

COUNTRY REPORT ON THE STATE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

VIETNAM



**VIET NAM
SECOND COUNTRY REPORT
ON THE STATE OF THE NATION'S
PLANT GENETIC RESOURCES
FOR FOOD AND AGRICULTURE**

**Pham Thi Sen, Luu Ngoc Trinh
Plant Resources Center**

Note by FAO

This Country Report has been prepared by the national authorities in the context of the preparatory process for the Second Report on the State of World's Plant Genetic Resources for Food and Agriculture.

The Report is being made available by the Food and Agriculture Organization of the United Nations (FAO) as requested by the Commission on Genetic Resources for Food and Agriculture. However, the report is solely the responsibility of the national authorities. The information in this report has not been verified by FAO, and the opinions expressed do not necessarily represent the views or policy of FAO.

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned. The views expressed in this information product are those of the author(s) and do not necessarily reflect the views of FAO.

CONTENTS

| | |
|---|-----------|
| SUMMARY | 6 |
| INTRODUCTION TO VIETNAM AND ITS CULTURE | 7 |
| 1. Location and Natural Conditions | 7 |
| 2. Population and Culture | 8 |
| 3. Agriculture and Socio-economic Conditions | 8 |
| CHAPTER 1 | |
| THE STATE OF DIVERSITY | 11 |
| CHAPTER 2 | |
| THE STATE OF <i>IN SITU</i> MANAGEMENT | 14 |
| 2.1 Survey and Inventory | 14 |
| 2.2 Conservation of Wild PGRFA in the Protected Areas | 14 |
| 2.3 Ecosystem Management for the Conservation of PGRFA and Crop-Related Biodiversity Outside the Protected Areas | 16 |
| 2.4 On-farm Management and Improvement of PGRFA | 16 |
| 2.5 Priorities for <i>in situ</i> conservation of PGRFA | 18 |
| CHAPTER 3 | |
| THE STATE OF <i>EX SITU</i> CONSERVATION | 19 |
| 3.1 The Existing Collections | 19 |
| 3.2 Collecting and Introduction | 20 |
| 3.3 Priorities for <i>ex situ</i> conservations of PGRFA | 20 |
| CHAPTER 4 | |
| THE STATE OF USE | 22 |
| CHAPTER 5 | |
| THE STATE OF NATIONAL PROGRAMS, TRAINING AND LEGISLATION | 25 |
| 5.1 National Programme and Networking | 25 |
| 5.2 National Legislation | 27 |
| 5.3 Capacity Building and Awareness Raising | 27 |
| 5.4 Recommendations/priorities | 28 |
| CHAPTER 6 | |
| THE STATE OF REGIONAL AND INTERNATIONAL COOPERATION | 29 |
| 6.1 Cooperative activities | 29 |
| 6.2 Participation in the international programs and agreements | 30 |
| 6.3 Shortcomings and Major Needs to Improve International Collaboration | 30 |

CHAPTER 7

**ACCESS TO PGRFA AND SHARING OF BENEFITS RAISING OUT FROM
THEIR USE, AND FARMERS' RIGHTS**

31

CHAPTER 8

**CONTRIBUTION OF PGRFA MANAGEMENT TO FOOD SECURITY
AND SUSTAINABLE DEVELOPMENT**

32

ACKNOWLEDGEMENTS

33

SUMMARY

Since 1987, with the issue of the provisional regulations on genetic resources management, the conservation of PGRFA has been considered a national task. A small working unit consisting of just 5 people, belonging to Vietnam Agricultural Science Institute, was then formed to start implementing this national regular task. Later, in 1996, on the basis of this unit, the Center of Plant Genetic Resources belonging to Vietnam Agricultural Science Institute was established, which had the mandate to coordinate all the activities relating to PGR in the country. A national network of PGR conservation was also established with 20 member institutions, each is responsible for *ex situ* conservation of certain crop genetic resources. More recently, in 2005 in order to better coordinate the national activities and programs towards effective conservation and sustainable use of PGR, the government of Vietnam found, as an up-gradation of the former Plant Genetic Resources Center, the Plant Resources Center (PRC) as an autonomous research institute under Vietnam Academy of Agricultural Sciences. Together with all this institutional development, capacity of institutions involved have also been strengthened, and facilities for *ex situ* conservation of PGR at the National Network members improved.

