VIETNAM:

COUNTRY REPORT TO THE FAO INTERNATIONAL TECHNICAL CONFERENCE ON PLANT GENETIC RESOURCES

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Note by FAO

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CHAPTER 1
Agricultural Production in Vietnam

1.1 NATURAL FEATURES OF VIETNAM

Vietnam is situated in Southeast Asia, with an area of 330,000 km^2 and a population of 72 millions of habitants. Mountais and highlands share three fourth of the whole territory. Vietnam stretches beyond 15 degrees parallel, from $8^0$30" to $23^0$30" N, making Vietnam´s climatic and soil characteristics diversified and complicated. Followings are some main features of Vietnam´s topography and climate. North Vietnam is characterized by high and rugged mountains, which are the last parts of the Himalayan range. It is due to the various high mountain ranges running in the Northwest - Southeast and North - South directions that in the winter, the monsoon winds easily flow from Central Asia to Vietnam, resulting in cold temperatures in North Vietnam. The west side of Central Vietnam is characterized by the Truongson range running from North to South, making a natural border between Vietnam, and Laos, Cambodia.

The Haivan pass at 16th N parallel prevents the winter northeast monsoon from spreading into the Southern part of Vietnam. This makes Vietnam have two clearly distinct climatic zones. At the north Haivan pass, there exist two annual distinct seasons: the wet, cold winter and humid, hot summer, with complicated weather fluctuations and much of natural calamities such as typhoons and flooding. At the south of Haivan pass, the climatic conditions are considered more stable, flooding and typhoons are rarely observed, but the weather is humid and hot all year round. In the south two distinct seasons, however can still be observed: the dry and the rainy.

In Vietnam, there exist two big deltas: the Red River Delta in the North and the Mekong River Delta in South. Soils in these two deltas are found most fertile over the world. Average annual precipitation in Vietnam is considered high, from 1,700 to 2,000 mm, coupled with densely river systems, making Vietnam a country rich water resources.
From North to South, Vietnam can be divided into 7 agro-ecological zones, described as follows:

- The north zone: mainly mountains and midlands, with subtropical climatic conditions. Temperate climatic conditions can be found in high mountain areas. Cold in winter with dry cold in early winter and wet cold in late winter due to long drizzle from January until April.

- The northwest zone: mainly mountains, with subtropical climatic conditions.
- The Red River Delta, including the Ma River Delta. This is the vast plain zone with very ferrite soil, subtropical climatic conditions, cold winter, also dry cold in early winter and wet cold in late winter.
- North central zone: mainly mountains and highlands, with a narrow strip of non fertile soil plain, coupled with hard climatic conditions, influenced by hot and dry winds flowed from Laos.
- Coastal south central zone: fertile soils and typical tropical climatic conditions.
- Central plateau: fertile soil, tropical climate with two distinct dry and rainy seasons. Water deficiency is found severe in dry season.
- Mekong River Delta: this is the largest plain with fertile soils, plentiful water resources, typical tropical climate.

1.2 SOCIAL ASPECTS AND VIETNAM AGRICULTURE

In Vietnam, there exist 54 nationalities, of which Viet group shares the largest part, with over 80% of population.

Vietnam represents one of the countries having early agricultural civilization. Agricultural production activities have been practiced in Vietnam since 2500 years B.C.

Nowadays Vietnam is still considered an agricultural economical country. The rural population shares over 80% of total population and agroproducts share over 40% of Gross National Products (GNP).

Of the whole country, the cultivated areas amount to over 5 millions of ha. The per capita of cultivated area in Vietnam is found lowest of the world.

Crop production shares two third of agricultural products. Main food crops are: rice, maize, sweet potato, cassava. Paddy equivalent production in 1994 was 25,5 millions of tons. Economically, apart from food crops, the following groups of crops can be mentioned:

- Industrial crops. These crops can be ranked, in terms export earnings, as follows: coffee, rubber, tea, groundnut, coconut, cashew. Then come the local consumption crops: sugar cane, cotton, jute...

- Fruit crops. The fruit crop growing area is so far 290,000 ha. Only banana gives export product, the rest merely gives products for domestic consumption.
- Legume crops. Soybean, mungbean and other pulses.
- Vegetable crops in Vietnam are very diversified. In North Vietnam, both tropical and temperate vegetables can be grown.

Animal husbandry still shares a low ratio in the agricultural production and in the National economy as a whole. The most economical domestic animals are: pig, buffalo, cattle, chicken, duck, goat, horse...

During war time, due to great demand of food production, the diversified crop nature of Vietnam agriculture had to be changed into monocultural production of rice and some few other food crops.

Two favorable conditions of Vietnam agriculture are fertile soils and large human resources. Main constraints are weather fluctuations and natural calamities such as drought, typhoons, flood, low temperature... which occur quite frequently. In recent decades, due to the reduction and narrowing of crop genepool, pests and diseases occur severely and frequently on crop fields.

The forest areas of Vietnam account for 19 millions of ha , sharing about 60% of the National territory. They are characterized by humid tropical forest, with many kinds of wood and valuable wild animals. Vietnam forest economy development in recent decades has focused mainly on exploitation. Little attention has been paid to afforestation and regreening of forest lands. Due to long war period, to rice shifting cultivation and to unappropriate forest exploitation, the forest areas have been substantially reduced. In 1943, about 43% of the national territory were covered by forest, in 1987 that ratio reduced to 28,2%.

It is estimated that annually an amount of 600,000 ha of forest areas was lost. The bare land, therefore has been remarkably increasing.

Since the renovation time of economical policy in 1988, the Vietnam agriculture has been witnessed a new period of rapid development. Two main things, among the others, in Vietnam agricultural development in recent years are:

- Agricultural production increases steadily and rapidly in all the crop groups. In the past, Vietnam had to import annually 500,000 tons of rice, however, since 1991 Vietnam ranks third among the top rice exporters. Annually around 2 millions of tons of rice are exported. Vietnam is also considered an important exporter of coffee, rubber, tea and other apoproducts.

- In 1985, the agricultural production shares 80% of GNP, however in 1994, that percentage reduced to 40% Within the agriculture sector, animal husbandry shares an increasing ratio, meanwhile food crop production reduces their sharing.
- Since 1990, the afforestation areas have been increasing and the bare land areas have been gradually reduced.

CHAPTER 2
Plant Genetic Resources of Vietnam

2.1 MAIN FEATURES OF VIETNAM PGR

Southeast Asian region is considered the most prosperous and richest in PGR over the world. Vietnam possesses not only this common richness of Southeast Asia but also the particular features, having both temperate and tropical PGR.

Following historical, geographical, economical, and social factors account for the diversified PGR in Vietnam:

- Historical factor. In unmemorial time, Vietnam territory was linked with Indonesian and Malaysian plains. This resulted in the interchanging of PGR with the South Asian region. Vietnam dwellers in the past had lived in the southern part of the Tjangste River Delta, then due to war conditions, they moved southernward to establish the Red River Delta civilization. When moving to the south, the Viet dweller brought along with them various crop species originated from northern areas.
- Geographical factor. Vietnam territory lies in the last chains of two big mountain systems, the Chinese end the India-Myanma. Therefore Vietnam flora are greatly influenced by the South Asia flora.
- Ecological factor. Vietnam is situated in the tropical region, but influenced by the monsoon from Central Asia, North Vietnam is characterized by a subtropical climate with some feature of temperate conditions in high mountainous areas. The PGR of North Vietnam, therefore involve tropical, subtropical and temperate species.

Vietnam PGR consist of three main components: indigenous species, introduced species from South China and introduced species from South Asia.

There exist 14,624 plant species in Vietnam, of which 150 are starchy species, 130 fruit crop species, 100 oil plant species, 90 fiber plant species, 1,000 woody species, 1,836 medicine species, hundreds of spice and volatile oil species.

2.2 CROP GENETIC RESOURCES

Prosperous PGR are the main factor to create diversified CGR in Vietnam. Vavilov. Zukovski, Zaven and other evolutionists agreed that Indochina was the origin of numerous crop species. Vietnam is the zone of origin or belongs to the region of origin of crop species such as Rice, Taro, Banana, some Citrus species, Jack Fruit, Mango, Coconut, Tea, local Onion,...

