. High humidity increases fungal growth, while low humidity dries cultures and creates dust problems.
- Use an isolated growth room for *in vitro* explants of materials taken directly from the field to allow time to detect insect infestations and prevent their spread to other cultures.
- Ensure a light intensity in the range from 10 to 1000 µmol S-1 m-2. Most plant cultures require 50–200 µmol S-1 m-2.
- Use ventilation systems or air-conditioning units to regulate temperature. Air should not flow directly onto the cultures. Common growth room temperatures range from 22ºC to 28ºC, depending on species requirements.
- Back-up generators are advisable for areas with frequent power cuts to control temperature and light.

Genetic stability during storage

Great care should be taken to select culture practices to reduce this variation and ensure genetic integrity.
Preferred practices are:
Avoid using germplasm propagated via dedifferentiated and adventitious routes for conservation.
Select germplasm from young cultures because somaclonal variation increases and totipotency decreases during prolonged culture.

Medium term storage using slow growth

- **Physical growth limitation**
  - Low temperature
  - Low light/restricted photoperiod
  - Minimal containment
  - Minimal O2
  - Osmotic (water) stress
- **Chemical growth limitation**
  - Growth regulator retardation
  - Growth inhibitors
- **Minimal nutrition**
  - Low macro nutrient levels
  - Low micro nutrients levels

Thank you

DNA Banks

DNA Banks

DNA banks can now be considered as a means of complimentary conservation. DNA storage is particularly useful for those species that cannot be conserved in traditional seed or field genebanks and nor conserved *in situ* due to high risk in that area

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DNA Banks

Advantages

DNA banking is an efficient, simple and long-term method to conserve the genetic information.

Disadvantages

There are problems with subsequent gene isolation, cloning and transfer of DNA back to a plant and it currently does not allow the regeneration of the same genotype as the original sample.

Storage strategy

Determining what to store and for how long is an important consideration, used to determine sample size, capacity of the DNA bank, preparation of samples and documentation. Long-term needs and expected volume and number of samples to be stored will determine organization and repository design.

DNA Banks

Processing of samples

DNA preserved in DNA banks will be stored either within cells and extracted upon retrieval from storage or extracted from cells and purified before storage. The quality of the DNA is expressed through yield, purity, molecular weight, amplification efficiency and authenticity of sequences. The quality of DNA extracted from plant specimens is dependent on the condition of the specimen before storage, the storage environment and the duration of storage. Rapid drying of plant samples with silica gel or lyophilisation helps to preserve the DNA.

DNA Banks

Storage

Once extracted DNA is a stable biomolecule, although it can easily be degraded during extraction and storage. Quality declines within days in hydrated samples held at room temperature or in refrigerators. Drying the sample or storing it in freezers or liquid nitrogen achieves better preservation of DNA molecular size. For this reason, DNA is better conserved in a form that is close to the original state and most DNA banks store cells or tissues and extract DNA upon request.

Storage

There is little information on the long-term stability of extracted DNA during frozen storage, but most repositories consider several years to decades as realistic. Information on the stability of purified DNA dissolved in buffer suggests that the overall fragment size decreases with storage time, and that the usefulness of the specimen for PCR-based assays may be 1–2 years when stored at 4 ºC, 4–7 years when stored at -18 ºC and greater than 4 years when stored at -80 ºC (Madisen et al. 1987; Visvikis et al. 1998). The choice of temperature usually depends on the moisture level within the sample.

It is proposed that replicated DNA samples can be maintained at -20ºC for short- and mid-term storage (up to 2 years), and at -70ºC or in liquid nitrogen for longer periods. For rice, DNA clones, such as ESTs, full-length cDNAs, BACs, PACs and YACs, are maintained in labelled 96-well microplates or 384-well microplates stored in -80°C ultra low temperature freezers. These clones are preserved in

Thank you!

Gene Sanctuaries

Gene Sanctuaries

A type of Insitu conservation

Gene sanctuaries

The genetic diversity is sometimes conserved under natural habitat.

In other words, areas of great genetic diversity are protected from human interference. These protected areas in natural habitat are referred to as gene sanctuaries.

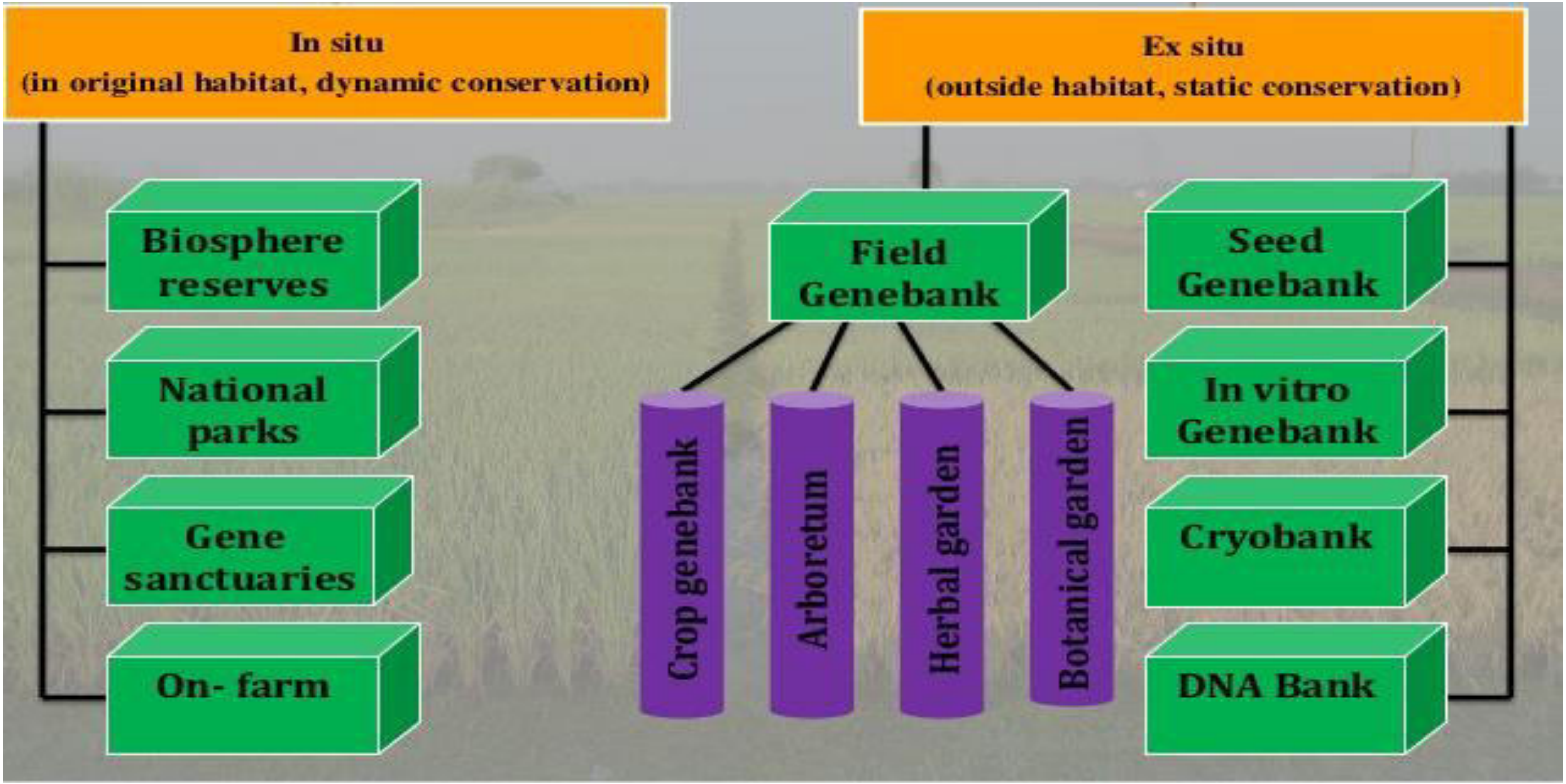
Gene sanctuary is generally established in the centres of diversity or microcenter.

Gene sanctuary

Gene sanctuary is Also Known As Natural Park or biosphere reserve.
Efforts are being made to setup gene sanctuaries for banana, sugarcane, rice and Mango.
In Ethiopia gene sanctuaries for conservation of wild relatives of coffee was setup in 1984.