During the last 10 decades, activities in all the areas of PGR conservation and sustainable use were promoted. The most significant achievements however were obtained in the area of *ex situ* conservation with the establishment of the National Genebank and of *ex situ* collections of various crops maintained by the National Network member institutions distributed all over the country. A significant number of germplasm accessions of different species were collected and maintained *ex situ*, bringing the total accessions number maintained *ex situ* to over 40 000. The characterization and information activities were also expanded. All the around 14 000 accessions maintained in the National Genebank were characterized and preliminarily evaluated, and a database containing all the relevant information was developed, maintained and shared using GMS. Each year over 1 000 germplasm accessions were accessed for different use purposes.

Attention to *in situ* conservation was also increased during the last 10 years. different projects were conducted with increased number of on-farm conservation sites and participation with increased number of local crop varieties recovered and re-introduced into production. Some varieties with specialty quality has been developed and registered.

Nevertheless, there are still important weakness in all the activity areas, namely poor storage facility and inadequate evaluation of the *ex situ* collections, limited participation and lack of methodology for *in situ* conservation, lack of supportive policies, limited human and financial source etc.

INTRODUCTION TO VIETNAM AND ITS CULTURE



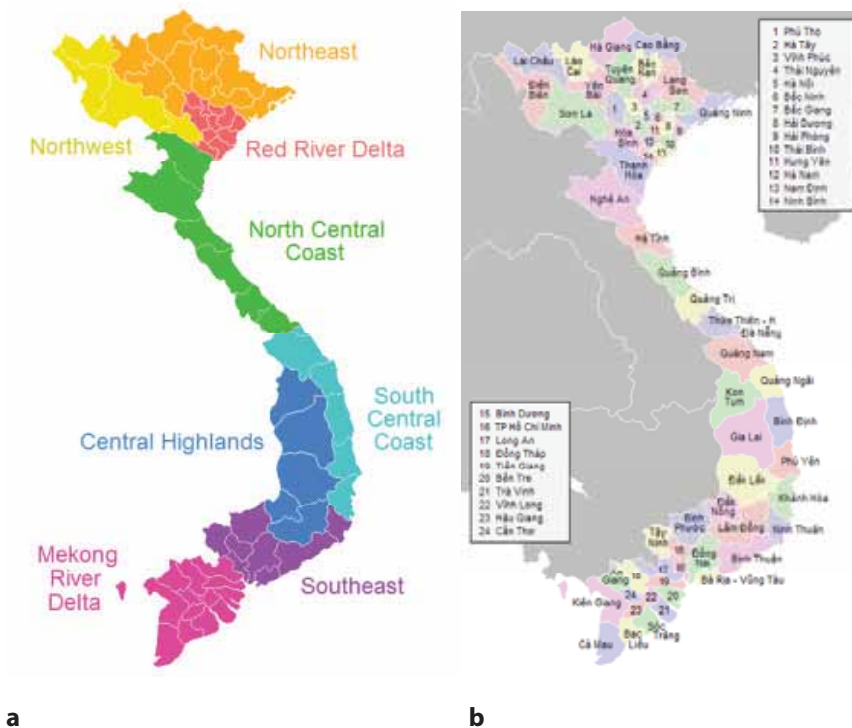
1. Location and Natural Conditions

Vietnam is located in the southeastern extremity of the Indochinese peninsula, borders China to the north, Laos to the northwest and Cambodia to the southwest. The country's total area is over 330 000 km², of which more than 9 345 000 ha are agricultural and ca.11 575 000 ha forest land. Mountains and highlands represent almost 3/4 of the country's territory.

Spanning over 15° parallel, from 8°30'N to 23°22'N, Vietnam has highly diverse topographical and climatic features. Administratively the country is divided into 59 provinces and 5 cities under the Central Government, but ecologically its territory can be divided into 8 different regions: North East, North West, Red River Delta, North Central Coast, South Central Coast, Central Highlands, South East and Mekong River Delta. Each of these regions is characterized with specific natural conditions and cultural conditions.