Apart from the main factor of prosperous flora, the diversified CGR in Vietnam take account from following reasons:

- Diversified climatic and geographic conditions, due to which North Vietnam is characterized by rich crop genetic resources, including tropical, subtropical and temperate crop species.
- The diversification in ethnic groups. Vietnam is the home of numerous ethnic groups, each has its own agronomic tradition and food preference.
- The age-old agricultural civilization of Vietnam people.
- At present, Vietnam is exploiting and using the following crop species:
    - Starchy food crops 39 species
    - Non-starchy food crops 95 species
    - Fruit crops 104 species
    - Vegetables 55 species
    - Oil crops 44 species
    - Fiber crops 16 species
    - Crops for beverage manufacturing purpose 12 species
    - Spice crops 39 species
    - Perfume crops 19 species
    - Cover crops for bare hill regreening 29 species

Beside, there exist hundreds of under-utilized crop species.
According to preliminary statistical data, Vietnam possesses so far about 700 crop species belonging to 70 genera.

There is a wide diversity of crop land races in Vietnam. The amount of 5,000 rice traditional cultivars is actually conserved in the National Genebank. Due to no organizing timely the collecting activities, an important part of traditional rice germplasm has been lost. It is estimated that there exist no less than 5,000 rice land races targeted for collecting in next years. They are mainly found in mountain, coastal and other adverse ecological condition areas. It is

worth to emphasize that rice resources of Vietnam are composed of both Indica and Japonica rice. Near an half of rice land races in mountain areas, including upland and rainfall low-land rice are Japonica rice. The other crops rich in valuable gene sources are Taro, Yam, Legumes and annual industrial crops.

Regarding the fruit crops, those that are endemic of Vietnam have a great diversity in land races, among which it can be mentioned Kaki, Litchi, Longan, Banana... The exotic land races of these species likely exist uniquely in Vietnam.

Since 1990, there is a clear tendency of increasing in Vietnam the agricultural production. In the groups of annual crops, farmers tend to grow the cultivars having high quality. In the group of perennial crop, land races are predominantly cultivated for a long time ago. The increasing production areas of fruit and industrial crops also result in using land races in large scale.

Wild relatives of crop species are also diversified, as Vietnam lies in the region of origin of many crops. Wild relatives have been play increasing role in breeding programs. Rice can serve as an excellent example. Valuable gene sources of rice wild relatives are now exploited widely. *O. rufipogon* collected from Dienbienphu valley and Cuulong River Delta are evaluated. The result indicates that. *O. rufipogon* from Cuulong River Delta has gene source highest over the world tolerant to sulphate acid soils and *O. rufipogon* from Dienbienphu Valley is highly resistant to tungro virus and blast . *O. officinalis* has gene sources tolerant to brown plant hopper and white-back plant hopper. *O.granulata* is tolerant to drought and having gene source capable to photosynthesize at the low sunshine intensity. *O. nivira* is immune to virus diseases, but unfortunately it was not found any more in Vietnam. Take the Sugar Cane as another example. Wild sugar cane *S.espontaneum* are found in Vietnam and its gene sources have been widely exploited in breeding programs. Almost all the commercial sugar cane varieties in Vietnam as well as in the world are hybrids of *S. officinarum* and *S. spontaneum*.

2.3 FOREST GENETIC RESOURCES

The Forest Genetic Resources of Vietnam consist of 12,000 species, 7,000 of which are from 1,850 genera in 267 families of Angiosperm. Among various fruit tree species, about 2,300 species can be used as food for man, feedstuff for animals or materials for other economic purposes. Vietnam forest GR are characterized by numerous special species having very high economic values such as Cinnamon, *Illicium verum*, *Chukrasia tabularis*, *Aquilaria, Agallocha*,

Dalbergia oliverli, *Dalbergia conchinchinensis*, *Diospyros mun*, *Sherea hardmandii*, *Pentace tonkinensis, Podocarpus fleurril, Pterocarpus pesatus, Pinus merkusii, Erythrophloelum fordii.*

2.4 MEDICINAL PLANT GENETIC RESOURCES

In Vietnam, there exist 1,863 medicinal plant species belonging to 236 families. About 700 species are often mentioned in Oriental Medicine literature. 150-180 medicinal substances derived from medicinal plants are popularly used by various traditional medicine hospitals or traditional local physicians. About 120 medicinal plant species are popularly used by local people, especially the ones living in rural or mountain areas.

A lot of valuable well-known and rare medicinal plant species are discovered in Vietnam flora, such as Ngoclinh Ginseng, *Smilax bauhinioldes*, *Panax pseudo-ginseng, Amomumm echinosphaera, Polygonum multiflorum, Coscinium usitatum, Strchnos nux-vomica,...*

Vietnam is one of the oriental countries having high degree of traditional medicine development, that is why our country has the prosperous and diversified medicine plant genetic resources.

2.5 EVOLUTION OF PGR SINCE THE GREEN REVOLUTION (1960 - 1965) UP TO NOW

During 20 -30 recent years, Vietnam PGR suffer huge changes. This process has been developing in two directions : either more prosperous or erosion.

Thanks to the agricultural development and the cultural exchange, the Vietnam PGR have got more diversified. Numerous high economic valuable crop species have been recently introduced into Vietnam such as Grape, Cashew, Okra, Avocado, Stevia, Dragon Fruit.

The genetic diversity of numerous annual crop species is remarkably increased, though germplasm exchange and crop introduction from various International research institutions and from those countries having sound scientific-technical cooperation relationships with Vietnam. Most important are rice germplasm introduced from IRRI, South China, Taiwan, South Korea, maize from CIMMYT, Thailand, food legumes including groundnut from ICRISAT.

The second trend, the imperative, is crop erosion, due to following main reasons:

- The Green Revolution and the intensive farming process caused negative problems. The expanding of irrigation system and the popularizing of chemical fertilizers make agriculture change from extensive to intensive farming. Countless local tradition crop cultivars, adaptable to local ecological conditions have been replaced by a few number of newly developed intensive crop varieties. After eliminated from production a lot of crop varieties have been disappeared forever as insufficient attention has been paid to their collection and preservation.
- The pressure of population increasing rate and ever growing food demands have resulted in the setting up of such development target as only crop yield increasing. This makes the crop resources being reduced and narrowed. In upland areas, the population pressure leads to burning forest for rice shifting cultivation everywhere, that is why crop and forest tree genetic resources are damaged or destroyed on large scales.

Long wars, bombs and herbicides have made Vietnam loss over two millions of ha of forest areas. Together with the destroying of such large forest areas, hundreds of species of crops, forest trees and medicinal plants have been disappeared forever.

Due to above mentioned reasons, a lot of crop species such as food legumes, cereals, fruit crops, are so far lost. The genepool of main crops is visibly reduced. The most typical example is Rice. Numerous local traditional rice varieties such as high quality rice, "loc", the group of rice land races tolerant to drought in Red River Delta, the salt tolerant Rices in the coastal areas, the flooding tolerant varieties and the acid sulphate tolerant Rices in the Mekong River Delta, all are lost.

As for the second important food crop, the Maize, numerous glutinous maize varieties for human consumption have been eroded. As for fruit crops, the genetic erosion occurs mostly in citrus species.

One of the most valuable fruit crops, special for Vietnam, is the *Diospyros kaki*. A lot of valuable Kaki varieties have been also lost.

CHAPTER 3
Activities on Plant Genetic Resources Conservation

3.1 *EX SITU* CONSERVATION

The activities of exploration, introduction and preservation of crop germplasm in Vietnam were started before the Second World War, concentrating in the crops with high export values. At that time, Indochina was one of the most important rice exporter in the world, every year exporting millions of paddy tons. In order to promote the rice production for exportation, the exploration and collection of local rice cultivars were promoted, then evaluated and selected those with high yield and good grain quality for releasing them again to the production. The cultivars that were heterogeneous populations were purified and separated into the pure varieties. The first collections of rice cultivars were developed in Mekong River Delta in 1930s, consequently since then, the *ex situ* conservation in field maintenance form was started. The valuable rice cultivars form Vietnam were introduced into France colonies in Africa, into Taiwan, Japan and other countries, some of which were domesticated and grown there. In 1960s, such those cultivars were transferred to the International Rice Research Institute and up to now they have been conserved in the International Rice Germplasm Center.