Thank you

Types of gene sanctuaries


In situ
(in original habitat, dynamic conservation)
Ex situ
(outside habitat, static conservation)
Biosphere reserves
National parks
Gene sanctuaries
On- farm
Field Genebank
Crop genebank
Arboretum
Herbal garden
Botanical garden
Seed Genebank
In vitro Genebank
Cryobank
DNA Bank

Thank you

Importance of gene sanctuary

Gene sanctuaries

Gene sanctuaries not only preserve the existing genetic diversity present in a population, it also allows evolution to continue. As a result new allele and gene combination would appear with time.

A gene sanctuary is best located in the center of origin of crop species concerned, preferably covering the microcenter within the center of origin

Gene sanctuaries

Gene sanctuary is a very good method of insitu conservation it protects the loss of genetic diversity caused by human intervention.

it allows natural selection and evolution to operate.

Gene sanctuaries

There are two main drawbacks of gene sanctuary.
Firstly, entire variability of a crop species can not conserved.
Secondly , its maintenance and establishment is a difficult task.
It is a very good method of in Situ Conservation.

Thank you!

Application of storage technologies for germplasm conservation and limitations

Application of storage technologies for germplasm conservation

Storage of seed is indispensable to most of plantation forestry, and the practice should not be dismissed too readily as a basic tool in maintaining genetic diversity. Conventional seed storage offers several advantages:

(1) seeds of many valuable species can survive long-term storage ('longterm' is defined as spanning a period of time longer than one rotation

(2) good storage facilities are now available in most of the world, and they are used extensively for tree seed storage for various regeneration purposes;

Application of storage technologies for germplasm conservation

(3) seed storage is a relatively cheap method for conserving a broad range of germplasm

(4) large land areas are not tied up in conservation

(5) international exchange of genetic material is facilitated by seed storage.

Limitations

1) seeds of many important tree species cannot adequately survive long-term storage;
(2) seeds of many tropical hardwoods cannot survive even a year of conventional seed storage;
(3) some genetic damage or change in gene frequencies may occur during seed storage. Cryogenic storage at its current level of technology offers great promise for long-term storage of true orthodox and sub-orthodox seeds. It has potential for application to recalcitrant species, but much more research and development will be required. Some advantages of cryogenic storage are:
(1) it can apparently extend storage life of true-orthodox species far beyond that possible in conventional storage;

(2) genetic damage may be much less than what occurs in conventional storage. Disadvantages include

(1)special equipment is required, which is not readily found in forestry facilities; (2) it is costly for large seeds

(3) recalcitrant seeds (both classes) cannot be stored cryogenically with current technology.

Thank you!

Invertebrates Genetic Resources

Invertebrates Genetic Resources

Genetic resources of Invertebrates means genetic material of actual or potential value from Invertebrates.

Invertebrates include a great number of species that perform valuable functions in agro-ecosystems

Invertebrates Genetic Resources

Micro-organisms and invertebrates together are the most numerous group of species on Earth. Invertebrates are animals without a backbone. They account for more than 95% of all animals and comprise many subgroups of diverse species ranging from tiny insects to giant squid.

Invertebrates Genetic Resources

Although the problems caused by invertebrate pests are well known – and considerable effort and resources are devoted to managing them – the vital contributions that invertebrates make to agriculture and food security are often overlooked.

Invertebrates Genetic Resources

- Perhaps the most neglected group of all – in research, in farming practices, and in policies and strategies for agriculture and biodiversity – are the soil-dwelling invertebrates
- Small, out-of-sight and uncharismatic these animals may be, but their significance is enormous. Some larger soil-dwelling invertebrates, such as earthworms, ants and termites, have been described as “ecosystem engineers”. They create the physical structures needed to maintain healthy soil communities and for basic soil processes such as water infiltration and storage, and sequestration and cycling of carbon.
- They help maintain the chemical fertility needed for plant growth. Also vitally important are the invertebrates that process the leaf litter that falls onto the surface of the soil

Invertebrates Genetic Resources

A second major group of invertebrate providers of ecosystem services are the pollinators. It has been estimated that at least 35 percent of world food production comes from crops that are dependent on insect pollination. Pollinating insects include wild species spilling over from natural or semi-natural habitats close to crop fields, and managed pollinators (usually honey bees) that can be brought in by farmers specifically to provide pollination. Both wild and managed pollinators are in decline – probably as a result of multiple interacting causes, including land-use change (e.g. the loss of flower-rich meadows), increased use of pesticides, socio-economic factors that make beekeeping less attractive, and the spread of the parasitic mite Varroa destructor and other pathogens of bees. The situation has caused such concern that it has been described as a “pollination crisis”

Thank you!

Effects of climate change on invertebrate Genetic resources and their management

Effects of climate change on invertebrate Genetic resources and their management

Climate change is expected to affect all three of the main groups of invertebrate ecosystem-service providers as well as invertebrate pests. Invertebrates have limited ability to control their body temperatures. Therefore, although some groups such as soil-dwelling organisms are to some degree buffered against the effects of temperature fluctuations in the wider environment, it is likely that rising temperatures will directly influence the distribution of invertebrate species. Many of the challenges associated with the management of invertebrate genetic resources in agriculture in the context of climate change will relate to climate-driven or human-assisted movement of invertebrate species.

Effects of climate change on invertebrate Genetic resources and their management

Most invertebrates are expected to change their geographical distribution in response to climate change so as to remain in areas to which they are well adapted.

This view is strongly supported by sub-fossil evidence of insect distribution during the glaciations and interglacial periods of the Quaternary Period.

Effects of climate change on invertebrate Genetic resources and their management

The current world is very different from that of the early Quaternary Period. Human activities have created barriers to the migration of invertebrate species. These barriers are likely to affect species in natural ecosystems rather more severely than those associated with agro-ecosystems. The movement of the latter is likely to be facilitated rather than hindered by human-induced landscape changes. In situ adaptation of invertebrate species is expected to be most marked where movement is not an option (e.g. on low, isolated islands).

Effects of climate change on invertebrate Genetic resources and their management

It is very difficult to predict how the combined effects of changing temperatures, changing rainfall patterns and elevated carbon dioxide levels will affect invertebrates and their capacities to provide ecosystem services or to act as pests. As yet, few studies have attempted to investigate interactions of this kind. Further complexity is added by the prospect that the other components of the ecosystem with which invertebrates interact – food plants, micro-organisms, etc. will also be affected by climate change.

Effects of climate change on invertebrate Genetic resources and their management

It has been suggested that, in the future, parts of the world will have novel climates
that have no current equivalent anywhere on the planet. This will inevitably lead to novel associations among invertebrate species and novel effects on agriculture. The consequences of such changes are difficult to predict.

Effects of climate change on invertebrate Genetic resources and their management

Extreme weather events such as heat waves, droughts and floods – which are predicted to
increase in frequency due to climate change – are often followed by pest outbreaks. Among other contributing factors, these outbreaks can occur because the extreme event eliminates or weakens a pest's natural enemies.

Effects of climate change on invertebrate Genetic resources and their management

Warmer, shorter winters will mean that many invertebrates become active and start reproducing earlier in the year. Some species may be able to produce additional generations of offspring in a single year, which in the case of herbivores can have a major impact on host plants. Similarly, warmer winters may mean that pests are able to establish themselves in areas where they have not previously caused problems. The capacity of locally occurring natural enemies to respond and keep these pest populations under control may be in doubt

Effects of climate change on invertebrate Genetic resources and their management

Climate change is expected to have a profound effect on soil invertebrates and the services they provide. Temperature is a key factor regulating many of the biogeochemical processes in which invertebrates participate or by which they are affected, including soil respiration, litter decomposition, nitrogen mineralization and denitrification.

Studies have shown that both elevated temperatures and elevated carbon dioxide levels affect the abundance of invertebrate species and the composition of soil communities. Some species are better able to adapt than others. For some invertebrates, the ability to migrate down the soil profile to cooler and moister levels will offer an important survival strategy.

Thank you!

Roles of invertebrate genetic resources in coping with climate change

Roles of invertebrate genetic resources in coping with climate change

Because of the many ecosystem services that they provide, invertebrates have a key role to play in adapting agriculture to the effects of climate change. The extent to which the individual services provided by invertebrates will be enhanced or impeded by climate change is difficult to predict. However, if invertebrate biodiversity is lost, the capacity of ecosystems to adapt is likely to diminish.