In general, the country has a tropical monsoon climate, with the annual average temperature of c.23°C, the sunshine time of around 2 300 h/year, the rainfall ranging between 1 500-2 000 mm/year, solar radiation varying among 100 – 130 Kcal/cm²/year and humidity between 75-90%. However these figures vary greatly from regions to regions and depends much on both the parallel and altitude.

FIGURE 1
Administrative map (a) and ecological regions (b) of Vietnam



Both North East and North West regions for example are characterized with complicated topography created by high and rugged mountains with the country's highest peak of Fan Si Pan of 3 142 meters. These regions have subtropical weather conditions with 4 distinct seasons (Spring, Summer, Autumn and Winter). In the winter the temperature can be as low as 0 -5°C, and thus both temperate and subtropical plants occur here.

The Red River delta is a triangular flat region of ca. 3 000 km² with subtropical climatic conditions with rather cold and dry winter. The entire delta region is no more than three meters, and much of it is one meter or less, above the sea level. The land here is fertile with much alluvial deposits brought by various rivers over a period of millennia, and is mainly planted to double-crop of wet-rice.

The Annamite Range (Truong Son) originates in the Tibetan and Yunnan regions of southwest China, runs North-South along Vietnam's border with Laos and Cambodia. This makes the climatic, soil and topographical features of the North Central Coast specific with very dry and hot summer with foehn winds often blowing through. Both tropical and subtropical plants can be found in this region. The South Central Coast is almost hot all the year round, with 2 clearly distinguished seasons, dry and wet, which however do not coincide with the dry and wet seasons in other regions of the country. While in both South and North the summer is wet, in the Central part summer is very dry.

The Central Highlands (Tay Nguyen) is approximately of 51 800 km² and with rugged mountains, extensive forests, and rich soils. Comprising 5 relatively flat plateaus of basalt soil spreading over the provinces of Dak Lak, Gia Lai, and Kon Tum, the highlands account for around 16% of the country's arable land and 22% of its total forested land. The climate here is typically monsoon tropical with 2 distinct seasons: dry and wet.

The Mekong delta of about 40 000 square kilometers is a low-level plain less than three meters above the sea level at any point with a maze of canals and rivers criss-crossing through. With about 10 000 km² of rice production area, the delta is one of the major rice-growing regions of the world. The southern tip, known as the Cà Mau Peninsula, or Mui Bai Bung, is covered by dense jungle and mangrove swamps. The region also has a typical tropical climate.

2. Population and Culture

Vietnam is economically an agricultural country with more than 70% of its population living in the rural areas, and around 28% of the total lands cultivated.

At the present, the total population of Vietnam is beyond 84 million, comprising people from 54 ethnic groups. Viet people, also called Kinh, form the largest group representing over 80% of the whole nation's population. Kinh, Hoa (ethnic Chinese) and Khmer Krom people reside mainly in the country's alluvial deltas and coastal plains. Other 51 ethnic minorities live mostly in the highlands. Each of these 54 ethnicities has distinct culture and language, making Vietnam highly diverse in culture and indigenous knowledge.

The population of Vietnam is young; about 30% of all Vietnamese are under 15 year old. The population growth rate reduced from 1.6% in 1996 to about 1.2% in 2006. Nevertheless with the present looser birth control, this rate intends to increase.

3. Agriculture and Socio-economic Conditions

During the last 10 years, with outstanding achievements deduced mainly to the adoption of new crop varieties and cultivation technologies, the agriculture sector has contributed significantly to the nation's success in the poverty reduction and food security improvement. The sector accounts for one third of the total export value of the country and shares about 20% of its GDP, equally around 6 billion USD per year. Rice is the dominant crop, planted over 80% of the total farm lands (over 7 300 million hectares, mainly in Mekong and the Red River Deltas) and providing above 90% of the nation's total food grain output. The country is the world's second rice exporter, after Thailand. In 2006 the national total rice production was 39.65 million tons, of which 4 million were exported. Other important food crops are maize (around 4 million tones/year), sweet potato, cassava, legumes, soybean, fruits and vegetables. Total area of fruit-trees was about 800 thousand hectares, planted mainly to oranges and tangerines, pineapples, mango, longan, grapefruit and litchi. Industrial plants also have important share in the total agricultural production. In 2005, the export value of coffee is about 7 million, rubber 772 million, tea 95 million, cashew nut 481 millions, pepper 46 millions, vegetable and fruits 235 millions US\$.