The industrial crop species that had been explored and conserved were Tea, Lacquer Tree, Jute... An important part of the collection of tea cultivars actually conserved had been collected before the Second World War.

Rubber, *Coffee arabica, Coffee robustica, Gossypium hirsutum* are important industrial crop species that had been introduced in Vietnam before 1945.

Regarding the forestry species, the Vietnam people have been exploring and conserving resources of Cinnamon and Anise, the two most important exotic traditional species, over a long period of time.

The medicinal plants have been cultivated since remote time in Vietnam. Hundreds of endemic medicinal species have been preserved evaluated and used over centuries.

After finishing the Indochina War, the PGR *ex situ* conservation in Vietnam has been gradually performed in systematical manner. In 1952 the Vietnam Government decred to establish the Vietnam Agricultural Science Institute

(VASI) and since then VASI has been assigned the responsibility of conserving crop germplasm. In 1950s, for solving the food problems, the exploration, evaluation and use of food crop germplasm were initiated. The unique form of genetic crop conservation at that time was the field maintenance. The following groups of crops had been preserved with the purpose of selecting their promising varieties to the production:

- Food crops: Rice, Millet, Maize, Sweet Potato, Cassava.
- Legume crops: Soybean, Mungbean, Groundnut, *Phaseolus* sp.
- Industrial crops: Sesame, Jute, Cotton, Coconut, Rubber, Tea, Cafe.
- Fruit crops: Banana, Pineapple, Litchi, Longan, *Citrus* sp.

The most significant PGR *ex situ* conservation activities in 1950s and 1960s had been concerned with medicinal plants. In the field of public health, the Vietnam Government has been planning the policy of continuing and developing the traditional medicine, so the medicinal plants have been explored and evaluated systematically, various preservation gardens had been setting up.

After the period of great achievement of Green Revolution, PGR, particularly CGR have been under serious threat of genetic erosion. Following common trend of the World, Vietnam has been focusing on the conservation of its PGR. However, suffering from the heavy consequence of war and the severe backwardness of economy, the PGR conservation in Vietnam has been performed with too slow rate in comparison with that in neighboring countries of the South East Asia. Before 1987, the PGR conservation activities in Vietnam, although had been promoted parallelly in all three PGR groups crop, medicinal and forestry plants, there had not yet been an unified coordinating program. In 1987 State Committee for Science and Technology (now Ministry of Science, Technology and Environment, MOSTE) promulgated. the Provisional Regulation on Conservation of Plant Genetic Resources. In 1988, the National Plant Genetic Resources System (NPGRS) was founded. The formation of NPGRS is consequence of un awareness from the Vietnam Government on the importance of PGR conservation upon the agricultural development.

The Vietnam Government, through Ministry of Agriculture and Food Industry (MAFI), designates to Vietnam Agricultural Science Institute (VASI) the function of coordinating the NPGRS and through MOSTE, sponsors to its activities. The NPGRS is composed of three parts:

- Crop Genetic Resources are under the direct management of MAFI.
- Forest Plant Genetic Resources are managed by Ministry of Forestry.

- Medicinal Plant Genetic Resources are managed by Ministry of Public Health.

In 1989, the National Genebank was established and assigned the duty of conserving the CGR. The National Genebank is the core organ of the NPGRS and possesses four main types of activities:

- Managing the cold seed storage bank which preserves the orthodox crop species.
- Maintaining the field genebank of the vegetatively propagated crop species.
- Coordinating the activities on field maintenance and characterization of working germplasm collections of 50 crop species at the network of 16 agricultural research institutions all over the country.
- Unifying methodology with the Forest Research Institute and the Medicinal Plant Research Institute on the conserving the forest and medicinal genetic resources, respectively.

The National Genebank implements three methods of preservation, those are: cold seed storage, field maintenance and *in vitro*.

3.1.1 Cold seed storage preservation

The activities of cold seed storage preservation were iniciated in 1989 regarding Rice, the must important crop of Vietnam. It was added to cold seed storage preservation Soybean, Mungbean and Groundnut in 1991 and Cotton in 1994. Actually, near 5000 varieties of five crops are preserved. From 1989 to 1993, only medium - term preservation was performed. Since the Spring 1994, the long - term preservation has been implemented.

Regarding the major crops such as Rice, Soybean, Mungbean, Groundnut... Vietnam is concentrating the efforts on conserving the local cultivars. The conservation of introduced varieties has not yet been got a high priority because of limitations on preservation capacity and on utilization needs demanded from the users. The improved varieties are too not the target of the actual preservation, as they are widely expanded in the production and their erosion does not yet occur. Approximately 80% of the cultivars preserved in the cold seed storage bank are uniquely conserved in only one place. The remain of 20% are duplicately conserved in other network institutions of Vietnam and in the International agricultural research institutions. The crop genetic resources conserved include the wild relative species.

3.1.2 Field preservation

The National Genebank is directly preservated in field condition 1200 cultivar samples of Tuber and Root Crops collected in Vietnam, mainly belonging to four genera: Colocasia, Xanthosoma, Dioscorea and Amorphophalus. These crop species possess high genetic diversity in Vietnam as Vietnam lies in the region of their maximum genetic diversity. Many valuable gene sources are found in those genera in Vietnam.

The wild relatives such as wild rice species are preserved by both approaches, cold seed storage and field maintenance in greenhouse.

3.1.3 *In vitro* preservation

Since 1990 the *in vitro* conservation has been performing in cultivars of some vegetatively propagated crop species such as Potato, Sweet Potato, Banana, Pineapple and *Citrus*, a genus owning with recalcitrant seeds. The number of cultivars preservated is approximately 200. It is remarkably noted two relevant problems through the research process of *in vitro* conservation:

- Expensiveness. It is estimated that the in the condition of Vietnam, the in-vitro conservation is 20 times more expensive than the field maintenance. Possibly the *in vitro* conservation in developed countries is cheap and that in Vietnam is expensive because in those countries, the price of chemical substance is too lower, but the price of man-power is too higher than in our country.
- Existence of mutation. It has not yet been implemented the research work in our country to quantify the rate of mutation as well as to minimize and eliminate it.

Due to such reasons, in Vietnam it is used mainly the field maintenance approach to preserve the crop species of vegetative propagation. However, the exploitation and utilization of *in vitro* technique in genetic conservation has been paid attention, especially for two purposes:

- For transportation and exchange of genetic materials as this approach simplifies both, transportation process and plant quarantine.
- For preserving those valuable crop species that are difficult to be preserved by cold seed storage or maintained in field condition.

At present, 7,000 cultivar samples of 50 crop species are maintained in the field conditions at the 16 agricultural research institutions all over the country. Here, two aspects of field maintenance should be distinguished :

- Regarding the perennial industrial and fruit crops, the preserved plantations are not only a form of crop genetic preservation, but also serve to research and development duties of the mastering institutions. Those plantations are considered as Field Genebank.
- Regarding the annual crop, the collection maintained in field condition working collections, mainly serving to the plant breeding subject of the mastering institutions.

There are duplicate accessions among the 7,000 cultivar samples above mentioned, because for several cultivars, the same can be used by different institutions.

3.2 COLD SEED STORAGE FACILITIES

The cold seed storage equipments used in our genebank are cold rooms having volumes of 12 - 20 m^3, made in France and introduced into Vietnam by 1978-1980. The too old equipments make difficult the preservation process: machines are too easy to be broken, technical parameters are not normally kept. The two main parameters, temperature and relative humidity are noted in the following table:

Type of storage	Long-term storage		Medium term storage	
Technical parameters	Theoretical	In practice	Theoretical	In practice
Temperature (t°c)	-5	0	0	+5
Relative humidity (%)	35	45	45	60

Furthermore, the often occurrence of electricity failure causes unstability to the preservation process.

Temperature and relative humidity in storage rooms are registered by the hydrotermographs, weekly changing the graphic papers. The graphs of these two parameters are conserved along all the storage preservation process.

