

**TROPICAL AGRICULTURAL CENTER FOR RESEARCH AND EDUCATION  
(CATIE)**

**TROPICAL SUSTAINABLE AGRICULTURE PROGRAM**

**Phylogenetic Resources Unit**

**PHYTOGENETIC RESOURCES AT CATIE AND THEIR  
IMPACT IN SUSTAINABLE AGRICULTURE**

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## I. BACKGROUND

The Tropical Agricultural Center for Research and Training (CATIE) initiated its first plant collections, principally rubber, coffee and cocoa, in 1948, in response to the growing loss of phylogenetic resources in the Mesoamerican region. At that time, plant and seed collections were established which were distributed worldwide.

The establishment of a genetic variability conservation center at CATIE was recommended by the Meeting of Genetic Resource Specialists, in Beltsville, Maryland in 1972. In December 1973 experts from eleven countries of the region attended this meeting in Turrialba, the FAO/CATIE defined work areas, crops and the role of the new germplasm conservation center.

In July 1976, the Genetic Resources Unit (GRU) was established at CATIE for the Central American and Caribbean Region (CACR), and it began its activities with the institutional support of the German Society for Technical Cooperation (GTZ).

For ten years (1976-86) this cooperative project developed an adequate infrastructure at CATIE, planned and carried out exploration, collection, conservation, characterization, documentation, exchange and training activities at the regional level.

The fundamental policy of the Genetic Resources Unit at CATIE has been the free exchange of plant germplasm; this has made possible the existence of copies of CATIE's collections in other countries. At the same time, CATIE's Germplasm Bank is the deposit for world collections of coffee (Coffea spp.), cocoa (Theobroma cacao), beans (Paseolus spp.), sweet pepper (Capsicum spp.), peach palm (Bactris gasipaes), squash (Cucurbita spp.), fruit trees (Pouteria spp.), as well as plantain (Musa spp.).

## II. SUSTAINABILITY IN PRODUCTION SYSTEMS

The development of sustainability is linked to the conservation of plant and animal species, and attempts to minimize adverse effects of production systems on air, water of natural environment quality, and to conserve the global integrity of ecosystems.

Sustainable development aims to satisfy the individual's basic needs and to allow everyone access to a an adequate life style. Responsible management of renewable natural resources is a requirement to maintain sustained economic growth.

Protection of the environment and the stimulus for economic development should not be separate goals. Economic development, per se, can not subsist in an environment of erosion and destruction of the base of natural resources.

The production of new genotypes through genetic improvement, which includes the evaluation and multiplication of elite germplasm under different environmental conditions, should be at the heart of the interdisciplinary effort to improve food production in CACR, where poverty regions.

The role of genetic resources in developing sustainability is very important, since research to diversify production systems should incorporate multiple use trees which permit the growth and improvement of agricultural productivity systems already in use.

The CACR, possesses a great area of land with wood and fruit bearing trees which produce sustainable economic and ecological benefits. Raising the value of some of these forests through sustainable commercial use can be the most effective way to assure their continuity in the region.

There is an urgent and indispensable need to promote and develop new production systems in perennial crops to widen the food base and improve nutrition and the security of the Central American population, particularly for low income families.

This focus can help farmers and those low income groups which commonly do not receive the benefit of economic development which is generated in the region through export crops.

### **III. THE ROLE OF PHYTOGENETIC RESOURCES IN SUSTAINABLE AGRICULTURE**

The CACR agriculture lacks improved productivity of native crops; this seems to stem from a lack of selection of better genotypes and for the need to develop appropriate technological packages for the management of these crops. This region has an enormous potential for food production. The possibility to produce all year round and the huge biological diversity are only two of the comparative advantages of this region. However, the lack of research in tropical crops, both by themselves, and in sustainable associations, needs to be addressed

At Turrialba, CATIE possesses one of the largest germplasm collections of tropical and exotic species, which definitely could serve as the basis for the selection of superior genotypes. Presently, there are approximately 300 species of actual or potential importance in its field collections and cold storage facilities. For CATIE, these phyto-

netic resources represent the strategic component which permits the carrying out of its goal, supporting conservation and agricultural development in its member countries (the countries of Central America, and Dominican Republic, Mexico and Venezuela).

Population growth in the region and food demand, among other factors, are exerting a strong pressure on the ecosystems, putting their fragile balance in danger. CATIE, as a Regional Center, has assumed the responsibility of conserving native phyto-genetic resources, as well as maintaining and introducing new exotic genotypes which have possibilities of showing importance for sustainable agriculture in the region.