The Ministry of Agriculture and Rural Development has set up the goal for the 5 year period of 2006 - 2010, with the average production growth rate of 4 - 4.5% per year, and the average export value increase of 12% annually. The main export agro-products are rice (4 million tons in 2006), coffee (750 000 tons), dry rubber latex (560 000 tons), cashew nuts (110 000 tons). Export values of vegetables and fruits and forest products are US\$ 330 million and 1.8 billion respectively.

Nevertheless, Vietnam is still among the world most poorly developing countries, with per capita income of only US\$ 580 (in 2005). The government considers achieving food security a national foremost priority and has approved a comprehensive plan to promote and monitor food security. As the result, the success of the agricultural sector, which grew at an average annual rate of almost 4%, has greatly improved the nation's food security and reduced poverty. During 1990-2003 the per capita income growth was about 6% annually, ranking second worldwide, after China (9%). Consequently, food consumption also rose and food security improved across all income levels. Average daily per capita calorie consumption increased from 2 149 in 1990 to 2 556 in 2002. The number of hungry people reduced from 28 million, equaling 41% of the population in 1992, to less than 10% in 2004. Other indicators of food security show similar trends. The number of malnourished children declined from about 50% in 1993 to around 25% in 2003. Also, the country's poverty rate declined from 58% in 1993 to 29% in 2002 and 26% in 2004. Although the poverty reduction trend occurs in all the regions, the gap between rural and urban areas remains large. In 2002, 6.6 % of the urban population was considered poor while in the rural areas this figure was 35.6%.

Thus, although Vietnam is well on the way to meet the World Food Summit goals, food insecurity remains a problem for the vulnerable. Declines in poverty across regions have been uneven and disparities across Vietnam are still huge; the poorest provinces locate in the mountainous areas of the northwest, central highlands and central region (Lao Cai, Quanh Binh, Quang Tri, Son La, Kon Tum, Bac Kan...) with the share of the population below the national poverty line more than 4.4 times higher than in the wealthiest provinces. Also, ethnic minorities face the biggest problems in overcoming poverty, they represent only 14% of the total population but 30% of the poor. Being aware of this, the government of Vietnam also aims at reduction the different between rural and urban areas. The country's Poverty and Growth Strategy and Nutrition Strategy outline the goal of the government to reduce the rate of poverty to less than 5% of the population by 2010 and to reduce the incidence of malnutrition in children under 5 to 20%.



THE STATE OF DIVERSITY



Because of the country's specific geographical location and due to its long history and complicated topographical, ecological and social features, Vietnam is recognized as one of the world's most prosperous, rich and diverse in PGR countries. While diverse climatic conditions diversified the country's flora with both tropical and temperate plants, thousands years of agricultural practice by 54 ethnic groups largely enriched its crop genetic resources with great numbers of local cultivars and land races, the country's location in the origin centers of various crops, such as rice, taro, banana, jack fruit, mango, coconut, tea, local anion and some citrus trees, results in richness and diversity in its crops relatives and wild plants of agricultural and social values.

According to the preliminary survey data, there are more than 800 plant species cultivated in largely diversified agro-systems throughout the country, of which the most popular are 41 starchy food, 95 non-starchy food, 105 fruit, 55 vegetables, 44 oil, 16 fiber, 12 beverage, 181 medicinal, 39 spice, 29 cover and bare hill re-greening, 50 ornamental, 49 woody and 5 shading (Annex 1). Regarding fruit plants, over 130 fruit species belonging to 39 families have been identified in the country, including tropical, sub-tropical and temperate ones. The most important tropical fruits are banana, pineapple, mango, papaya, jack fruit, guava, durian, mangosteen, coconut-palm, cashew, tamarind, carambola, pomelo, annona... Subtropical fruits with the most important values include citrus, litchi, longan, persimmon, chestnut etc. Temperate ones are peach, plum, apricot, apple, pear, strawberry. A large portion of fruit germplasm found in Vietnam has local origin and many of them are with high level of both species and genetic diversity such as banana, jack fruit, citrus, carambola and mango.

