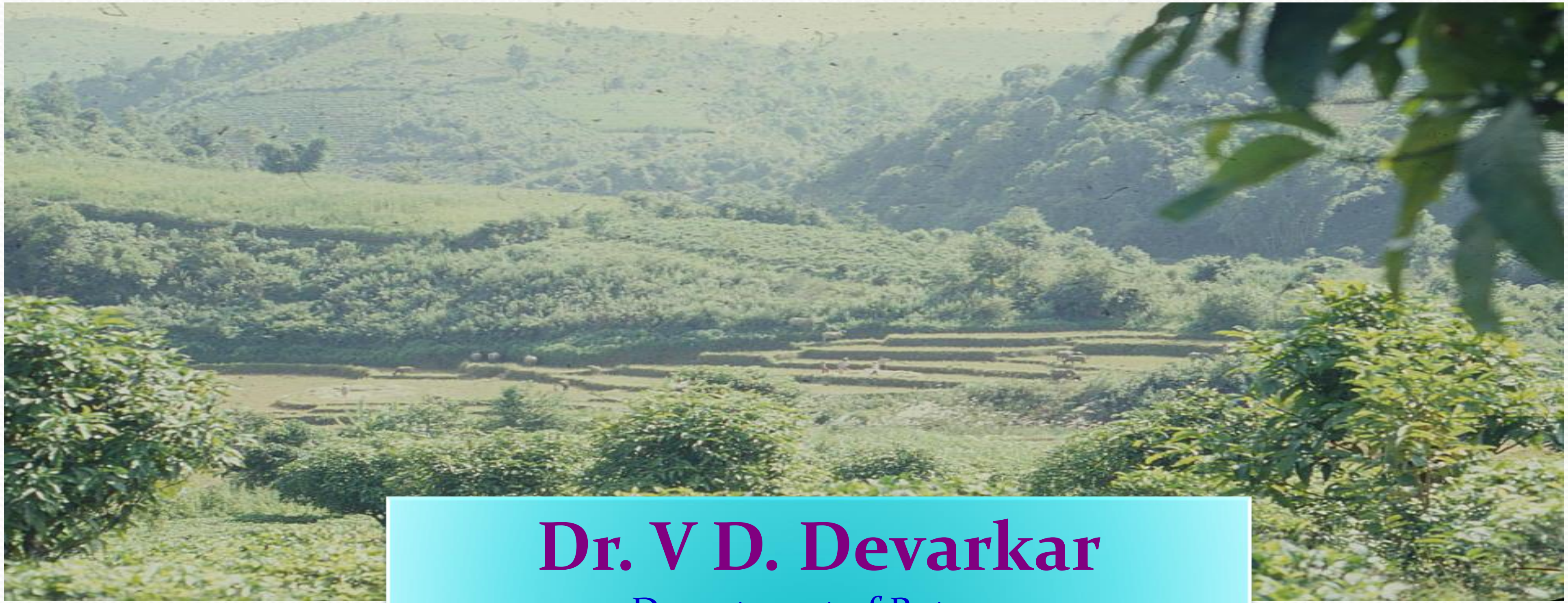
In situ Conservation



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Genetic Resources

Genotypes or populations

- Cultivars
- Genetic stocks, &
- Related wild & weedy species

Maintained as

- Plants, seeds, tissue cultures etc.

- Conservation

→ Species level
→ Genepool level
→ Ecosystem level

Threats to forest genetic resources as perceived by national experts

Cambodia: Encroachment and shifting cultivation at former concession sites; unsustainable harvests at concessions

Indonesia: Illegal logging and illegal trade of timber; forest fires

Lao PDR: Encroachment into forest for permanent or slash-and-burn agriculture; forest fires; logging; infrastructure development

Malaysia: Plantation and infrastructure development

Myanmar: Illegal logging, shifting cultivation, etc.

Philippines: Land hunger

Thailand: Illegal logging

Vietnam: Shifting cultivation; inappropriate harvesting practices

In situ conservation means the conservation of GR in their natural habitat

In situ conservation aims to

- Safeguard the evolutionary potential of ecosystems and species
- Ensure enhancement & sustainable use of genetic variation available to meet present & future human needs

Conservation of GR of agricultural species is quite clearly oriented towards species

- "Forest genetic resources" include genetic resources of all component species in an ecosystem
- Thus, their conservation goes beyond the scope of single species

In situ conservation

➔ Dynamic method

Main justification

- Ability to maintain evolutionary potential of species/populations
- Empower local communities over their GR
- Complement *ex situ* conservation

Why *In Situ* Conservation?