Roles of invertebrate genetic resources in coping with climate change

Healthy soils – and healthy, diverse soil invertebrate communities – will be vital to climate change adaptation. For example, earthworms help to maintain soil structure and the availability of water throughout the soil profile. Studies have shown that the presence of these animals can help to alleviate the effects of drought on crop Production. Studies have also revealed the remarkable ability of diverse soil invertebrate communities to restore the structure of degraded soils

Roles of invertebrate genetic resources in coping with climate change

he potential for managing soil invertebrates to enhance their beneficial roles has been

little explored. Few if any deliberate attempts have been made to introduce soil invertebrates

into new countries or ecosystems. Given the potential for such species to become invasive, it

is inadvisable to attempt any such introductions until soil ecology is much better understood

than it is today. However, every effort should be made to avoid agricultural

practices that disrupt resident soil invertebrate communities and the services

Roles of invertebrate genetic resources in coping with climate change

in the case of classical biological control agents, the genetic diversity of introduced
populations may be relatively low because the introduction was based on a small founder population. This lack of diversity may inhibit the ability of the population to respond to climate change.

Roles of invertebrate genetic resources in coping with climate change

It is likely that some pests, as they move into new areas in response to climate change, will at least temporarily “escape” from their natural enemies. This is likely to increase demand for classical biological control agents, especially in places where the newly established pest population is separated from its original home by a physical barrier such as the sea or a mountain range. For this reason, access to new classical biological control agents is likely to be particularly important for island countries

Thank you!

Conservation of invertebrates genetic resources

The IUCN's Red List of Threatened Species includes 44,838 species with assessed conservation statuses in its 2008 update . This number has been increasing each year and undoubtedly reflects the work of many, yet it still only represents 2.73% of all described species to date. Moreover, a quick analysis allows for a view of really how biased these assessments are towards some taxonomic groups. Considering the better studied ones, mammals and birds, 100% of the currently described species have been evaluated for their conservation statuses and, out of these, 21% out of 5,488 mammal species and 12% out of 9,990 bird species are considered to be endangered.

Turning our attention to one of the lesser studied groups, we see that only 0.13% out of all the described insect species have an evaluated status, 50% of which are endangered. This means that half of the few insect species whose conservation statuses have been assessed were classified as threatened, yet extremely few out of the 950,000 calculated species known to science have been graced with conservational study. Let me highlight that this last number does not include an estimate of the insect species that are yet to be described (surely many more than birds or mammals), which means that considering insects alone, the actual number of threatened species could easily surpass that of the sum of all existing vertebrates. A similar scenario is shared by the rest of invertebrates, plants, algae, lichens and mushrooms: very few known species have been evaluated for their threatened statuses, with few exceptions. Therefore, it appears necessary to enrich the Red List of Threatened Species with many invertebrate species endemic and/or living in specific habitats easily endangered (caves, small lakes, small rivers).

Generally all invertebrate populations would benefit from:(a)A reduction in all forms of environmental pollution.

(b)An immediate cutback in greenhouse-effect gas emissions, in order to prevent short-term climatic changes.

(c)A decrease in the current rate of habitat destruction resulting from human activities. An example of how habitat conversion for human usage could be compensated would be achieved by a more frequent adoption of what is known as “Green roofs”. This architectural practice is common, for instance, in some northern European regions and consists of creating gardens or other green areas in roof tops, thus ‘giving back’ a certain percentage of the soil surface that was ‘robbed’ by the construction.

Maintaining insect species that can provide pollination services for a wide range of crops is also vital to the future of agriculture in the face of climate change. Pollinator populations not only need to be able to cope with changing climatic conditions, they must also be able to provide the pollination services needed to meet increasing demands for food and retain the capacity to adapt to potential changes in the types of crops grown

The natural habitats of wild pollinator species need to be identified and preserved. As land use changes, it may be necessary to protect or develop corridors of suitable habitat that ensure food and nesting resources are available for pollinators. The presence of areas of natural and semi-natural habitat next to crop fields has been shown to increase the diversity of pollinator populations and enhance the services they provide . Deliberate planting of climate-resilient plants that favour pollinators can serve as a means of maintaining the habitats and floral resources needed by wild pollinators and managed bees. An advantage of having a range of (non-crop) food resources available in the landscape is that the diverse vegetation is likely to support a diverse assemblage of pollinators. This is important, as crops with generalized flowers (i.e. flowers that can be pollinated by a range of species) may produce more reliably when a variety of different pollinator species are present. The insurance provided by a diverse assemblage of pollinators may also facilitate adaptation, because different species will have different capacities to respond to climatic changes. The world's most important managed pollinator species is the honey bee. This reflects the species' adaptability. It can flourish under many different conditions – from arctic to tropical and from rainforest to desert. Climate change may mean that, in any given area, new honey bee races or hybrids that suit local conditions will need to be introduced (e.g. those that are drought resistance or do not abscond).

Thank you!

Forest Genetic Resources

Introduction of Forest genetic resources

Forest genetic resources or **tree genetic resources** are genetic material of shrub and tree species of actual or future value.

Forest denotes a stand, population or landscape of trees, and typically other associated woody plants.

Definition

- Forest genetic resources are essential for forest-depending communities who rely for a substantial part of their livelihoods on timber and non-timber forest products (for example fruits, gums and resins) for food security, domestic use and income generation.

- These resources are also the basis for large-scale wood production in planted forests to satisfy the worldwide need for timber and paper.

Forest genetic resources

- • Genetic refers to variation of genetic (DNA) origin, and variation of genes at different levels:
- (1) variation between species,
- (2) variation between populations within species
- (3) variation between individual trees within populations. The largest variation is between species, and loss of whole species is therefore also the most dramatic loss of future options.
- • Resources refers to the use of genetic variation—in the broad sense stated above—considered to be of potential value for humans at present or in the future.

The State of the World's Forest Genetic Resources

In 2014, the Food and Agriculture Organization of the United Nations published the first State of the World's Forest Genetic Resources .The publication addressed the conservation, management and sustainable use of forest tree and other woody plant genetic resources of actual and potential value for human well-being in the broad range of management systems.

Forest genetic resources and climate change

Diversity of forest genetic resources enables the potential for a species (or a population) to adapt to climatic changes and related future challenges such as temperature changes, drought, pests, diseases and forest fires. Though forest trees are known for showing great plasticity in their response to climate changes, not all species are naturally capable to adapt at the pace necessary.

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THANK YOU

Significance of Forest Genetic Resources

Significance of forest genetic resources

Forests provide us with many benefits, from the tangible economic returns of high-value timber to more nebulous but no less important ecosystem services, such as regulating water flows.

Forests provide human beings with drinkable water, food, medicines, an environment to enjoy and fuelwood for energy, among other goods. They bind soil on steep hillsides, preventing flooding and erosion further down river valleys. They help to regulate the local climate too. Globally, forests remove carbon dioxide from the atmosphere and produce oxygen.

Significance of forest genetic resources

While it is impossible to assign a precise economic value to forests, it is clear that their contribution is huge. In Europe, one estimate put the value of “marketed non-wood goods” from forests at €2.3 billion and the value of “marketed services” at €619 million The environmental value of forests – through the ecological services they provide, essentially for free – is probably even greater than the value captured by markets.

Why do forest genetic resources matter?

The high levels of genetic variation that are present within many tree species can be beneficially developed and used by foresters and tree growers. Whereas agricultural crop breeders and farmers often substantially modify the growing environment to suit a specific crop species or variety, tree growers commonly identify species and provenances which can provide some improved levels of the goods and services required even without intensive selection and improvement, or intense management requirements, or major modification of the external environment.

Threats

Forests are under threat, chiefly as a result of human activities, including climate change.

On a continent-wide scale, changes in rainfall patterns and temperature mean that some tree species will be unable to survive in their current locations. Others may be able to colonize new areas. Changes in climate also make it possible for pests and diseases to invade new areas, destroying the forests there. Overall, we can be sure that the composition and distribution of forests will change. It is because humans – and indeed the whole planet – derive so many benefits from forests and trees that we need to be concerned about how they will adapt to climate change.