It usually takes several months from the moment of finishing the collecting or the harvesting activity up to the entering seed samples into the cold storage rooms. This long time of seed processing also affected the seed longevity and thus, the quality of seed preservation. Vietnam is not yet equipped with dehumidifiers for seed drying. After harvesting, seed drying is performed through natural sunshine and after seed cleaning seed are again dried by silicagel. The drying by silicagel can decrease the moisture to the standard level, but it consumes a lot of time to dry a large number of seed samples. In cold storage rooms, seeds are kept in bags made from aluminum.

The long-term storage preserves the basic state collection, the germination test is done every two years. The medium-term storage preserves the active collection with germination test every year. The seed supplied to the users and used for the seed regeneration are taken from active collection.

The germination test is done in the petri dishes, 50 seeds per accession is used each time.

In general, Vietnam does not yet possess an International level standard equipment of cold seed storage. In order to prevent the loss of preserved materials, sometime the rules of cold storage operation could not be followed strictly, but must be changed to adapt to "the practical conditions".
The Seeds are supplied to all the requests of users, without fees and with 100 seeds per requested accession. The minimum interval between two seed supplies to the same user is not yet fixed. It is only demanded that the requestees return to Genebank the data on utilization of crop genetic resources, but event this regulation is not strictly fulfilled.

Vietnam needs to renovate the cold seed storage equipments, however this is a too expensive problem. We are in the process of searching for the funding, but
up to now the donor is not yet found.

3.3 EVALUATION AND DATA MANAGEMENT

From 1960 to 1989 it had been used in Vietnam the evaluation procedures of the Institute of Plant Industry from the former Soviet Union. This approach does not differentiate the characterization from the evaluation. Nevertheless, the evaluation at that time could be called the characterization because it concentrated on the morphological descriptions. Almost all the crop germplasm collections were characterized in around 10 agromorphological characters. The major crops such as Rice, Corn, Sweet Potato... were evaluated in more characters.

Since 1989, the IBPGR evaluation procedures of plant genetic resources have been adapted in Vietnam, which clearly differentiate characterization from evaluation. We plan to characterize all the preserved germplasm collections by next few years. One part of characterization work is performed directly by National Genebank, the other one is done by the network institutions but sponsored and coordinated by National PGR System.

The evaluation has been performed in a limited number of characters, mainly the resistance to pests and diseases and only in approximately 20% of crop genetic resources preserved. In general, the evaluation has not yet been widely

implemented as this is an expensive work, furthermore its data are not yet extensively used by the crop genetic resources users.

The characterization data are well documented and have been effectively serving to both kinds of work, preservation and utilization of germplasm.

The genetic diversity evaluation and the classification of crop germplasm were implemented. The isozymes pattern and the Glazsmann's algorithm were used to classify the traditional rice germplasm. The result shows that Vietnam rice is composed of 87% India rice, 11,5% Japonica rice and 1,5% unclassified. There exist two groups of characterization data, one followed the former Soviet Union's procedure and the other followed the IPGRI. A part of first group was transformed into the second one.

Before 1990, the characterization data were documented in form of typing. Since 1991 the computer data management has been used.

3.4 SEED REGENERATION

The seed regeneration of preserved genetic material is performed when one of two following parameters reaches the limited level: quantity of seed is lower than 100 grams or seed viability is lower than 85%. Actually, in our condition of genebank, the long-term cold seed storage can maintain the preserved material no more than ten years and the medium-term no more than 5 years. Every year more than 20% of the preserved accessions should be regenerated.

3.5 *IN SITU* CONSERVATION

In comparison with the neighbour countries in the Southeast Asia region, the *ex situ* conservation, especially the cold seed storage genebank, was initiated relatively late in Vietnam. In such situation, the *in situ* conservation in our country likely plays a more important role.

Before the establishment of National Genebank in 1990, all the germplasm collections of annual crops were maintained in field genebank.

Regarding the genetic resources of perennial crops, medicinal plants and forest trees, the *in situ* approach is the unique form of genetic conservation. Several preserved plantations of germplasm collections of industrial and fruit crops have been implemented and managed by agricultural research institutions.

There are two kinds of *in situ* conservation of medicinal genetic resources: in research stations managed by Government institutions and in gardens of private sectors. The forest genetic resources are conserved mainly by the public institutions. Many National parks and protected forests were established by our Government.

The places of *in situ* conservation of plant genetic resources are listed in the appendix.

CHAPTER 4
In-Country Uses of Plant Genetic Resources

In Vietnam, the plant genetic resources are used for two purposes:

- As genetic materials in breeding programmes.
- As cultivars directly cultivated and exploited in production.

The first purpose is related specifically to crop genetic resources but the second one is to all kinds of plant genetic resources. Since 1990, when agriculture production started to demand the crop and cultivar diversification of crops and cultivars, the need for direct utilization of crop genetic resources has been remarkably increased.

The objective of utilization of genetic resources in large scale for production has been popularly recognized for all three groups of PGR, crops, forest, medicine. However the utilization of PGR for breeding programme has been focused only on CGR.

Vietnam is one of the oriental countries having high degree of traditional medicine development. That is why the utilization of MGR by the Vietnam people has been marked for thousands years. As mentioned in chapter 2, primary results of MGR inventory show that there are approximately 180 medicinal plant species in Vietnam. These have been conserved in the medicinal plant gardens funded by formal sector and in household gardens.

Medicinal plants play an important role in the Medicine and Public Health of Vietnam. Nowadays Vietnam Government strengthens the study and exploitation of traditional medicine, so that medicinal plant have been paid more attention. The improvement of medicine have been mainly focused on the introduction and domestication of species and cultivars from abroad.

FGR have been mainly conserved in the National Parks and Forest Reserved Areas. In recent years, the burning forest for shifting upland rice occurred in large scale, by which the forest areas have been remarkably reduced and consequently the forest genetic resources have been seriously eroded. Since 1990, the Vietnam Government has been paying great attention to the forest preservation. Various National Parks and Forest Reserved Area have been established which conducts to a better conservation of FGR. The Governmental policy on regreening bare hills has strengthened the exploitation and utilization of FGR, making its role getting an increasing importance. The utilization of agricultural genetic resources is most diverse. Regarding the perennial fruit

and cash crop; animal food crop including both annual and perennial tuber crops; vegetable of tropical and subtropical origin; the genetic resources have been directly used in agricultural production in large scale.

Concerning the annual crops, such as food; legume; oil crops and vegetable of temperate origin, the genetic resources have been used directly in agricultural production and in breeding programmes. Relating to the three most important crops of Vietnam namely Rice, Maize and Sweet potato, in the period of 1960-1990, the genetic resources had been mainly used in breeding programmes, only a few number of traditional exotic cultivars have been accepted by the production. Since 1990, due to the crop diversification and agricultural sustainable development, the land races of those crops have been remarkably reintroduced. Into the agricultural production, therefore the direct utilization of their genetic resources have been increasing.

4.1 USE OF PGR COLLECTIONS

The order of crop genetic resources that are most frequently demanded by agriculture production is as follows: Cereals (Rice, Maize), Fruits, Industrial Crops, Vegetables, Tubers and Legumes.

The seed supply from National Genebank during last three years is listed in the following table:

Number of seed samples supplied in 1992-1994

Crops	1992	1993	1994
Rice	75	194	318
Cotton	0	0	300
Maize	0	6	10
Legumes	12	27	35

The main institutions that have requested seed samples from National Genebank during that time are:

- Rice Breeding Department, Vietnam Agricultural Science Institute.
- Immunology Department, Vietnam Agricultural Science Institute.
- Nhaho Cotton Research Center.

- Cuulong Delta Rice Research Institute.
- Institute of Agricultural Genetics.
- Biotechnology Institute.
- Plant Protection Institute.

In general, the utilization of crop genetic resources collections conserved in National Genebank is still limited. No more than 5% of preserved crop cultivars are requested and used by the users. The limitation of using crop genetic resources is due to two reasons. First and main reason is that the needs from the users is not high. Second, the germplasm evaluation is not yet well implemented, consequently the users are not provided with useful informations on the genetic resources.

4.2 CROP IMPROVEMENT PROGRAMME AND SEED INTRODUCTION

Our National plant breeding programmes own with three functions, their sequence of importance is:

- Hybridization.
- Selection and adaptation of introduced cultivars to local conditions.
- Improvement of local cultivars.