In the last two decades, the appearance of new technology, the substitution of local cultivars by high-input cultivars and the exploitation of new areas has caused accelerated and deep genetic erosion of many cultivated plants as well as wild relatives of crop plants and plants of potential agricultural use in the future.

CATIE's aim of raising food production and quality as a means of ensuring adequate nutrition in the region, requires the protection and adequate use of germplasm on a short, medium and long term basis.

#### **IV. ACTIVITIES IN THE UNIT OF PHYTOGENETIC RESOURCES**

Maintenance of germplasm for immediate and future use is an operation designed to conserve the greatest genetic diversity of the largest possible number of crops. This operation should be done while avoiding losses of viability and strength, preventing mechanical mixtures in the case of seeds, maintaining the genetic identity of entries, and documenting them in such a way that they can be correctly identified. Plant health quality of the material should also be assured.(Figure 1)

##### **a) Conservation in field collections**

This type of conservation is required for species which produce recalcitrant seeds and at CATIE utilizes a 50 hectare farm, with approximately 4700 introductions of 300 different species, some of which form part of active work programs. Of the existing germplasm in these collections, those with agronomic potential, such as cocoa, peach palm, coffee, yam bean, plantain, tropical fruit trees, and some spices (vanilla, black pepper and achiote) are being studied.

#### **b) Conservation in holding chambers**

Two holding chambers are available for those genotypes which produce orthodox seeds; one for short term (5 degrees C and 35% relative humidity) and another for long term (-17 degrees C). In the latter, seed samples are conserved in waterproof bags, with a humidity content of between 5 and 7%. Up until December 1994, the total number of introductions conserved in both chambers was 6034, plus a duplicate of a bean germplasm from CIAT with 23,427 introductions.

#### **c) Conservation in vitro**

In vitro conservation techniques are being developed in the biotechnology laboratory at CATIE to minimize risks and maintenance costs of germplasm especially for coffee, bananas and plantains, roots and tubers, as well as for other species. At the same time, micropropagation and/or agamic multiplication techniques for some elite genotypes are being developed.

#### **d) Collection, characterization and evaluation**

During this aspect of the work, experiments in different sites are established to evaluate the behavior of the new crop under a wide range of environments. Cultural practices, harvesting methods and crop yield are evaluated. It is important to note that at this stage a high genetic diversity is maintained to enable selection of the most desirable materials for yield in regional experiments.

Efforts have been concentrated on characterization and selection of elite genotypes of collections of cocoa, coffee, peach palm, fruit trees, roots and tubers, and some spices.

#### **e) Documentation, mailing and recollections**

Since 1942, CATIE has distributed germplasm from its collections in an unrestricted manner. This activity has run parallel to the exploration and collection of germplasm in all of Latin America.

Documentation is done electronically and there are data bases available for cocoa and coffee. Passport data and other characters of agronomic interest exist for the other collections. The elaboration of catalogs with field collection information facilitates the use of germplasm. CATIE has promoted this documentation system since it permits a better understanding of genetic variability under conservation.

#### **f) Teaching and training**

The Phylogenetic Resources Area actively supports CATIE's postgraduate program, giving Phylogenetic Resources and General Plant Breeding courses. In parallel, there is a permanent active program involving direction of masters degree students in these areas, and short course and in-service training for professionals and students from America as well as from other continents.