Within species or genetic diversity of different crop are also very high:

Rice

The most important staple food crop: There are more than 6.000 varieties/genotypes/landraces of rice existing in the country, of which around 700 are landraces. In accordance to their genetic nature, rice germplasm in Vietnam can be divided into 3 types: (1) Indica (89%); (2) Japonica (9,5%) and (3) unidentified (1,5%). Wild rice species of *O. rufipogon*, *O. officinalis*, *O. nivara*, *O. australiensis*, *O. minuta* and *O. rhizomatis* also occur in the country.

Maize

The second important food crop: Germplasm of 4 subspecies of maize are identified in Vietnam, including Hard flint maize *indurata* Sturt; Semi-dent maize *semiindurata* Kulesh; Glutinous maize *ceratina* kulesh and Pop corn *everata* Sturt, each with high genetic diversity. For many highland residents maize remain their main food crops.

Sweet potato

The most important root and tuber crop in Vietnam: there are many local varieties and landraces with valuable traits. Germplasm of other species of the genus *Impomea* are also identified, such as *I. digitata*, *I. hederacea*, *I. maritima*, *I. aquatica*. Nevertheless, no wild species closely related to sweet potato is observed in Vietnam.

Taro

The second most important root and tuber crop: There are different species of taro grown in Vietnam for different use purposes, for food, feed and medicine. The most important species are *C. esculenta*, *C. antiquorum*, *X. sagittifolium* and *A. campanulatus*. There are also wild relatives occurring along road sides and forest margins.

Yam

Both cultivated and wild forms occur over all the country's territory. The following species, *Discorea bulbifera*, *D. esculenta*, *D. altata*, *D. cirrhosa*, *D. perinmilis*, *D. hispida*, *D. floribunda* and *D. deltoidea* are found in Vietnam.

Cassava

At least 40 cultivars are planted in the country, most of them are farmers' varieties or landraces.

Canna

Germplasm of 6 different types are identified in Vietnam: (1) with tall plants and broad violet leaves; (2) with tall plants are narrow violet leaves; (3) with short plants and narrow violet leaves; (4) with tall plant and narrow green leaves; (5) with tall plants and broad green leaves, and (6) with short plants and narrow green leaves. Many of them are with beautiful flowers and can be used as ornamental plants.

Citrus

There are 11 species/forms of citrus identified in Vietnam, including *C. sinensis*, *C. limon*, *C. aurantifolia*, *C. aurantium*, *C. jambishi*, *C. peticulata*, *C. grandis*, *C. paradisi*, *C. medica*, *Sinensis x reticulata* and *Citrus* sp. with a around 200 cultivars in total. Some local varieties are with special fruit quality, such as orange of Bo Ha, Van Du, Xa Doai; pomelo of Phuc Trach, Nam Roi, Dien, Doan Hung; mandarin of Bac Son, Lai Vung, Canh... Plants of other genera of family *Rutaceae*, such as *Poncirus* and *Fortunella* are also found in Vietnam.

Banana

About 100 cultivars belong to 6 genotype groups (AA, AAA, AB, AB, ABB and BB), of which many are with special fruit quality (chuoit Mit, Chuoit Ngu) and some are endemic. Wild plants of *Ensete*, *Musa itinerans*, *M. ornata*, *M. borneensis*, *M. Ballbisiana* and *M. acuminata* also present in the country.

Pineapple

Cultivars of 3 pineapple groups, Queen, Cayenne and Spanish, are planted in Vietnam.