- **Diversity of stakeholders**
- **Diversity of objectives**

For *in situ* conservation we need

- **Assess, locate & monitor GD**

Most important

➔ Spatial & temporal distribution GD

In Situ Conservation

- A strategy to conserve the process of evolution and adaptation
- A strategy to conserve diversity at different levels -- ecosystem, species, within species
- A strategy to integrate user-groups into the national conservation system

CBD (Article 8)

- Promote in situ/on-farm conservation
- Preserve IK, innovations & practices of indigenous & local communities

Conservation Approaches & Methods

Two approaches to conservation

- ***Ex situ* & *In situ***

***Ex Situ* Conservation**

Conservation of seeds

- **Storage facilities extend viability of seeds**
- **Efficient & reproducible technique for orthodox seed species**
- **Low MC/Low temperature**
- **Conditions with life processes minimized**

Additional methods for seed storage

→ Mainly for recalcitrant seeds

- Imbibed storage
- Storage in LN_2
- Storage of ultradry seed

Conservation of Plants

Difficult-to-conserve species

- **Field genebanks (FGB)**

Some problems

- **Damaged by natural calamities**
- **Infection**
- **Neglect or abuse**
- **Substantial no. of individual genotypes**
- **Require more space**
- **Relatively expensive to maintain**

However

→ Provide easy & ready access

→Alternative methods yet to be developed

→Major role for perennial species

Conservation of Tissues/Cells

Difficult-to-conserve species

- Recalcitrant seeds
- Vegetatively propagated
- Large seeds

➔ For some species the only option

Cryopreservation

➔ Rapid progress made

➔ Great potential for conservation

Conservation of Pollen

Mainly developed as a tool for controlled pollination of
➔ **Asynchronous flowering genotypes**

- **Better utilisation of available PGR**
- **Fewer quarantine problems**
- **Pollen dried to 4-5% MC (silica gel)**
- **Stored under vacuum**
- **Viable for**

Cryopreservation
→ **Additional technique for GR**
- **Conservation of genes**

➔ **Additional research is needed**

DNA Storage

In principle
- Simple
- Widely applicable
- Easy & Cheap

However
  - Strategies
  - Procedures

How to use the stored DNA
  Role is not clear yet

Botanical Gardens

> 1500 BGs worldwide

Objectives

- Maintain ecological and life support systems
- Preserve GD
- Sustainable use of species & ecosystem

Play limited role in conservation

Greater role in

- PA
- Education

Good management + Planning

→ May emphasise conservation of some groups of species (like FGB)

In situ Conservation

Dynamic

- **Maintains evolutionary potential**

→ **Research & monitoring needed**

- **Assay of GD within a target species in an area**
- **Intraspecific morphological & molecular variation**
- **Diversity as recognized by users/ farmers/communities**

Need

- **Regular inventory of species numbers**
- **Observations on**

→ **General ecological conditions &**

→ **Habitat alteration**

  - **Including farming systems**

Biosphere Reserves

Conservation at

- Species & Ecosystem level

  Conservation of wild species/crop relatives

  - Location
  - Designation
  - Management
  - Monitoring of GD

→ Not very accessible for use

→ Difficult to monitor and manage

→ Limited characterization & evaluation

→ Vulnerable to natural & human disasters

However

→ Most potential method for perennial species

On-farm conservation

In situ **conservation of agrobiodiversity**

Maintenance of

- **Landraces**
- **Farming systems**

Effects of growers-practices paramount

- **Presently little information available**
- **Systematic documentation of IK**
- **Community participation**
- **Control of land rights in local communities**
- **Education, extension &**
- **Development of environmental awareness**
- **Benefit to the local communities**

Home gardens

- Similar to on-farm conservation
- Smaller in scale

Community of home gardens

- Unique/rare diversity
- Underutilised species
- Testing grounds for

→ New cultivars &

→ Wild and semi-domesticated types

Though

Vulnerable to changes in management practices

- Continue to have role in conservation and use

  → in rural areas

Complementary Conservation Strategy

Two main approaches

Ex situ & *in situ*

→ Complementary in nature

Conserving a genepool

- Employ a combination of methods
- No single method can conserve all GD
- Balanced use of available methods
- Differs from genepool to genepool

Functional point

→ CCS appears to be a combination of methods

In principle it is

- A decision-making process

→ leading to conservation of GD in a target gene pool

To link all different elements

→ Secure, sustainable, accessible and cost-effective way

CCS should be

→ Participatory & dynamic process

Use of a combination conservation methods

→ one method complements the other

- Optimally conserving maximum diversity
- In efficient and cost-effective way
- Supporting the use of GRs

→ Crop improvement or direct use

In situ conservation of Forest Biodiversity: A people centred approach

Some description of forests

- Primary forest
- Undisturbed forest
- Primeval forest

- However, virtually all forests on the planet have been substantially influenced by humans, most for at least several thousands of years
- Studies show that forests & people have evolved together over thousands of years

In situ conservation of Forest Biodiversity (contd.)