The predominant objective of plant breeding programs is increasing the production. In the past, sometime this objective had been rather formal and lacked the practical reality. During last years, plant breeding programmes have been more oriented with objectives to widen the crop genepool, to reduce the crop vulnerability and to extend cultures and cultivars to the diverse production systems.

Before 1990, all efforts of plant breeding programmes were focused on satisfying the national food needs. Since 1990, the orientation on finding the markets for exportation has been increased.

In Vietnam all the plant breeding activities are conducted by Government funded programmes. The varieties released by in-country plant breeding programmes are easily available to the farmers. Actually, regarding the major annual crops, 30% of cultivated areas are occupied by the local cultivars, 30% by the in country bred varieties and 40% by the introduced varieties.

CHAPTER 5
National Goals, Policies, Programmes and Legislation

5.1 NATIONAL PROGRAMMES

In Vietnam, the National System of Plant Genetic Resources Conservation is sponsored by the Government through the Ministry of Science, Technology and Environment (MOSTE). The NPGR System is participated by two Ministries:

- Ministry of Agriculture and Rural Development for Crop and Forest Genetic Resources.
- Ministry of Public Health for Medicinal Plant Genetic Resources.

The Crop Genetic Resources are the most important part of all PGR. The Vietnam Agricultural Science Institute, the major research institute of the Ministry of Agriculture and Rural Development, who manages the National Genebank, is designated the function of coordinating the NPGR System.

The NPGR System possesses three main duties:

- Management of the National Genebank.
- Coordination of the network of PGR conservation all over the country.
- Performance of the research works on genetic diversity and biodiversity.

The plant genetic resources collections of Vietnam are protected by the Government Regulation on Plant Genetic Resources Conservation.

5.2 TRAINING

The NPGR System was founded only six years ago, the short time is not enough to train an adequate staff. The scientists and researchers working on PGR conservation are Bachelors in Agronomy or Biology, a part of them are Masters or Doctors in specialties such as Genetics, Plant Breeding, Plant Pathology... The major part of the PGR staff had received a short training course on PGR conservation, but in general they have not yet owned with a systematical and balanced knowledge. There is a lack of specialists on important branches of sciences such as Taxonomy, Seed Technology, Biochemistry, Computer and Data Management.

To improve the knowledge of the staff and train the skill researchers, we purpose the application of the on-job training.

5.3 NATIONAL LEGISLATION AND OTHER POLICIES

There exist in Vietnam strong quarantine laws. Although the quarantine control is strict, it does not affect the import of plant genetic resources accessions. The quarantine laws are not applied to the exported plant genetic resources.

During last years, as a result of crop diversification, the utilization of traditional cultivars in agricultural production has been increased and consequently, the possibility of implementing the on-farm conservation of crop genetic resources could be taken place. A considerable attention has been paid to the role of farmers in the crop genetic resources conservation.
The export of plant genetic resources is decided by an expert commission of the Government.

The staff of NPGR System are actively involved in the planning of major agricultural development project. The plant genetic resources conservation is linked organically with the agricultural development strategy.

CHAPTER 6
International Collaboration

6.1 UNITED NATIONS INITIATIVES

6.1.1 UNCED

The Vietnam Government participated in the Rio de Janeiro Summit, June 1992 and signed the International Convention on Biological Diversity. After this important event, our activities on conservation of Biological Diversity in general and of Plant Genetic Resources in particular were remarkably strengthened.

The Convention on Biological Diversity strengthens the role of FAO Commission on Plant Genetic Resources. The FAO Commission is an institutional organization, the UNCED has rather the characters of an international agreement, therefore they must possess separate roles.

6.1.2 FAO Global System

Recently Vietnam was offered the membership of FAO Commission on Plant Genetic Resources. We hope that this event could open the possibility to strengthen our National activities on plant genetic resources conservation through the following aspects:

- FAO assistance.
- More realizable collaborations with International institutions.
- More realizable bilateral cooperation with other FAO member countries.

Regarding the "International fund", like the other developing countries, Vietnam is as a beneficiary counterpart.

6.2 INTERNATIONAL AGRICULTURAL RESEARCH CENTERS

Our country has fruitful collaboration with the International Agricultural Research Centers within the CGIAR System, such as IPGRI, IRRI, ICRISAT, CIMMIT, CIP, and with AVRDC, a regional research institution. The

collaboration brings benefits to Vietnam in the following subjects of PGR conservation:

- Introduction of improved varieties and plant genetic resources.
- Scientific and technical assistance.
- Training of specialists.
- Funding to research projects.

Among the collaborative institutions, IPGRI has a revenant role. At our consideration, in the next decade, the functions of IPGRI should be concentrated in:

- Scientific and technical assistance to the National PGR program.
- Help to the developing countries in searching for the funding sources to strengthen the PGR conservation activities.
- Organization of the training activities.

6.3 BILATERAL INITIATIVES

There is a project with NIAR, Japan, sponsored by IPGRI, on PGR collection in Vietnam. Through this project, NIAR is beneficiary by the PGR collected from Vietnam.

CHAPTER 7
National Needs and Opportunities

1. Renovation of the cold seed storage equipments and facilities of the National Genebank, towards the establishment of a new National Genebank with International standard level on *ex situ* conservation. Budget: 15,000,000 USD. This is an expensive project. Vietnam plan to apply an ODA supportand call for assistance of ICPPGR in searching for an appropriate and adequate donor.

2. Assessment three component of the biodiversity and their evolution process during last four decades. Evaluation and inventory of the reserve of crop, forest and medicinal GR and their wild relative in our entire territory, both in the wild and farmers fields, especially in four agro-ecosystems : high mountain, midlands, flat lands and deepwaters and coastal plains. This is accompanied by the critical survey of the existing collections. This work is planned to be performed and completed during 5 years. Budget: 4,000,000 USD.

3. Collection of important crop species of CGR in all over country, putting high priority to the areas where the genetic erosion occurs with rapid rate. Budget for first five years: 3,000,000 USD.

4. Performance of research and implementation activities on *in situ* conservation of agricultural biodiversity in five ecologically representative areas all over the country. Budget for first five years : 3,000,000 USD.

5. Promotion of the characterization and evaluation of the conserved collection in order to better utilization of valuation gene sources. For those evaluated biochemical and biomolecular methods as isozyme, RFLP, RAPD etc... should be used to form the core collection, so as to reduce the conservation costs. It is planned to develop a laboratory with modern equipments and facilities for studying and evaluating the genetic diversity. Budget : 5,000,000 USD.

6. Implementation of activities on collection, preservation, evaluation and utilization of under-utilized genetic resources. Budget for first five years : 500,000 USD.

7. Implementation of activities on collection, preservation, evaluation and utilization of ornamental genetic resources. Budget for first five years: 500,000 USD.

8. Development of human sources.

- In-country training of personnel for curators of various collections with MSc degree.
- Training course on *in situ* and on-farm conservation with new concepts for scientific card and farmers. Training course on documentation and data management.
- Preparation of the text book on PGR management as a compulsory subject for the student studying related matters in Universities.
- Prepare of necessary but simplified documents to educate our farmer communities on PGR conservation. Budget for first five years: 500,000 USD.

CHAPTER 8
Proposals for a Global Plan of Action

1. Concretize the realizable measures and the practical steps to translate into reality the International Convention on Biological Diversity.

2. Assist the developing countries to develop fruitfully their National activities on PGR conservation in order to prevent the rapid occurrence of genetic erosion and to conserve effectively the existed PGR. Predominant works are:

   - Explore and inventory the PGR reserve, timely collect the PGR before their extinction in many areas on the World.
   - Develop an efficient plan of *ex situ* conservation to prevent the loss of existedly preserved PGR.
   - Develop a feasible plan of *in situ* conservation, link the *in situ* conservation with the sustainable agriculture development.
   - Strengthen the training activities.