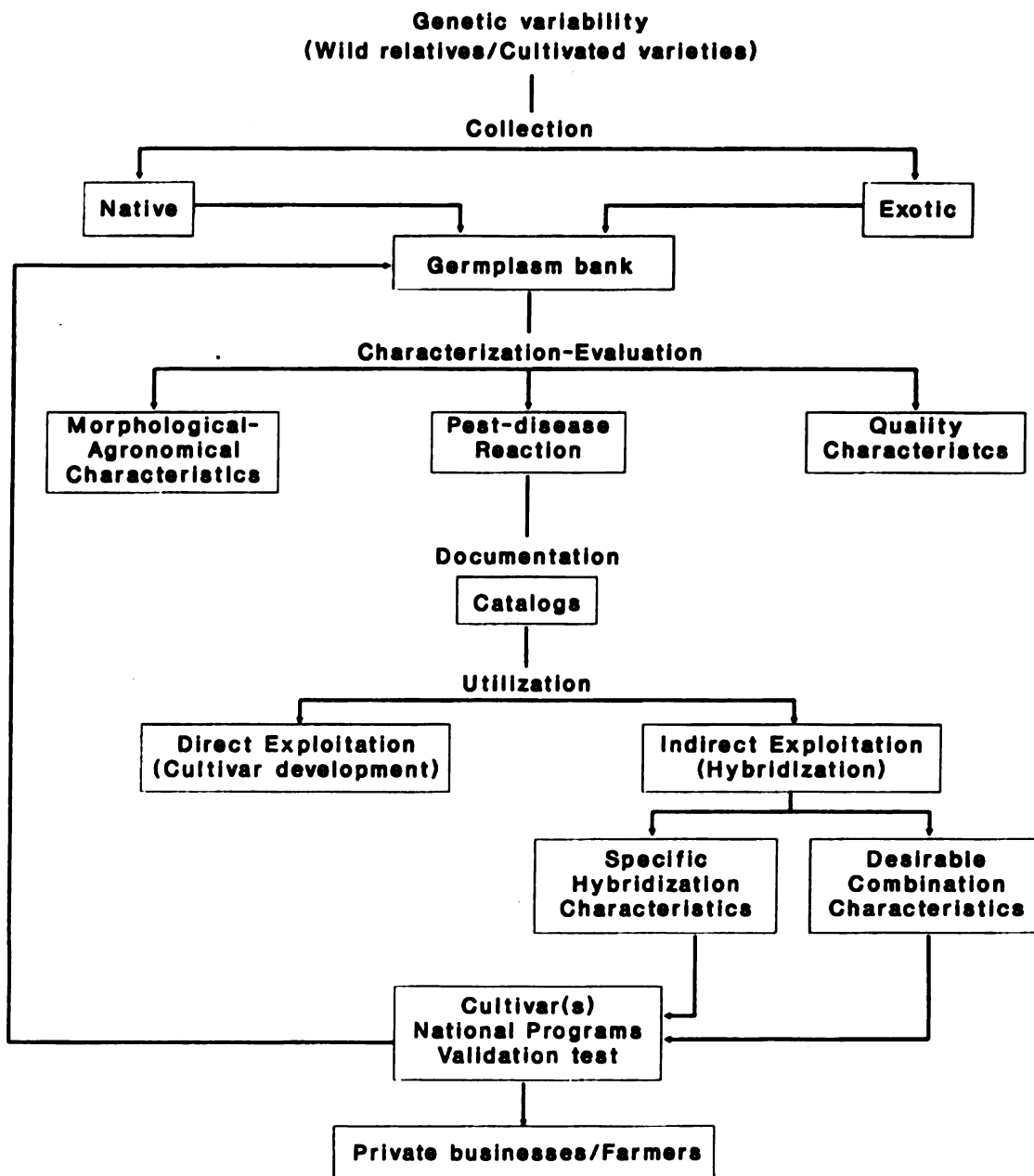
### **V. EXPECTED REGIONAL IMPACT**

The recognition and consciousness which has brought about the rational use of phylogenetic resources on a worldwide level, justify CATIE's continuing support of conservation activities and promotion of the use of its diverse collections, as an essential base for sustainable agriculture in the American tropics.

This focus will help farmers and those low income groups who generally do not receive the benefit of economic development generated in the region. From ecological, social and economical points of view, phylogenetic resources will play a very important role as the basis for diversity for genetic breeding programs, and as the basis for diversification of cropping systems.

Thus, CATIE, through the Sustainable Agriculture Program, promotes the conservation and adequate use of phylogenetic resources. It aims to strengthen existing collections of high demand and priority crops at the regional and worldwide levels with the support of special medium and long range sustainability projects, to select superior genotypes, to modernize characterization, conservation and documentation methods, to promote teaching and training in Phylogenetic Resources and Plant Breeding to facilitate the decisive support that national programs require in the region.

We should emphasize that training, in the above sense, will provide the valuable human resource base needed to design phylogenetic resource systems which are able to combine economic development with environmental conservation in each country. Ecological subjects are very important right now. We should stimulate research into environmentally sustainable agriculture, which is in harmony with economic development. A dynamic and rational agriculture, which combines and takes complete advantage of all resources and which makes agricultural activity an admirable and dignified profession. Development of sustainable agricultural systems will require that disciplinary groups work together closely to achieve multiple objectives. Such teams represent the interests of both preservation and use of diversity of plant resources for the purpose of regional development.



**Figure 1. Diagram of collection, evaluation, documentation and utilization of phylogenetic resources at CATIE, Costa Rica. 1994**