Thank you!

The impacts of climate change on FGR

The impacts of climate change on FGR

Climate change may also result in high variability in temperature and precipitation, with an increase in incidence of extreme events, such as flooding, late frosts and intensive summer droughts, amongst other events. In some areas, such as the Mediterranean and the Neo-tropics, an increase in seasonality is also expected. Under such conditions, natural selection may not result in efficient adaptation because selection pressures are multi-directional, involving traits that may be inversely correlated at the gene level. The standing genetic variation in populations may then not be large enough to create the rare new genotypic combinations that are required. Ecosystems affected by abrupt change may sustain rapid and widespread transformation as ecological tipping points are exceeded. Given the pivotal role of trees in ecosystem function, abrupt climate change impacts on them may thus have profound consequences for forests as a whole. Irreversible loss of ecosystem integrity and function may follow, with replacement by new non-endemic ecosystems.

Direct impacts of climate change

These include high tree mortality through extreme climatic events, particularly drought in combination with widespread regeneration failure, for example, examined the evidence for anthropogenic climate change leading to future large-scale “dieback” in Amazonian rainforest. Analysis suggested that dry-season water stress is likely to increase in eastern Amazonia over the 21st century, with the region tending toward a climate more appropriate to seasonal forests.

Effects of changing climate on organisms associated with trees

In particular, changes in the biology of insect pests and diseases may make ecosystems more susceptible to tree mortality. Because of improved environmental conditions for the pest and reduced tree resistance due to increased stress, pests may react to climate change with range expansions and/or increases in attack severity.

Changes in abiotic disturbance regimes

These include changes in fire regimes, flooding, landslides and/or hurricanes. Fire and climate are closely linked and are also associated with changes in land use . Coupled climate and fire-risk models suggest not only an increase in the frequency of fires but also in fire size and length of the fire-risk season, with some areas subject to risk that were not before.

Malhi et al. (2009) considered how tipping points may be reached in Amazonian rainforest by a combination of increased dryness and an increased incidence of fire events

Invasion by organisms foreign to local ecosystems

This includes the increased risk of establishment by invasive species which accidentally arrive into ports of entry, through globalized commerce. By making new niches available, climate change will facilitate the survival of mammals, insects, diseases and/or weeds foreign to endemic ecosystems.

Thank you!

Responses of tree populations to environmental change

Responses of tree populations to environmental change

Tree populations rely on three interplaying mechanisms to respond to environmental change:

- adaptation
- Migration
- phenotypic plasticity

1. Adaptation and ‘standing’ genetic variation

Genetic adaptations that make a population more suited for survival are achieved through gene frequency changes across generation. Many tree species have high genetic variability in adaptive traits and can therefore grow under a wide range of conditions. Indeed, phenotypic traits of adaptive importance, such as drought tolerance, cold-hardiness, resistance to pests and diseases, and flowering and fruiting period, have been shown to vary across ecological and geographic gradients to an extent that may be as important as the differences observed amongst species

2. Migration via pollen and seed movement

Pollen is known on occasions to travel very long distances, particularly in wind-dispersed broadleaves and conifers, but also sometimes for animal-pollinated species. Pale ecological reconstructions of the decolonization of temperate zones during the Holocene have also suggested that seeds are capable of travelling long distances rapidly, in the range of several hundreds of meters per year. Landscape genetic approaches, macrofossil evidence and theoretical studies, however, indicate that cryptic refugia may have been overlooked, considerably reducing migration estimates. In addition, modern estimates of contemporary seed dispersal, although pointing to the existence of long distance dispersal events, generally indicate that median migration rates are in the range of a few tens of meters per year.

3. The role of phenotypic plasticity

"Phenotypic plasticity is defined as the capacity of a particular genotype to express different phenotypes under different environmental conditions."

3. The role of phenotypic plasticity

The concept is often extended to populations and species, with ‘plastic’ trees those with flexible morphology and physiology that grow at least reasonably well under a range of different environmental stresses without genetic change. A degree of phenotypic plasticity is found in most trees, but varies substantially amongst and within species. Even in species with very little genetic diversity, such as *Pinus pinea*L, strong phenotypic plasticity is expressed for growth-related traits, which may have helped the species colonise new environments.

3. The role of phenotypic plasticity

At least in the short term, high plasticity is likely to favour tree survival under changing environmental conditions, although trade-offs between traits can be expected.

Since phenotypic plasticity has a heritable basis and may be selected for under changing environments, complex interactions between traits are possible, depending on the magnitude and structure of change

Thank you!

Responses of tree populations to catastrophic biotic and abiotic disturbances

Responses of tree populations to catastrophic biotic and abiotic disturbances

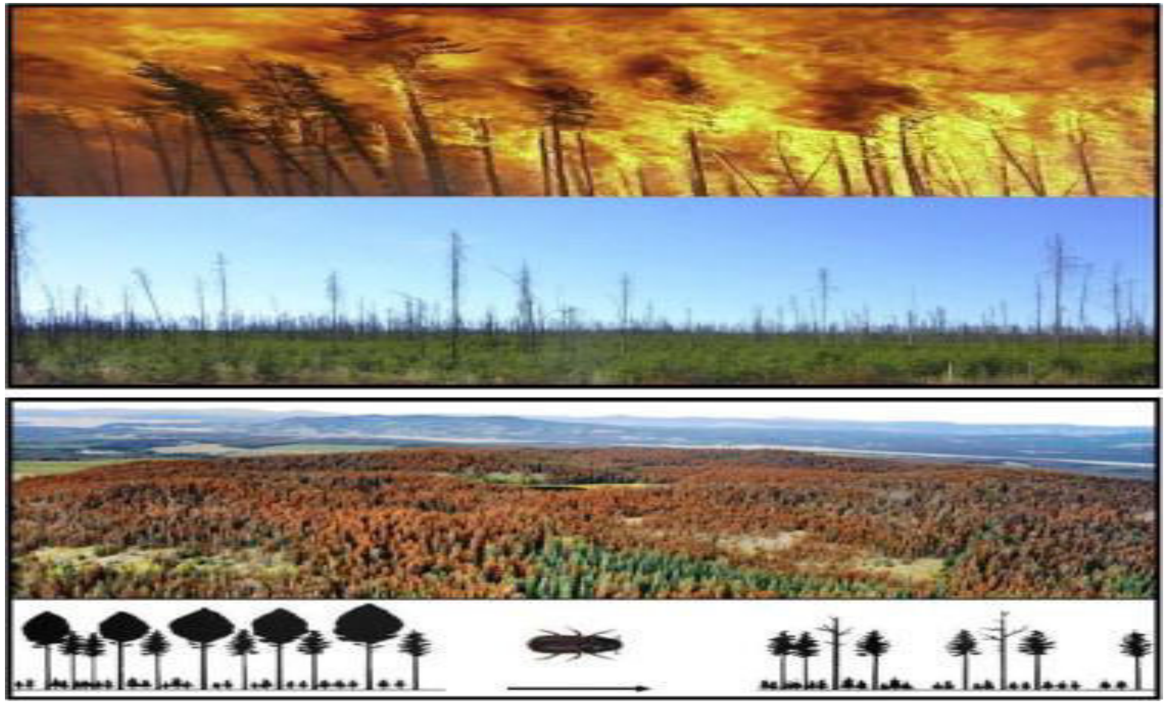
Tree populations have developed mechanisms to respond to naturally occurring disturbances within their range. North American conifers, for example, have adapted to outbreaks of the defoliating insect spruce budworm (*Choristoneura fumiferana* Clem.) that have recurred at periodic intervals (~every 35 years) at least since the middle of the Holocene, 6000 years ago. Climate change may however cause range expansions in herbivorous insects and in diseases, causing increased mortality in non-adapted populations. This is illustrated by whitebark pine, where a warming climate has increased the access of stands to native bark beetles that are now able to reach higher elevations, resulting in high mortality due to low defenses in trees that have had little previous contact with this beetle

Responses of tree populations to catastrophic biotic and abiotic disturbances

Tree populations respond to abrupt, non-linear environmental changes through the mechanisms already outlined:

natural selection favours genotypes with increased tolerance or resistance to disturbances, and phenotypic plasticity plays a role.