Some common practices by people

- **Planting the trees they prefer**
- **Using fire to burn forests to improve hunting conditions**
- **Managing forest fallows to maintain their agricultural fields**

Thus, forests are part of the human landscape, & the biodiversity found in today's forests has been profoundly influenced by people

- **Hence, any approach to conserve forest biodiversity should have people as a focus**

Problem statement

Rapid loss of large number of forest species/populations

➔ Require conservation measures

Major limitation: Our limited knowledge of the

➔ impacts of deforestation

➔ Uncontrolled exploitation & other threats

➔to genetic diversity in tropical forests

➔ 95% unsustainably managed

Major challenges to developing strategies include

- **Setting priorities for interventions**
- **Scaling up research findings**
- **Feeding results into national/regional action plans**
- **Generating a set of good practices for forest biodiversity management**
- **Raising awareness, and, very importantly**
- **Engaging local communities in conservation actions**

➔ Making sure that people benefit directly from the sustainable management & use of forest resources

Role of *in situ* conservation

- Conservation of evolution & adaptation processes
- Conservation of diversity at all levels
- Integrating user communities into national conservation systems
- Conservation of ecosystem services, functions & health
- Maintaining local forest management processes
- Improving livelihoods & quality of life of communities
- Empowering local communities to influencing policy decisions on forest biodiversity management

A systematic approach to conservation of forest genetic resources

The sequence of activities could be:

- Selection of priority species
- Assessment of their genetic variation
- Assessment of their conservation status
- Identification of key-populations to be conserved
- Identification of appropriate conservation measures
- Organization and planning of specific conservation activities
- Preparation of management guidelines for the objects of conservation

➔ Emphasis here is on organization of specific conservation actions

In situ conservation with focus on Community Based Forest Management (CBFM)

- **There is increasing recognition of the need for commutes should be involved in forest management & forest biodiversity conservation for its success**
- **CBFM offers a new framework for relations between the many stakeholders in forest resource management**
- **Involves developing partnerships initiate dialogue & open space for new voices to be heard instead of confrontation & tension**
- **Successful partnerships depend on mutually accepted rules to share decision making & to ensure the participation of all partners, including traditionally weak and disenfranchised groups**

Genecological zonation: separating the distribution into major gene pools

Defined as

An area with sufficiently uniform ecological conditions to assume similar phenotypic or genetic characters within a species

Such zonation is based on

➔ Compromise between the variation in ecological factors & expectations of gene flow

Zone should be not *too small*:

➔ To prevent that any genetic differences develop between populations due to gene flow

It should be not too large

➔ So as to be able to focus on existing differences between populations within each zone

Genecological zonation *(contd.)*

A genecological zonation system

➔ **Can be a common system for all species considered, groups of similar species, or even single species.**

Factors typically used for zonation are

- **Natural vegetation**
- **Topography**
- **Climate**
- **Soil**
- **Barriers to pollen and seed dispersal**

Genecological zonation *(contd.)*

Target species may differ in several ways

- **Differences in reproduction biology**
- **Differences in reactions to environmental clines or heterogeneity**
- **Differences in life histories in terms of**

➔Migration, hybridisation events or use by humans

Thus, the zonation should be

➔Specific for individual species, or at least for major groups of species

Important to note: Zonation is dynamic

Conservation Stands

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Conservation Stands (contd.)

Regeneration

- **Regenerated with as little genetic influence from outside as possible**

➔ Requires isolation

- **Isolation distance of 300-500 m recommended**

Tending

Should promote stability & regeneration

May include

- **Culling of competitive species or for certain bushes (non-target species)**
- **Controlled animal grazing or fire**
- **Pure stands – Random thinning - Support naturally selective forces**
- **Mixed stands- regulation of species composition with care**

Establishing a *CBFM* conservation programme: Major considerations

Institutional framework

- **Forest dependent communities practise *in situ* conservation informally**
- **Focused programme requires institutionalising at local level**
- **Organizations committed to *in situ* conservation**
- **Guidelines for interactions**
- **Roles of different institutions**
- **Linkages for working together**

Establishing CBFM (contd.)