The places of in situ conservation of Crop Genetic Resources

No	Name of Institutions	Conserved Collections
1	Institute of Food crops	Rice, Legumes, Vegetable
2	Maize Research Institute	Maize, Wheat, Barley, Bruckwheat
3	Vegetable and Fruit Crop Research Institute	Vegetables of tropical and subtropical origin
4	Phu ho Fruit Crop Research Center	Citrus, Bananas, Kaki, Pineapple, Litchi, Longan, Plum, Peach, Apricot, Sugar apple
5	Phu quy Fruit Crop Research Center	Citrus, Coffea arabica
6	Phu ho Tea Research Center	Tea
7	Viet hung Mulberry Experimental Station	Mulberry
8	Livestock Research Institute	Forage crops
9	Mekong Delta Rice Research Institute	Rice
10	Southern Agricultural Research Institute	Rice, Maize, Tuber crops, Legumes, Vegetables
11	Nho ho Cotton Research Center	Cotton, Grape, Cassia, Dragon Fruit
12	Ben cat Sugar Cane Research Institute	Sugar Cane
13	Research Institute for Oil Crops and Volatile Oil Plant	Groundnut, Soybean, Coconut, Sesame, Volatil Oil species
14	Eckmat Coffee Research Institute	Coffea robustica, Cacao, Cassia
15	Bao loc Mulbeery Research Center	Mulberry
16	Long dinh Fruit Crop Research Center (founded in 1994)	Fruit crops of typically tropical origin

The places of in situ conservation of Medicinal Plant Genetic Resources

No	Institutions	Number of preserved species
1	Vandien Medicinal Plant Station, Hanoi City	294
2	Tamdao Medicinal Plant Station, Vinhphu province	175
3	Sapa Medicinal Plant Station, Laocai province	63
4	Hanoi Pharmacy College	134
5	Army Medicinal College, Hatay province	95
6	Lamdong Medicinal Plant Research Center, Lamdong province	88
7	Gingseng Research Center, Laocai province	6

ANNEX 1
Project Proposal of Vietnam for *In Situ* Conservation of Agricultural Biodiversity

Submitted by:

Luu Ngoc Trinh
National Coordinator PGR System of Vietnam

PART 1 GENERAL ASPECTS

1.1 Main features of Vietnam PGR

Southeast Asian region is considered the most prosperous and richest in PGR over the world. Vietnam possesses not only this common richness of Southeast Asia but also the particular features, in the country there exist both temperate and tropical crop genetic resources.

Following historical, geographical, economical and social factors account for diversified PGR in Vietnam:

- Historical factor. In unmemorial time, Vietnam territory was linked with Indonesian and Malaysian plains, this resulted in the interchanging of PGR with south Asian region. Vietnam dwellers in the past had lived in southern Jan-ste River Basin, then due to war conditions, they moved southern ward to establish the Red River Delta civilization. When moving to the south, the Viet dweller brought along with them various crop species originated in northern areas.
- Geographical factor. Vietnam lies in the last chains of two big mountain systems, the China and the India-Myanma. Vietnam flora is greatly influenced by those of the South and the East Asia.
- Ecological factor. Vietnam is situated in tropical region, but influenced by the cold monsoon from Central Asia, North Vietnam, is characterized by the subtropical climate with some feature of temperate conditions in high mountainous areas. North Vietnam PGR therefore involve tropical, subtropical and temperate crop species.

Vietnam PGR consist of three main components: indigenous species, introduced species from South China and from South Asia. There exist 14,624 plant species in Vietnam, the most important plant group are:

	species
Starchy plant:	150
Fruit plant:	130
Oil plant:	100
Fiber plant:	90
Wood plant:	1000
Medicine plant:	1863

1.2 Crop Genetic Resources

Prosperous PGR are the main factor that create the diversified crop genetic resources in Vietnam. Vavilov, Zukovski, Zaven and other evolutionists agreed that Indochina is the region of origin of numerous crop species. Vietnam is the zone of origin or belongs to region of origin of such crop species as Rice, Taro, Banana, some Citrus species, Jack fruit, Mango, Coconut, Tea, local Onion, Kaki, Litchi, Longan etc.

Apart from the main factor of prosperous flora, the diversified CGR in Vietnam take account from following reasons:

- Diversified climatic and geographic conditions. North Vietnam is characterized by rich crop genetic resources, including tropical, subtropical and temperate crop species.
- The diversification in ethnic group. Vietnam is the home of numerous ethnic group, each group has its own agronomic tradition and food preference.
- The age-old agricultural civilization of Vietnam people.

At present, Vietnam is exploiting and using following crop species:

species	
Starchy food crops:	39
Non-starchy food crops:	95
Fruit crops:	104
Vegetables:	55
Oil crops:	44
Fiber crops:	16
Crops for beverage manufacturing purpose:	12
Spice crops:	39
Perfume crops:	19
Cover crops for bare hill regreening:	29

Beside, there exist hundreds of under exploited crop species.

According to preliminary statistics, Vietnam possesses so far about 700 crop species belonging to 70 genera.

There is a wide diversity of land races of different crop species in Vietnam. The amount of 5,000 traditional rice cultivars is actually conserved in Genebank.

Due to no organizing timely the collecting activities, an important part of traditional rice germplasm has been lost. It is estimated that there exist no less than 5,000 rice land races targeted for collecting in next years. They are mainly found in mountain, coastal and other adverse ecological condition areas. It is worth to emphasize that rice resources of Vietnam are composed of both, Indica and Japonica rice. The classification based on isozyme pattern showed that 89% of traditional rice germplasm in all over Vietnam are Indica rice,
9,5% are Japonica rice and 1,5% are unclassified . The other annual crops rich in local cultivars are sweet potato, legumes and annual industrial crops. Regarding fruit crops, those that are endemic of Vietnam have a great diversity in land races, among which it can be mentioned Kaki, Litchi, Longan, Banana...Same valuable exotic land races of Kaki, Litchi, Longan,... likely exist uniquely in Vietnam.

Since 1990, the agricultural production in Vietnam has been considerably increasing. In group of annual crops, farmers tend to cultivars having high quality. Regarding group of perennial crop for a long time ago land races are predominantly cultivated. The increase of production areas under fruit and industrial crops also result in using land races in wide scale.

Wild relatives of crop species are also diversified, as Vietnam is in the region at origin of many crops species. Wild relatives have been playing an increasing role in breeding programs. Rice can serve as an excellent example. Valuable gene sources from wild rice species are now widely exploited. The evaluation data showed that the *O. rufipogon* collected from Dien Bien Phu Valley owns with gene source highly resistant to blast and tungro virus and the *O. rufipogon* from Cuu Long River Delta possesses gene source highest over the world tolerant to sulphate acid soils. *O. oficinalis* has gene tolerant to brown plant hopper and white back plant hopper. *O. granulata* is resistant to drought and has gene source capable to photosynthesize at the low sunshine intensity. *O. nivira* are immune to virus diseases, but unfortunately it was not found any more in Vietnam. Take the sugar cane as another example. Wild sugarcane species *S. espontaneum* are found in Vietnam, the gene sources of which has been commonly exploited in breeding program. Almost all the commercial sugarcane varieties in Vietnam as well as in the world are hybrid between *S. oficinarum* and *S. spontaneum*.

1.3 Evolution of PGR since the Green Revolution (1960-1965) up to now

In 20-30 recent years, Vietnam PGR suffer huge changes. This process develops in two directions: either more prosperous or under the threat of erosion.

Thanks to agricultural development and cultural exchange, the Vietnam PGR has been getting more diversified. Numerous high economic valuable crop species have been recently introduced into Vietnam such as Grape, Cassia, Okra, Avocado, Stevia.

The varietal diversification of numerous annual crop species is markedly increased thought germplasm exchange and introduction of varieties from various international research institutes and from those countries having sound scientific-technical cooperation relationships. Most important are rice germplasm introduced from IRRI, South China, Taiwan, South Korea, maize from CIMMYT, Thailand, food legume including groundnut from ICRISAT.

The second trend which is most dominant is erosion of crop genetic resources, due to following main reasons:

- The green Revolution and the intensive farming process. The expanding of irrigation system and popularizing of chemical fertilizers make agriculture change from extensive to intensive farming. Countless local tradition crop cultivars, adaptable to local ecological conditions have been replaced by newly-developed intensive crop varieties. After being eliminated from pro-

duction, a lot of crop cultivars have been disappeared forever since insufficient attention has been paid to their collection and preservation.