It is well known, for example, that populations of *Pinus contorta*Dougl. ex Loud. and *P. banksiana* Lamb. from parts of North America more prone to natural fires have a higher proportion of serotinous cones than those from elsewhere. Serotinous cones remain tightly closed until a hot fire has destroyed standing trees, then releasing seed to initiate rapid post-fire regeneration.



Forest transformation by natural disturbances.

Co-evolution and biotic disturbances

Co-evolution' describes a situation where two (or more) species reciprocally affect each other's evolution.

such as the classic case of host-pathogen interaction, where changes in *R*-gene resistance in the host lead to corresponding changes in *v*-gene virulence in the pathogen, triggering further rounds of change in one and then the other

In trees, such gene-for-gene relationships have, for example, been found in a number of North American white pines in their interaction with blister rust. Further important examples of co-evolution in trees include interactions with herbivores and pollinators.

In the former case, a number of constitutive and induced defence systems, both mechanical defences (e.g., resin canals, sclereid cells and thorns) as well as chemical defences (e.g., the production of toxic phenols and terpenoids), have evolved in response to herbivory. Insects and pathogens have developed mechanisms to de-activate these defences and even utilize them for their own benefit; for example, some insects use tree terpenes as precursors for their communication pheromones or incorporate them into their own defense systems

Responses to alien invasive species

Under climate change, FGR are likely to be increasingly threatened by alien invasive species i.e., more competitive trees, fungal and other diseases and herbivores that do not occur naturally in their local ecosystems, and to which they lack adequate defenses.

The consequences of exotic pest invasions may be a catastrophic elimination of FGR, such as the cases of chestnut blight and white pine blister rust. At a provenance level, exotic introductions may result in hybridisation and out-breeding depression in local tree populations already stressed by climate change, but, more positively, hybridisation may also introduce the new genetic variation required by trees to adapt to novel environments

Thank you!

FGR-based strategies to respond to climate change

FGR-based strategies to respond to climate change

Isbell et al. (2011) stated that "many species are needed to maintain multiple functions at multiple times and places in a changing world".

As climate change progresses, poorly-performing trees will be naturally replaced by alternatives that are better suited to new conditions, altering the relative abundance of different species and genotypes in landscapes. As resilience rests on the maintenance of genetic, species and ecosystem diversity, management strategies should support diversification at all three levels

FGR-based strategies to respond to climate change

To date, few countries have however taken practical steps to reduce the risk of FGR loss due to climate change. Relevant steps are usually only indirectly incorporated into action plans for forest management under climate change. In France, for example, FGR are not explicitly mentioned in the national adaptation strategy . They are, however, part of the action plan for forests, one of the sectors included in the national strategy for biodiversity, where recommendations for their conservation and sustainable use are explicitly mentioned

Assisted migration

Assisted migration involves human movement of tree seed and seedlings from current locations to sites modelled to experience analogous environmental conditions in the future.

Assisted migration may be undertaken over long distances, or just beyond the current range limit of particular genotypes and populations, or within the existing range . A gradual form of assisted migration could consist of reforestation of harvested sites with seed from adjacent locations likely to be better adapted to the planting site under future climate (e.g., in the Northern hemisphere, using seed from sources to the south; in mountainous regions using seed from lower elevations).

Selection and breeding

Climate change-related traits including plasticity and adaptation to increased drought need to be incorporated more actively into breeding programs (IUFRO, 2006). Many existing provenance trials were established before the need to respond to large scale anthropogenic environmental change was considered an important research issue and the traits measured have therefore often not been the most important ones from this perspective. Nevertheless, information from old trials can be reinterpreted in the context of climate threats . New trials established to assess explicit responses to climate change are being established in a number of countries

Selection and breeding

Traits needed to respond to different climatic conditions not often considered previously in breeding include:

Pest and disease resistance

climate-change-mediated increases in pest and disease attack are a crucial issue in commercial forestry. To date, one of the most extensive programmes to develop trees with resistance to insect pests in temperate regions is in British Columbia

Selection and breeding

Drought resistance

Drought stress induces a range of physiological and biochemical responses in plants and an assortment of genes with diverse functions are induced or repressed in organ-specific changes , which may make breeding more difficult, for example, using microarray analysis, detected that up to 113 genes were significantly induced by drought in two Mediterranean pine species. Species-dependent features shape the transcriptome response; for example, almost none of the 27 genes reliably responsive to water stress in *Arabidopsis thaliana*(L.) Heynh., differentially regulated under drought in poplar and pine. Candidate genes for drought tolerance include those involved in the synthesis of abscisic acid, transcriptional regulators of drought-inducible pathways, and late embryogenesis abundant proteins; shifts at such loci have been linked to global warming*sistance*

Selection and breeding

Fire resistance/tolerance

Since fire incidence and severity will increase in many regions under climate change, breeding for features such as serotiny, thicker bark and higher water use efficiency may all be required

Selection and breeding

Cyclone resistance/salt tolerance

Rising sea levels and an increase in the frequency of storms have the potential to wreak heavy damage on coastal forests, with low elevation islands at particular risk. Differential abilities to withstand storms and salinity are found more commonly amongst, rather than within, species, but the possibility of intra-specific selection should be further explored.

Selection and breeding

Phenotypic plasticity

Important but generally poorly understood, the plasticity of particular tree species and populations is vital for responding to climate change, and can be studied in common garden tests . Plasticity across environments can be quantified and response functions for particular populations generated, which describe the change in a trait as a function of the transfer distance or the change in an environmental factor. Populations vary in their response functions: in *Pinus contorta*, for example, some populations have a high growth rate over a much wider range of climatic conditions than others do

Thank you!

Conservation of FGR

Conservation of FGR

Safeguarding the genetic variety of forest trees is an important part of biodiversity conservation. Genetic diversity ensures the success of species in environments that are highly variable and subject to change.

Insitu management

For most forest tree species, management plans for the conservation units allow silvicultural interventions directed towards the support of and quantity of regenerating material. Applying given critical values for the number and density of seed trees, shortening of the regeneration time, regulating competition by other tree species and controlling invasive species should also be taken into consideration. A good level of genetic diversity and reduced consanguinity in the regenerated seedlings should be a management objective. Natural regeneration should be the preferred means but if this fails to occur, assisted regeneration can be carried out using local seed lots to maintain local phenotypic identitynatural regeneration both in terms of quality

Conservation of FGR

Three different strategies have recently been proposed to enhance resilience of forest stands to climate change in central Europe.

This includes

1) 'Conservation of forest structures' by silvicultural intervention for older stands located in areas predicted to have low impacts from climate change;

2) 'active adaptation' by thinning, re-spacing and choice of alternative species are proposed for stands where the impacts are anticipated to be severe and

3) 'passive adaptation' for stands of low value (ecological and economic) that will rely on natural evolution facing the future climate shift.

Ex situ conservation

Conservation of FGR is likely to become more complicated with rapidly changing climate. Therefore, actions for ex situ conservation will become increasingly important as a complement to, or substitute for, in situ conservation . Generally defined as planted forests established outside the original habitat of the genetic resources, ex situ conservation stands may be genetic resources of unknown genetic variability or characterized genetically by phenotypic traits or molecular markers. They tend to be expensive to establish and to maintain. Dynamic conservation can take place in ex situ stands when natural selection occurs at a site and when artificially planted trees (species, provenances, families) can be regenerated from seeds without much intervention . If the original population is sufficiently sampled and the stand is large enough (minimum viable population size) (FAO, 1992), these stands could provide sources of reproductive material for commercial forestry. Although costly, multi-site stands can ensure further adaptations to a range of different environmental conditions and prevent unexpected losses of genetic material

Conservation of FGR

Static ex situ. Seed orchards, clone banks and clonal archives are examples of static ex situ conservation units, in that no changes will naturally occur in the genetic structure of the collection. These plantings are established with the sole purpose of preserving the genetic diversity of a valuable population, to safeguard endangered species that otherwise might be lost or to conserve/increase the genetic diversity of rare species of those with scattered distribution.

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Thank you!

Laws & Legislation

Laws & Legislation

Learning Objectives

- What is Law?
- Laws of Pakistan

Laws & Legislations

Laws

"The system of rules which a particular country or community recognizes as regulating the actions of its members and which it may enforce by the imposition of penalties."