Sensitizing & strengthening local communities

- Identify grassroot institutions with matching objectives
- Strengthening the capacity of local organisation
- Strategy for on-farm conservation will only succeed if local communities & grassroot organisations are involved
- Know what/how/why they do
- Sensitize all partners to conservation needs

Establishing *CBFM* programme (Contd.)

Promote collaboration

- **Many different stakeholders**
- **Teamwork**
- **3-M approach (multidisciplinary, multiinstitutional & multisectoral)**
- **To be effective, good coordination, effective communication, networking & participatory approaches needed**
- **Identify hurdles to collaboration & remedy them**

Establishing *CBFM* (Contd.)

Framework for collaboration

- **Develop MoUs to promote institutional understandings**
- **Build close rapport between teams**

➔ **Most essential steps to success**

- **Building rapport & collaborative arrangements with forest-dependent communities**

Need time to develop a framework

- **Participation of forest-dependent communities crucial in setting goal**
- **Essential to link *in situ* conservation with market outlets & incentives**

➔ **Forest-dependent communities see the value of conservation**

Establishing *CBFM* (Contd.)

Representative partnerships & equitable sharing of benefits

***In situ* conservation initiatives should promote**

- **Equity at all levels**

  ➔Participation of Forest dependent communities in management & decision-making

- **Equitable gender, ethnic & other minority involvement**
- **Increased women, minority & farmer participation in decision-making**

Establishing *CBFM* (Contd.)

Process of *CBFM*

CBFM conservation efforts begin with reaching understanding between institutions, collaborators & forest-dependent communities

Preparation

- **Collect data on descriptor information, databases of genebanks, herbaria, published & unpublished literature**
- **Set criteria for site & farmer selection**
- **GD, accessibility & farmer's interest**

Participatory approaches to on-farm management of agrobiodiversity

Process of CBFM (contd.)

Generalized criteria

- **Diversity of ecosystems**
- **Intra-specific diversity in target species/habitats**
- **Specific adaptations: Extreme conditions**
- **Threat of genetic erosion**
- **Diverse use values**
- **Interest of communities**
- **Socio-cultural/economic diversity**
- **Diversity of livelihoods Importance of target forest biodiversity**
- **Community knowledge & practices**

Criteria (contd.)

- Household use and market opportunities
- Partners with interest in community & cooperation & skills
- Logistics: accessibility & resources

Combine existing data with

- Information from exploratory survey, using
  - Rapid Appraisal
  - Participatory Rural Appraisal (PRA), or
  - Similar approach

Sensitize community to

➔Issues on hand

Benefits (contd.)

Communities conserve forest biodiversity

→ Only when they benefit from it

Forest are multifunctional and have several uses

Broadly, Total Economic Value of forest could be estimated as the total of

→ Goods and services (timber and non timber products, recreation, climate regulation, carbon sequestration, existence value etc.)

However, for a community, these may be more in the context of meeting day to day needs

Their day to day life so closely associated with the forests that they depend on

Hence, sustainable management of these can be a strong motivation force

Benefits (contd.)

Generally, forest dependent communities derive the following benefits

- **Building materials**
- **Medicine**
- **Fuelwood**
- **Subsistence/marketable products (fruits and nuts, NTFPs mushrooms, game meat, birds etc.)**
- **Cultural uses**
- **Pride**
- **Risk avoidance, etc.**

Needs & preferences of communities

➔ May change over time

Benefits *(contd.)*

Important to enhance benefits

→To community from forests

In terms of

→ Food, Fuel, Medicines & Household Incomes

→ Means of adding value

♦ Increasing forest biodiversity competitiveness

♦ Improved access to markets

♦ improved access to credit, skills, marketing services, etc.

→Increase consumer demand through

- **Processing & diversifying product base**
- **Respect for the environment & aesthetic values**
- **Public awareness& Changes to policy**
- **Linking to eco- & agro-tourism etc.**

Benefits *(contd.)*

Means of adding value (contd.)