- The pressure of population increasing rate and ever-growing food demand has resulted in the setting up of such development target as only crop yield increasing. This makes the crop genetic resources being reduced and narrowed. In upland areas, the population pressure leads to slash and burn the forest to shift the upland rice everywhere, that is why crop and forest tree genetic resources are damaged or destroyed on large scales.
- Long wars, bombs and herbicides have made Vietnam loss over 2 millions ha of forest. Together with the destroying of such large area, hundreds of crop, forest tree and medicinal plant species have been disappeared.

Due to above mentioned reasons, a lot of crop species such as food legumes, cereals, fruit crops, are so far lost. Numerous forest tree and medicinal plant species are also destroyed. The genepool of main crop is greatly reduced. The most typical example is rice. Numerous local traditional rice cultivars such as high quality rice, the "lóèc" rice, a type of upland rice in the delta, the salt tolerant rice at the coastal areas, the floating rice and the acid sulphate tolerant rice in the deep water areas are eroded.

As for the second important food crop, the maize, numerous glutinous maize cultivars human consumption are now eroded.

As for fruit crops, the genetic erosion occurs mostly in citrus species. One of the most valuable fruit crops, special for Vietnam is the Diospyros kaki. A number of delicious Kaki cultivars have been lost.

1.4 Plant genetic resources conservation in Vietnam

The activity of exploration, introduction and preservation of crop genetic resources in Vietnam had been initiated before the Second World War, concentrating in the crops with high export value. At that time, Indochina was one the most important rice exporter in the World. In order to promote the rice production for exportation, it was started the exploration and collection of local cultivars, evaluated and then selected those with high yield and good grain quality for releasing them again to the production.

The main industrial crop species that had been explored and conserved were Tea, Lacquer Tree, Kenaf, Jute, Cinnamon, Anise, etc., Rubber, Coffee (Coffea arabica and Coffea robustica), Cotton (Gossypium hirsutum) are industrial crops that had been introduced prior to 1945 and become economically important crops in Vietnam.

During four decades, from 1945 to 1985, the conservation activities of crop genetic resources in Vietnam had been interrupted by severe wars and economical difficulties. It was the period that our crop genetic resources had been seriously eroded. The threat to genetic diversity was remarkable caused by the Green Revolution, as in those critical years, the land races of many manual crops had not been timely collected and adequately conserved before they were replaced by improved varieties.

In 1987, the Vietnam State Committee for Science and Technology, now is the Provisional Regulation for PGR Conservation and assigned to Vietnam Agricultural Science Institute (VASI) the function of coordinating the PGR Systems all over the country. In 1990, the Nation Crop Genebank at VASI was established and has been playing a key role in the research activities of National PGR System.

1.5 The existence of *in situ* conservation of crop genetic resources

The activities of *ex situ* conservation of crop germplasm in Vietnam, in particular that of cold storage preservation, was started relatively late in comparison with those in the other neighbor countries in the South-East Asian Region. It is such the fact that likely makes the *in situ* conservation in Vietnam having an actually important role.

There is no clear difference in Vietnam between the *in situ* and *ex situ* conservation through the field maintenance. The difference is remarkable only cosigning the annual crops, where the cultivars collected from ecologically different areas are maintained together under field condition of a few places. Regarding to the perennial crops, such as fruit and industrial plants, there exist also the phenomenon of field maintenance in the same places of cultivars originated from decent localities. However, the conserved plantations were developed for the long time and type of field maintenance the plants have been adapting to the local conservation, this type of field maintenance could be called *in situ* conservation. There are such type of *in situ* conservation of hundreds of fruit tree gardens of the farm household level and dozens of industrial crop plantations established by Governmental institutions in Vietnam.

The on-farm conservation is a new variant of *in situ* conservation. The difference is attributed to the fact that for the first one, the crop genetic resources have to be included in farming system and generate benefits to the farmers and for the second one, it is needed the additional supplies of human and material resources to safeguard the genetic resources.

There are two projects of on farm conservation of crop germplasm developed in Vietnam during recent years. One is organized and sponsored by Can Tho University and SEARICE in Mekong River Delta dealing with rice plant. The other by VASI and CIC in Red River Delta and working with four groups of crop: Rice, Legumes, Tuber crops and fruit trees.

PART 2. *IN SITU* CONSERVATION OF AGRICULTURAL BIODIVERSITY: PROBLEM AND POSSIBILITY OF IMPLEMENTATION

The conservation of plant genetic resources is an actually important subject of scientific research and implementation, its appropriate performance still requires several of matters to be studied.

The *ex situ* conservation responds to the principal requirement of a conservation work, that is safeguarding and keeping no loss of the preserved genetic materials. Today the *ex situ* conservation of crop genetic resources in genebanks is the popular method of genetic conservation, but its limitation on holding the crop germplasm in a static state needs to be complemented in the *in situ* conservation approach. In comparison with the *ex situ*, the *in situ* conservation is remarkably more complicated, not only for performance, but also for conducting research activities because it closely links with agricultural development tendency, mainly the market orientation.

2.1 Aspects to be considered in planning the *in situ* conservation

Since 1990, it started to speak on the need for implementing in large scale of the *in situ* conservation of plant genetic resources. During last two - three years, on-farm conservation, a variance of *in situ* conservation specialized for annual food crops, has been raised with special emphasis, however a little is known on both, theoretical background and practical performance.

Usually it is spoken that the *in situ* conservation of agricultural biodiversity is a approach of genetic conservation that combines in its activities the biological and social sciences. In the concrete conditions of Vietnam, we assign first priority to the two revenant aspects of those sciences:

1. **In Biological Science**. Conventionally the biological diversity is defined to be composed of three components: genetic diversity, diversity in species and diversity in ecosystems. It is widely recognized that the genetic diversity has been suffering from the most serious erosion, so all the effort of genetic

conservation up to now has been concentrated mainly in that of genetic diversity.Unlike *ex situ* conservation, the success of *in situ* conservation of genetic diversity depends on the management of conservation of the other two components of biodiversity.Therefore, in biological aspect, the *in situ* conservation of crop species and of genetic diversity with in species must be linked with the rehabilitation and conservation of traditional farming system.

2. **In Socioeconomical Science**. Actually the *ex situ* genebank conservation preserves a very big number of cultivars of each crop species. How to conserve by *in situ* approach such the number of crop cultivars is highly problematical. Major part of cultivars preserved in Genebank is not accepted by the nowadays agricultural production because it can not give to the farmers a normal income. Thus, in subjects to be studied, a lot of problems to be solved, but the key issue is market integration.

Relating to this relevant in socioeconomical regard, cultivars under *in situ* conservation should be separated into two groups which need quite different approaches of performance:

- Cultivars that can be included in cropping system and generate satisfying incomes to the agricultural production. In Vietnam since 1990, when agriculture started to develop in econogical tendency, they have been remarkably increasing in number.
- Cultivars that require additional supply of materials to the farmers to keep their normal income. It is difficult to develop the *in situ* conservations for this kind of cultivars. In concrete situation of each crop species, it can be chosen between two variant. The first one is establishing the field genebank funded by formal sectors in area econogically suitable for crop species. The second one is providing to the farmers the material supply to include the cultivars needed to be conserved in farming system.

2.2 Classification of plant genetic resources for their *in situ* conservation

1. **Annual Food Crops**. This is the most important group, which composes of Cereals, Legumes, Tubers and Oil Seed Crops.Approach: *Ex situ* conservation is the main, *in situ* is the supplemental.
2. **Vegetable crops.** Approach: combination of two, *ex situ* and *in situ*.
3. **Perennial Fruit Crops**. Approach: *in situ* conservation, which combines concentrated germplasm plantations by managed formal sector and farmer household gardens.

4. **Perennial Cash Crops.** Approach: *in situ* conservation. Actually there exist in Vietnam germplasm plantation managed by research institutions of important crops such as Tea, Coffee, Rubber, Coconut, Mulberry, Sugar Cane, Cassia, Cacao.

5. **Forage species.** Approach: on-farm conservation by both, formal and informal sectors.

6. **Forest Plant**. Approach: *in situ* conservation. Actually there are in Vietnam more than 30 conservation areas.

7. **Medicinal Plant**. Approach: *in situ* conservation, combines formal sector germplasm gardens and household gardens.