- A person could be held guilty if he breaches Law

Legislations

- The process of making or enacting laws."

Laws for Environmental Resources in Pakistan

➢Some major laws dealing with different resources present in environment are as follow;

- Pakistan Environmental Protection Act, 1997
- Pakistan Penal Code, 1860
- Forest Act, 1927
- Pakistan Terrestrial Water & Maritime Zones Act, 1976

Pakistan Environmental Protection Act, 1997

- **PEPA** provides for;
- Protection,
- Conservation,
- Rehabilitation and
- Improvement of the environment;
- PEPA provide framework for prevention and **control of pollution**
- Helps in protection of **sustainable development**.

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Pakistan Panel Code, 1860

➢ The polluter of the environment can be punished under this code for certain types of pollution.

➢ These punishment are of following types;

- Punishment for water pollution
- Punishment for atmospheric pollution
- Punishments for general pollution

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Forest Act, 1972

- This law empowers provincial governments to manage forests under their area.
- The government can reserve the state-owned forest land, assume control of privately owned forest land and declare any government owned land in a protected area.
- It prohibits the clearing of forest for cultivation, grazing, hunting, removing forest produce, quarrying and felling.

Pakistan Terrestrial Water & Maritime Zones Act, 1976;

- It includes provisions for preservation, development and protection of marine environment
- This law controls marine pollution and exploration, development, conservation and management of living resources in Pakistan's Exclusive Economic Zone (EEZ)
- This law means that a ship carrying nuclear and hazardous substances will have to inform the Government of Pakistan.

Laws & Legislation

Laws & Legislation

Learning Objectives

- Laws of Pakistan

Laws for Environmental Resources in Pakistan

➢Some major laws dealing with different resources present in environment are as follow;

- West Pakistan Fisheries Ordinance, 1961
- The Cutting of Trees (Prohibition) Act, 1992;
- The Wild Birds and Animals Protection Act, 1912
- The Prevention of Cruelty to Animals Act, 1890

West Pakistan Fisheries Ordinance, 1961

- It is an ordinance to amend and consolidate the law relating to fisheries in the West Pakistan.
- It says that no person will be allowed to use dynamite, pesticides or other explosives for catching the fish.
- Government can declare any water area as sanctuary.
- Then there will be no permit for fishing except some license.
- An Inspector of Fisheries may without a warrant arrest any person committing in his view any offence under section 6, 7, 8, 9 or 11.

The Cutting of Trees (Prohibition) Act, 1992;

- An act to provide for the prohibition of cutting of trees near the external frontiers of Pakistan
- If a person violates the law he will be punished by a fine up to 5000 rupees.

The Wild Birds and Animals Protection Act, 1912

- An act to make better provisions for the protection and preservation of certain wild birds and animals.
- It deals with the hunting, sale and import of the wild birds and animals.
- Whoever does or attempts to do, any act in contravention of section 3 of this act, shall be punishable with fine which may extend to fifty rupees.

The Prevention of Cruelty to Animals Act, 1890

- An act for the prevention of cruelty to animals.
- If a person beats, overdrives, binds or keeps it in starvation or thirst he will be punished.
- If any person overloads any animal, he shall be punished with fine which may extend to fifty rupees, or with imprisonment for a term which may extend to one month.
- If any person employs in any work or labour any animal which by reason of any disease, infirmity, wound, sore or other cause is unfit to be so employed, or permits any such unfit animal in his possession or under his control to be so employed, he shall be punished with fine which may extend to one hundred rupees.

International Treaties

International Treaties

Learning Objectives

- What is international treaty?
- International treaties to which Pakistan is signatory
- Convention of Biological Diversity

International Treaties

"**Treaty**, a binding formal agreement, contract, or other written instrument that establishes obligations between two or more subjects of international law"

- Treaties do not need to follow any special form.
- A treaty often takes the form of a contract, but it may be a joint declaration or an exchange of notes.

International Treaties

➢ Pakistan is signatory to a large number of international treaties and conventions.

➢ These are listed below;

- Convention on biological diversity, 1992
- Cartagena protocol on Bio Safety, 2001
- CITES, 1973
- Ramsar Convention, 1971
- Convention on the conservation of migratory species, 1981

Convention on Biological Diversity, 1992

- **CBD** is about the conservation and wise use of different biological resources (plants and animals).
- It was adopted in 1992 at Rio De Janeiro, Brazil and entered force on January, 1993, which was 90 days after the 30^{th} ratification.
- Pakistan signed it in June 1992 at United Nations Conference on Environment and Development held at Rio De Janeiro, Brazil
- Pakistan ratified it on 26^{th} July 1994.

Convention on Biological Diversity, 1992

➢ The Convention on Biological Diversity covers biodiversity at all levels:

- Ecosystems,
- Species
- Genetic resources

➢ It also covers biotechnology, including through the Cartagena Protocol on Biosafety.

➢ In fact, it covers all possible domains that are directly or indirectly related to biodiversity and its role in development, ranging from science, politics and education to agriculture, business, culture and much more.

Objectives of CBD, 1992

- The three inter-related **objectives** are:
- The conservation of biological diversity;
- The sustainable use of its components;
- The fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate
    - Access to genetic resources,
    - Transfer of relevant technologies,
    - Funding.

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Facts & Figures of CBD, 1992

- According to CBD;
- Ecosystems, species and genetic resources should be used for the benefit of humans, but in a way that does not lead to the decline of biodiversity.
- Substantial investments are required to conserve biodiversity, but it will bring significant environmental, economic and social benefits in return.
- The Ecosystem Approach, an integrated strategy for the management of resources, is the framework for action under the Convention.
- The precautionary principle states that where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat

Thank you!

Nagoya Protocol

Fair and equitable benefit-sharing

1. benefits arising from the utilization of genetic resources as well as subsequent applications and commercialization shall be shared in a fair and equitable way with the Party
2. Each Party shall take legislative, administrative or policy measures, as appropriate, with the aim of ensuring that benefits arising from the utilization of genetic resources that are held by indigenous and local communities,
3. To implement paragraph 1 above, each Party shall take legislative, administrative or policy measures, as appropriate.
4. Benefits may include monetary and non-monetary benefits.
5. Each Party shall take legislative, administrative or policy measures, as appropriate, in order that the benefits arising from the utilization of traditional knowledge associated with genetic resources are shared in a fair and equitable way with indigenous and local communities holding such knowledge. Such sharing shall be upon mutually agreed terms.

Access to genetic resources

access to genetic resources for their utilization shall be subject to the prior informed consent of the Party providing such resources

In accordance with domestic law, each Party shall take measures, as appropriate, with the aim of ensuring that the prior informed consent or approval and involvement of indigenous and local communities is obtained for access to genetic resources where they have the established right to grant access to such resources.

Access to traditional knowledge associated with genetic resources

In accordance with domestic law, each Party shall take measures, as appropriate, with the aim of ensuring that traditional knowledge associated with genetic resources that is held by indigenous and local communities is accessed with the prior and informed consent or approval and involvement of these indigenous and local communities, and that mutually agreed terms have been established.

Contribution to conservation and sustainable use

The Parties shall encourage users and providers to direct benefits arising from the utilization of genetic resources towards the conservation of biological diversity and the sustainable use of its components.

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Global multilateral benefit-sharing mechanism

Parties shall consider the need for and modalities of a global multilateral benefit sharing mechanism to address the fair and equitable sharing of benefits derived from the utilization of genetic resources and traditional knowledge associated with genetic resources that occur in transboundary situations or for which it is not possible to grant or obtain prior informed consent. The benefits shared by users of genetic resources and traditional knowledge associated with genetic resources through this mechanism shall be used to support the conservation of biological diversity and the sustainable use of its components globally.

Scope

This Protocol shall apply to genetic resources within the scope of Article 15 of the Convention and to the benefits arising from the utilization of such resources. This Protocol shall also apply to traditional knowledge associated with genetic resources within the scope of the Convention and to the benefits arising from the utilization of such knowledge.

Thank You!

Nagoya protocol

History and objective

Nagoya protocol

The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity, also known as the Nagoya Protocol on Access and Benefit Sharing (ABS) is a 2010 supplementary agreement to the 1992 Convention on Biological Diversity (CBD).