Increase consumer demand through

- ♦ **Processing & diversifying product base**
- ♦ **Respect for the environment & organic farming**
- ♦ **Public awareness& Changes to policy**
- ♦ **Linking to eco- & agro-tourism etc.**

Identifying forest genetic diversity to conserve *in situ*

GD - central to conservation & use

For effective conservation & use

We need

- Information on status of GD in forests

Important to consider

- forest history (origin etc.)
- Community knowledge/traditional knowledge
- Local forest management practices

Translating research results into practice: Biological research questions & practices

What is the potential of economically important, priority species to adapt to climate change?

➔ **Understand adaptive mechanisms in tree species & support 'active' forms of gene management in preparation for response to rapid environmental and climate changes**

- ***Which species are more sensitive to threats?***

➔ **Develop genetic erosion vulnerability maps or indices to identify species that require priority conservation action**

- ***For more-or-less intact ecosystems containing priority species, where do we establish in situ conservation areas? What is their optimal size?***

➔ **Characterize structure & distribution of infraspecific diversity of target species to define the locations & the minimum sizes of areas to be preserved**

Translating research results into practice (Contd.)

- ***When natural ecosystems have become seriously fragmented, what size and shape should fragments have to be in order to maintain minimally adequate diversity in target species, and what is the degree of ecological connectivity that will allow adequate gene flow?***

➔ **Determine the level of genetic erosion resulting directly or indirectly from reduced gene flow to determine the effectiveness of forest corridors assessing the genetic integrit (gene flow)**

Translating research results into practice (Contd.)

- ***What are the sustainable levels of exploitation NTFPs in target species?***

➔Determine genetic processes of trees harvested for NTFPs to determine balance between the needs of forest-dependent peoples & the genetic integrity of the resource

How widespread and how damaging is genetic pollution in target species?

➔ Determine genetic pollution to provide a scientific basis to the regulatory frameworks that control the movement of genetic material within and across national boundaries

Identifying crop genetic diversity to conserve *in situ* (contd.)

Above may be used as
•Criteria for site selection

Then one can determine GD

Information on GD
➔ Rationalize the number of sites
➔ Choose additional sites

GD can be determined using
- **Morphometric methods – currently used**
- **Molecular markers – Possible**

Other considerations

***In situ* conservation → Long-term**

- **Requires control of land rights**
- **Education, extension & development of environmental awareness**
- **Management by local communities to link conservation & use**

Hence, most important are:

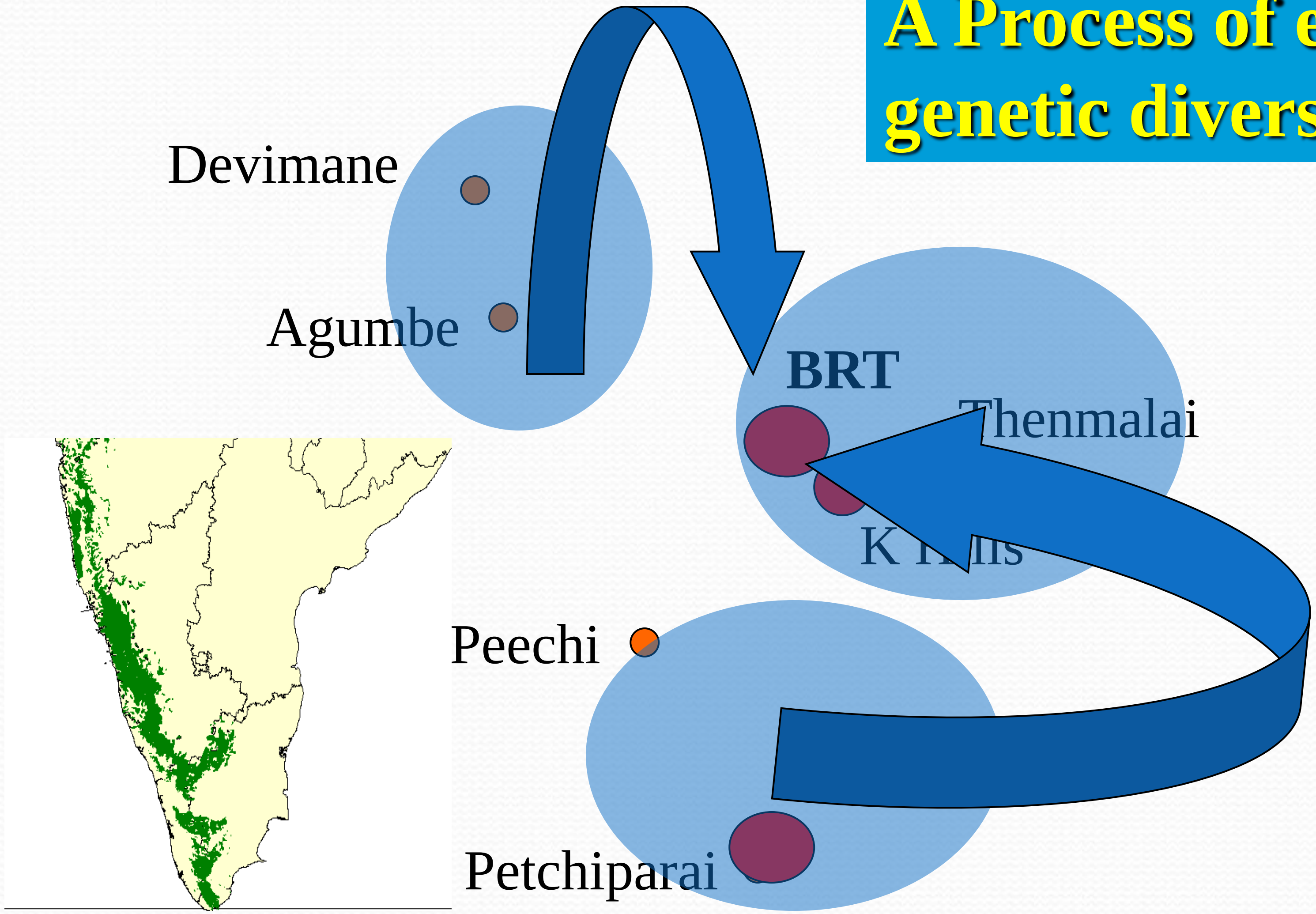
- **Peoples' participation**
- **Cooperation between local people, researchers, conservationists & NGOs**