PART 3 AREAS OF PROJECT IMPLEMENTATION

As the Vietnam territory is extended over 15 parallel degrees, from 8°N to 23°N, so ecology is diverse and crop resources are prosperous. Thus *in situ* conservation must be done in various places, but in the framework of the project, the activities should be focused in three places.

3.1 Xuan thuy, Hai hau and Nam ninh districts, Nam ha province

This area is presentative of the Red River Delta Eco-system. Crop species to be conserved in this area will be as followed. The first place is regarding with rice, specifically aromatic rice in all the area and acid sulfate and salt, tolerant rice in coastal area. In Vietnam, aromatic rice is mainly produced in these three districts. In several villages, the producing area of aromatic rice has been occupied approximately 80% of the total rice production area. In general, local rice cultivars are spreadly cultivated in this zone. The second place is Legume Food Crops such as *Phaseolus* spp., Mungbean, Soybean; Tuber Crops, Sweet Potato, particularly Lowland Taro cultivars, Vegetable of Tropical and Subtropical origin in the families *Brassicaceae*, *Cucurbitaceae*, *Solanaceae*, Oriental Shallot (*Allium ascalonicum* L.), Fruit Crops, specially Bananas and Kaki. This is an area owning with the famously delicious Bananas and Kaki of our country.

National PGR Programme (NPGRP) will manage both the financial and professional activities of the Project. The district People's Committees will play an important role in the process of implementing the project.

Budget:
International support: 540,000 USD.
National contribution: 135,000 USD.

3.2 Nghia dan, Quyn luu and Quy chau districts, Nghe an province

This is a representative of Central Vietnam region. These three districts extend from mountain to coastal. Crop to be conserved will be: fruit and industrial crops, especially *Citrus* spp., pineapple, *Coffea arabica*, *Pandanus fibrosus* etc.

This area is marked by the famous species and cultivars of Citrus gunus such as Phuctrach Pomelo cultivars, Vinh Orange cultivars. Next is oil crops such as sesame, groundnut and tolerant drought crops like millet and upland rice.

The Phu quy Fruit Crop Research Center (PFCRC) is located in this area. Germplasm collections of fruit and industrial crops actually conserved in PFCRC are under the coordination of National PGR Programme. It is planed that both the NPGRP and the PFCRC coordinate and manage the professional and financial activities of the Project.

Budget:
International support: 300,000 USD.
National contribution: 75,000 USD.

3.3 Daclak province

This area represents to the ecology of the Central Plateau. Crops to be conserved will be Upland Rice; Legume Crops; Fruit and Cash Crops, in particular *Coffea robusta*, Cashew, Avocado, Tea etc... The project implementation on Daclak province will be based on the Tay nguyen University and the Agricultural Development and Research Center (ADRC) headed by Prof. Vo Tong Xuan, at the Can tho University. The project activities developed in this area professionally and financially managed by the Tay nguyen University under the Coordination of NPGRP.

Budget:
International support: 360,000 USD.
National contribution: 90,000 USD.

PART 4 TIMETABLE FOR PROJECT ACTIVITIES

The plan of project activity implementation will be as the following :

1996: Survey the biodiversity in the above mentioned places. The survey should get the following objectives :

1. Existence of crop resources including composition of species, composition of cultivars in each species and the process of their erosion.
2. Cultural patterns, mainly dynamic of their evolution during last three decades since starting the Green Revolution. Especial emphasis will be dealing with the traditional cultural practices.
3. Market orientation concerned with the introduction of crop land races in large scale into the cropping system of farmers. Since 1994 the NPGRP has been performing the work of biodiversity assessing in several areas all over the country. Thus, the survey of biodiversity in areas, where the *in situ* conservation will take place, has advantage because the its procedures were developed and our staff already owns with experience on this kind of research activity.

1997: Starting the project implementation.

1. **Annual crops**: Conservation of the local cultivars, which have high commercial values and give normal income to the farmers, will be implemented. This means that the introduction of crop resources into the cropping systems of farmers which need to be conserved will be performed. Thus, at the same time, two objectives should be got: conservation of genetic resources and maintenance of normal agricultural productivity.

2. **Perennial Fruit and Cash Crops**: Strengthening the conservation work of germplasm collections which are being conserved in research institutions and of cultivars planted, in household gardens.

1998 - 2000: Continuing the project implementation.

1. **Annual Crops**: Gradually introduce into production the crop cultivars, of which have the capacity of giving low income to the farmers. Study the marketing relationship in order to choose an appropriate variant of implementing the conservation of genetic resources. The chosen variant is establishing the field genebank funded by National budget or subsidizing to the farmers to maintain the genetic resources in their farms.

2. Perennial Fruit and Industrial Crops : Continue to extend the conservation of species and cultivars in the household gardens and germplasm field genebanks.

In the year of 2,000, evaluate the results of implementing the project in phase I The evaluation should be concentrated on the following items:

- Which species and cultivars can be appropriately conserved by *in situ* method? Thus how the effects of *in situ* conservation on genetic and crop diversity?
- Which crop cultivars can be conserved by *in situ* method in the household gardens but keep the normal income to the farmers? Which cultivars need to be subsidized when conserved in the household gardens? Comparison the effect and advantage between two choosing solutions: PGR conservation in the household gardens with partial subsidize or in the field genebank.
- Effectiveness of *in situ* conservation method in the development of sustainable agriculture and in the safeguarding of environment.
- Psychology of the farmers in marketing economy in reestablishing the traditional cultural practices and reintroducing the crop land races into their cropping systems.

PART 5 PROJECT COORDINATION AND MANAGEMENT

5.1 National Advising Committee:

Dr. Nguyen Quang Ha, Vice-Minister, Responsible for Science and Technology

Dr. Ngo The Dan, Vice-Minister, Responsible for Agriculture Extention and Rural Development

Dr. Vu Tuyen Hoang, Chairman, Science and Technology Council, MARD

Dr. Nguyen Ngoc Kinh, Director, Department of Science, Technology and Agroproduct Quality, MARD

Dr. Nguyen Huu Nghia, Director, VASI/MARD

5.2 Coordination Committee

Dr. Luu Ngoc Trinh, National PGR Coordinator, VASI/MARD, Project Coordinator

Dr. Vo Tong Xuan, Director, ADRC/MET

Dr. Phan Quoc Sung, Rector of Tay nguyen University/MET

Dr. Bui Huy Hien, Deputy Director,VASI/MARD.

Mr. Le Quoc Doanh, Head, Scientific Planning and International Collaboration Office, VASI/MARD

Mr. Le Dinh Son, Director, PFCRC/MARD

5.3 Working Group on Farming System

Dr. Dao The Tuan, VASI/MARD

Dr. Vo Tong Xuan, ADRC, Can tho University/MET

Mr. Le Quoc Doanh, VASI/MARD

Mr. Dao The Anh, VASI/MARD

5.4 Working Group on assessment of agricultural biodiversity

Dr. Luu Ngoc Trinh, VASI/MARD

Dr. Ta Minh Son, VASI/MARD

Dr. Nguyen Ngoc Hue, VASI/MARD

Mr. Nguyen Phung Ha, VASI/MARD

Dr. Nguyen Xuan Hong, VASI/MARD

5.5 Working Group on analysis of genetic diversity

Dr. Luu Ngoc Trinh, VASI/MARD

Dr. Dao The Tuan, VASI/MARD

Dr. Tran Duy Quy, IAIG/MARD

Dr. Nguyen Ngoc Hue, VASI/MARD

Mr. Tran Danh Suu, VASI/MARD.

PART 6 FINANCIAL REQUIREMENT

The total required budget to implement the Project during five years is 1,500,000 USD, of which the International support is 1,200,000 USD and the National contribution is 300,000. The proposed expenditure is as follows.

No	Expenditures	International support (USD)	National contribution (USD)
1	Training	120,000	30,000
2	Travel	360,000	90,000
3	Equipments and Facilities	360,000	
4	Personnel Supply	120,000	90,000
5	Data Analysis	60,000	30,000
6	Conference and Workshop	60,000	15,000
7	Project Coordination and Administration Expenses	60,000	30,000
8	Contingency	60,000	15,000
Total		**1,200,000**	**300,000**