Nagoya protocol

The protocol was adopted on 29 October 2010 in Nagoya, Japan, and entered into force on 12 October 2014. It has been ratified by 97 parties, which includes 96 UN member states and the European Union. It is the second protocol to the CBD; the first is the 2000 Cartagena Protocol on Biosafety.

Development Goals,

Acknowledging the linkage between access to genetic resources and the fair and equitable sharing of benefits arising from the utilization of such resources,

Recognizing the importance of providing legal certainty with respect to access to genetic resources and the fair and equitable sharing of benefits arising from their utilization,

Objective

The objective of this Protocol is the fair and equitable sharing of the benefits arising from the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding, thereby contributing to the conservation of biological diversity and the sustainable use of its components.

Cartagena Protocol on Biosafety

Cartagena Protocol on Biosafety

Learning Objectives

- What is Cartagena Protocol
- Objectives of Cartagena Protocol
- Areas of protocol

Cartagena Protocol on Biosafety

- The Bio safety (Protocol to CBD) deals with;
  - Safe handling,
  - Storage
  - Trans-boundary movement of the Genetically Modified Organisms (GMO).
- Cartagena protocol was adopted on June 2001 in Cartagena, Spain
- It entered into force on September 11th; 2003.
- Pakistan signed the Cartagena protocol in June 2001
- Pakistan has ratified it in May 2009.

Objectives of Cartagena Protocol on Biosafety

- The Protocol states that it aims to;
- Contribute to ensuring an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity,
- It takes into account risks to human health, and specifically focusing on transboundary movements.
- It seeks to protect biodiversity from the potential risks of living modified organisms (LMOs) resulting from modern biotechnology.

Cartagena Protocol areas…

- The Protocol covers:

"transboundary movement, transit, handling and use of all living modified organisms that may have adverse effects on the conservation and sustainable use of biological diversity, taking into account risks to human health".

- It does not cover:

•Products derived from LMOs (e.g. paper from GM trees)

•LMOs, which are pharmaceuticals for humans that are addressed by other relevant international agreements or organizations

Quarantine Regulations

Quarantine Regulations

Quarantine legislation is in place in countries worldwide restricting the import of non-indigenous plant and animal pathogens. Those who wish to import such organisms must hold the relevant import permit, which can be obtained, from the relevant country Authority.

Quarantine Regulations

Learning objectives

- Introduction of quarantine regulation
- General concept of plants and animals quarantine

Quarantine Regulations

Quarantine practices in most countries have at least three common functions.

1. The first is exclusion or regulatory actions to prevent or reduce the risk of entry of exotic pathogens, pests, or parasites along artificial pathways.
2. Second is the containment, suppression, or eradication of pests or pathogens that have been recently introduced.
3. Third is the assisting of exporters to meet the quarantine requirements of importing countries.

Animal and plant quarantine programs are intended to protect agriculture from the threat of entry of exotic hazardous organisms.

In some countries this objective may be extended to the protection of natural domestic flora and fauna.

Both types of programs regulate the importation of living individuals

The general concepts and objectives of plant and animal quarantine are similar; but differences in biology, agricultural production, marketing, exporting, and importing necessitate a variety of quarantine procedures.

Animal and plant quarantine procedures. Animal and plant quarantine programs are intended to protect agriculture from the threat of entry of exotic hazardous organisms.

In some countries this objective may be extended to the protection of natural domestic flora and fauna.

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Thank you!

Pakistan Plant quarantine act, 1976

Definitions

A) convention” means the International Plant Protection Convention, 1951

(b) “crop” includes all agricultural or horticultural crops and all trees, bushes, grass or plants;

(c) “import” means the bringing or taking by sea, land or air across and customs frontier as defined by the Federal Government

(d) “infection” means infection by any insect, fungus, or other pest injurious to a crop or plant;

(e)“pest” means any living stage of any or all insects, nematodes, slugs, snails, protozoa, or other invertebrate animals, fungi, bacteria, or other parasitic plants or reproductive parts thereof, virus or any organism, or any infections substance which may directly or indirectly injure or cause disease to any cop or plant; and

(f) “plant” means all species of plants or parts thereof whether living or dead including stems, branches, tubers, bulbs, corns, stock, bud-wood, cuttings, layers, slips, suckers, roots, green scum on stagnant pools, leaves, flowers, fruits and seeds.

Import of plant material

Import of Plant material

No person shall import any plant or plant material which may be a source be a source or medium of infestation or infection by diseases and pests destructive to agriculture or medium for the introduction of noxious weeds, except under a valid import permit obtained prior to such importation in Form issued by the Director or the Entomologist (Quarantine) and except through the ports or points of entry

Plant material for which special permit is required:

Plant material likely to carry new complex of pests or diseases may be imported into Pakistan in limited quantities by special permit in Form I for the purpose of introducing new varieties and propagating stock from countries which maintain regular plant quarantine and inspection service.

Application for permit to import plant material:

1)~~Before any plant or plant material is imported, an application for permit shall be submitted to the Director~~ or to the Entomologist (Quarantine).

2) All such applications shall be signed by the person who intends to import the pant or plant material or his duly authorized agent and shall specify:

(a) the kind and quantity of plant or plant material;

(b) the country and locality of origin;

(c) destination;

(d) the name and address of the consignor and the consignee;

(e) means of transport;

(f) the prescribed port or point of entry;

(g) the prescribed for which the plant or plant material is proposed to be imported e.g., consumption propagation or processing.

Notice of arrival by the importer:

The importer shall inform the Director or the Plant Quarantine Officer, of the probable date of arrival of the plant or plant material at the prescribed port or point of entry

Refusal and revocation of permits:

A permit to import plant or plant material may b revoked if, in the opinion of the Director or the Entomologist (Quarantine), the importer has willfully contravened any provision of these rules or there is reason to believe that the plant or plant material will be imported in violation of the provision of these rules.

Freedom of plant material from San, Soil or Earth:

An imported plant or plant material shall be free from sand, soil, saw dust or earth and the plant roots, rhizomes and tubers shall be washed thoroughly.

Packing material

All packing material employed in the importation of nursery stock and other plants

Plant material imported by post:

Plant or plant material imported through the post shall be inspected by the Plant Quarantine Officer upon notification or their presence at the Post Office.

Exports

Inspection and Certificate for exports:

All persons who intend to export plant materials must submit to the Department, an application for inspection of plant or plant material before the dispatch of such consignments.

Application for inspection of plant material for export

1. a) If the plant or plant material upon inspection are found to be free from plant diseases and injurious insects, a certificate shall be issued by the Director or Entomologist (Quarantine) to the exporter to accompany the shipment.

(b) If the Director, or as the case may be, the Entomologist (Quarantine) considers necessary he may, before issuing a certificate require the disinfestations or disinfection of plants or plant materials by fumigation 19 through a person, firm, agency organization or company registered with the Department.

c)The Department may register any persons, firm, agency organization or company for carrying out disinfestations or disinfection of plant or plant materials on such terms conditions and on payment of such fees as it may determine

Application for inspection of plant material for export

D) No official certificate shall be granted for plant or plant material which have been from or mixed with other plants which are diseased or infested.

(e) The official certificate shall not be granted for any plant or plant material intended for shipment to a country in which their entrance is absolutely prohibited.

2. All risk or damages or any kind associated with or resulting from fumigation or other treatment shall be at the risk of the owner.

3.The certificate implies that the plant or other matter was inspected by a duly authorized officer of the Department and was fund to conform to the inspection standards or procedures associated with the issuance of official certificates tags or other documents.

Thank you!

The Pakistan Animal Quarantine Ordinance, 1979

The Pakistan Animal Quarantine Ordinance, 1979

To regulate the import, export and quarantine of animals and animal products in order to prevent the introduction or spread of diseases and to provide for matters connected therewith or incidental thereto

Definitions

A)animal" includes all kinds of

- Birds
- cold-blooded creatures
- creatures by means of which any disease may be carried or transmitted;
- crustacean
- fish
- four-footed beasts which are not mammals
- mammals, except man; and
- reptiles

Animal product

B) animal product" means anything originating or made, whether in whole or in part, from an animal or from a carcass

C) carcase" means the carcase of an animal and includes any part or portion thereof

(d) "diseased" means suffering from or carrying any infectious or contagious disease or such disease as may be declared by the Federal Government from time to time by notification in the official Gazette

(e) "fodder" means hay, roughage, concentrate or any other substance used for feeding animal

Power to regulate and prohibit import and export of animals and animal products

The Federal Government may, by notification in the official Gazette, prohibit, restrict or otherwise regulate, subject to such conditions as it may think fit to impose, the import or export of any animal or class of animals or animal products likely to introduce diseases to any other animal, animal product or man.