Can also consider establishment of

- **Areas of intensive management**
- **High yielding plantations**
- **→ Long term sustainability of *in situ* conservation**

Forest Gene Bank Concept

A Process of enriching genetic diversity



FOREST GENE BANK

- Surveyed and Identified one large swamp (SINK)
- Genetically diverse populations identified
- Seedlings raised from these populations (DONORS)
- Sapling were transplanted in the swamps
- Monitoring the populations

Forest Gene Banks: Advantages

- Cost effective Genetic Repositories
  - One place for conservation
  - Can be augmented with protected area concepts
  - No Cost of maintaining in artificial conditions
- Genes Grow (as Interest in Banks)
  - Encourages Ecological and Evolutionary interactions
- Banks for depositing and withdrawing genes
  - Unlimited variability

Next steps

- Create/use existing institutional framework
- Locate diversity (e.g. crop diversity fair)
- Measure & assess diversity
- Understand value of GD
- Understand & validate processes that maintain GD
- Monitoring GD (e.g. CBR)
- Sensitize & strengthen stakeholders
- Developing strategy for *in situ* conservation
- Linking problems with new opportunities
- Institutionalizing ins situ conservation strategy integrating communities into national conservation system

Next steps (contd.)

- **National partners to spend some time to workout above steps for specific target sites/species**
- **Community participation is central to *in situ* conservation**
- **Sensitize NPs & communities before *in situ* programme could be piloted**

- **To set off in this direction, we need**
- **Share *in situ* conservation experiences with all partners**
- **Identify partners who wish to integrate *in situ* conservation of forest biodiversity**
- **Discuss & develop process of *in situ* conservation with all stakeholders**
- **Identify resources**

Next steps (contd.)

3 research strategies needed

1. Assay genetic variation
2. Conduct genecological studies
3. Study of any special features

Effective FBD *in situ* efforts need information on:

- Genetic erosion due to introduction of new species
- Identification of genetic diversity rich regions
- Fragmentation & genetic diversity
- Temporal/spatial changes in genetic structure
- Biogeographic studies
- Minimum viable populations sizes & areas
- Effects of inbreeding and seed banks
- Effects of farmers' practices
- Effects of cultural preferences
- Effects of environmental factors

Concluding Remarks

- ✓***In situ*** **conservation forest biodiversity is feasible**
- ✓**Is a component of CCS**
- ✓**Many countries are conserving plant GD *Ex situ* approach - main current focus**
- ✓ **Need to focus on *in situ* approach**
- ✓**Together they can help to conserve & maximum GD**
- ✓**Need to understand how communities**
  - ➔ **Value forest biodiversity**
- ✓**Some assumptions have to be made**
- ✓**A win-win situation**
- ✓**Conserving & using FBD for benefit of those who depend on it &**
- ✓**Contributing to environmental health**