Any condition imposed under this section may require

(a) the examination, inspection and detention in quarantine by the quarantine Officer of the animals or animal products brought in or to be taken out:

(b) the obtaining of health certificate:

(c) the treatment or detention , confiscation and destruction of diseased animals or animal products:

D)that any animal or class of animals or animal products shall not be imported or exported except by a specified agency of the Federal Government .

Penalties

whoever contravenes or attempts to contravene any of the provision of this Ordinance or the rules or any notification issued thereunder , shall, without prejudice to any penalty to which he may be liable under the provisions of the Customs Act, 1969, be punishable with imprisonment for a term which may extend to three years, or with fine which may extend to five thousand rupees, or with both .

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Thank you!

The principles of successful quarantine

The principles of successful quarantine

One recent study (Plucknett and Smith, 1988) describes six principles of successful quarantine. They are summarized as follows

1.Sound scientific and technical principles should form the foundation of a quarantine program.

Pests and pathogens should be ranked by quarantine services according to the potential danger they pose to crops and the potential for success in excluding them. For example, germplasm from centers of diversity should receive a high priority because of the potential for such accessions to harbor coevolved pests or pathogens.

The principles of successful quarantine

Animal and plant quarantine regulations are similar in that they may:

- Require import permits issued by the quarantine service of the importing country (these may require the exporting country to certify that specified conditions have been met prior to shipment);
- Specify things that are prohibited from entry;
- Grant exceptions to the prohibitions for scientific purposes;
- Require inspection of imported materials upon arrival;
- Require appropriate treatment, if warranted, as a condition of entry; and
- Require, after arrival, quarantine or isolation in an approved facility.

The principles of successful quarantine

3. When germplasm must be planted and grown for the purposes of quarantine testing, it should be done in an area geographically and ecologically separated from the major growing areas for that crop, to prevent the establishment of crop-specific pests or pathogens.

4. When germplasm is endangered or the need for particular accessions is particularly urgent, some discretion should be possible on the part of quarantine officials in allowing exceptions for controlled entry, despite existing regulations to the contrary.

The principles of successful quarantine

5. Decentralized quarantine services are generally more efficient because they enfold a wider range of expertise in germplasm assessment.

6. Because delays in transit can be detrimental for any germplasm accessions, access to good communication and transportation services is essential for quarantine.

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Thank you!

Management of Genetic resources

Management of Genetic resources

The Plant Genetic Resources Program (PGRP) is the main National Program that is functioning for overall management of PGRs including

- exploration,
- collection,
- exchange,
- safe storage on long, medium and short term basis,
- evaluation,
- documentation
- and distribution to other research institutes for sustainable utilization of plant genetic resources of crops and wild relatives within the country and abroad.

Management of Genetic resources

Other research and educational institutes both at Federal and Provincial level are also handling conservation and use of plant genetic resources of selected crop commodities or groups of plant species

Attack oil refinery in Rawalpindi has also developed a biodiversity park as an environment improvement strategy for compensating the pressure on biodiversity due to industrial processing in the nearby vicinity

Management of Genetic resources

Institute of Agricultural Biotechnology and Genetic Resources (IABGR)

PGRP is regularly funded by the government of Pakistan

Management of Genetic resources

Plant Genetic Resources Institute hosts the sole National Genebank of Pakistan for conservation of plant genetic resources and six labs including

1. germplasm exploration lab
2. seed preservation lab
3. in vitro conservation lab
4. germplasm evaluation lab
5. plant introduction and seed health lab
6. Data management lab

Management of Genetic resources

National Gene bank of Pakistan at Plant Genetic Resources Institute has two types of conservation facilities

- Active collection
- Base collection.

Management of Genetic resources

Seed stock in the Gene bank is periodically subjected to germination tests in Seed Preservation Laboratory.

In vitro laboratory of PGRI has employed a variety of techniques for conservation of the germplasm of vegetative propagated species namely grapes, peach, pear, sweet potato, banana and sugarcane.

Without evaluation, utilization of germplasm in crop improvement is not possible. When Plant Genetic Resources Institute was established in 1993, considering the importance of germplasm evaluation, a modern state of the art Germplasm Evaluation Laboratory was also present in the institute.

Management of Genetic resources

Clonal repository is field Genebank where genetic resources of clonally propagated crops like fruits are preserved as living plants.

Various institutions are involved in the capacity building to develop AnGR, in the country. These institutions have their own set-ups at federal and provincial level. These institutions include

- Ministry of Food
- Agriculture and Livestock at federal level
- livestock departments at provincial level

Management of Genetic resources

- The main institutes devoted to research for the development of livestock are: Animal Sciences Institute (ASI) at National Agricultural Research Centre, Islamabad;
- Livestock Production Research Institute (LPRI), Bahadurnagar, Okara;
- Barani Livestock Production Research Institute (BLPRI), Kherimurat, District Attock;
- Research Institute for physiology of Animal Reproduction (RIPAR), Bhunikey, Pattoki,
- Kasur; Poultry Research Institute (PRI), Rawalpindi;
- Animal Nutrition Research Centre, Rakh Dera Chahl, Lahore and Poultry Research Institute, Karachi

Thank you!

Future Perspective of Genetic conservation

Future Perspective of Genetic conservation

Pakistan has rich Genetic Resources wealth But there is lack of associations or community based social organizations that can voice for conservation of indigenous resources.

Much work is being done for the conservation of plant genetic resources but animal genetic resources (AnGR) still need attention.

Future Perspective of Genetic conservation

Following strategies should be followed for effective conservation and utilization of AnGR:

1. Formulating the National Livestock and wild-life Breeding Policies.

2. Encouraging the Formation of Breed Associations.

3. Developing Professional Human Resources.

4. Strengthening Research and Development Institutions

Future Perspective of Genetic conservation

5. Developing Infrastructure for marketing International co-operation and assistance is needed in capacity building to remodel available livestock farms/research stations to conserve and develop genetic resources.

Thank you!

Improvements needed

Gaps and needs

Much progress has been made over recent years in linking the conservation and use of PGRFA with endeavors to increase food security and develop more sustainable agricultural systems. However, there are still many gaps in our knowledge and in the range of action required to improve the situation. Attention is needed, for example, in the following areas:

1. There is a need to step up efforts to conserve landraces, farmes' varieties and CWR before they are lost as a result of changing climates.
2. Special efforts are needed to identify those species and populations that are most at risk and that are most likely to harbour traits that will be important in the future;

Gaps and needs

3. There is a need for more efficient, strategic and integrated approaches to the management of PGRFA at the national level.

4. Links need to be strengthened between those individuals and institutions in both the private and public sectors who are primarily responsible for conservation and those who are primarily concerned with genetic improvement and seed production and distribution

5. At the international level there is also a need for greater coordination and cooperation among agencies and institutions concerned with international and intergovernmental aspects of the conservation and use of PGRFA and those concerned with agricultural production, protection, sustainability and food security, as well as related areas such as health and the environment.

Gaps and needs

- Greater efforts are needed to estimate the full value of PGRFA, to assess the impact of its use and to bring this information to the attention of policy-makers and the general public so as to help generate the resources needed to strengthen programmes for its conservation and use.
- There is a need for more accurate and reliable measures, standards, indicators and baseline data for sustainability and food security that will enable better monitoring and assessment of the progress made in these areas.

Gaps and needs

Greater attention needs to be given to the development of more decentralized, participatory and gender sensitive approaches to plant breeding in order to more effectively generate varieties that are specifically adapted to the particular production environments and socio-economic situations of the poor in less favored environments.

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Thank you!

Final Term Syllabus
Lecture 61 to 120

Efforts By

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Contact us to join our esteemed group

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REMEMBER IN PRAYERS

KEEP SMILING

SAY NO TO CURRUPTION

HELP TO OTHERS

Regards,

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