Sugarcane

Numerous forms of 3 species occur in Vietnam, including *Saccharum officinarum*, *S. sinense* and *S. spontaneum*. In total, over 500 cultivars and forms have been identified. Especially, there are local cultivars of *S. officinarum* with high quality, such as Mia Tien and Mia Thuoc, and many other are with high resistance to pest and stresses.

Tea

Almost 150 genotypes and forms are occurring in Vietnam, of which various are indigenous with specific quality, such as the Shan tea.

Coffee

As introduced crop, coffee has been grown in Vietnam for a long time, since 1850's. Varieties of 3 coffee species are planted in Vietnam, of which *Coffea arabica* is the most popular one which occurs in 2 types, Typica and Bourbon. *C. canephora* (Robusta) and *C. dewewerei* are also grown but in much smaller area.

Cotton

An important exotic industrial plant with over 1 300 varieties introduced from different sources (FAO, India, US, Mexico, France, China...).

Coconut

There are around 50 different types of coconuts occurring in Vietnam. However, each year tens thousand of hectares of coconut are destroyed for plating of other plants which are considered to have higher values. As a consequently many coconut varieties are lost and few tree of the stripe coconut palm remain, and so the sweet tree coconut (having the husk as sweet as sugarcane). Other types, including pineapple coconut (its milk as sweet and aromatic as pineapple), sap coconut (with thick interior) and etc. are facing high risks of being cut down.

Vegetables

Among 403 plant species used as vegetables in Vietnam, 293 (of 84 families) are indigenous, of which 252 are conventional vegetables and 41 spices. The number of species in four main families as follow: *Fabaceae* has 36 species in 19 genera, *Compositae* has 23 species in 18 genera, *Cucurbitaceae* has 16 species and *Poaceae* has 16 species.

The number of species described as crop relatives amounted to more than 1 300, belonging to 77 families, of which a number have been collected, studied and used in crop breeding. Regarding rice for example, *O. rufipogon*, *O. officinalis*, *O. frnolata*, *O. nivira* have been identified in Vietnam as having different desirable characteristics of resistance to pests and abiotic stresses. Similarly, the sugarcane relative *S. spontaneum* and banana wilds of *Ensete*, *Musa itinerans*, *M. ornata*, *M. borneensis* have also been identified and used.

Due to various factors, however, PGR of Vietnam especially those for food and agriculture still face serious threats of erosion and eradication. Many traditional crops varieties of special values have been replaced by newly developed high yielding ones, and the genetic base of various crops dramatically narrowed. The number of local varieties of crops greatly reduced in the production, estimated about 80% of local varieties no longer exist in the production systems. Also, numerous plants of agricultural values are being under-studied and under-utilized (Annex 2). There is a large and increasing number of threatened plant species; as described in the Red Book of Vietnam, in 1996 there were 356 plant species threatened at different levels while in 2003 the figure increased to 450.

The main reasons for the PGRFA erosion are:

- high speed of new crop varieties' introduction and of agriculture modernization and market orientation;
- other human interfaces, including destruction and non-rational exploitation of forests and lands, urbanization, modernization;
- natural disasters, and biotic and abiotic stresses;
- negligence and insufficient management.

Up to now, the inputs spent for study the diversity of PGRFA is still limited. Not any study carried out to access the erosion of PGRFA, nor for establishing a monitoring and early warning system for PGRFA loss. Thus, the foremost priority is to conduct comprehensive survey of PGRFA for:

- identifying the priorities for collecting, and for *ex situ* and *in situ* conservation, of PGRFA;
- accessing the risk of losing crop germplasm in production and natural systems and to develop an early warning system for PGRFA loss.



THE STATE OF *IN SITU* MANAGEMENT

The country's attempts spent for *in situ* conservation of PGRFA during the last 10 years were expressed in a significant number of projects undertaken in the following activity areas:

2.1 Survey and Inventory

During the past 10 years, a significant number of plant species belonging to 56 families were identified as new discoveries either to Vietnamese flora or to the world's, among them various have agricultural values. They include families of *Annonaceae* (with 28 species), *Araceae* (29), *Araliaceae* (8), *Asclepiadaceae* (3), *Aspleniaceae* (1), *Balcaniaceae* (1), *Basellaceae* (1), *Bignoniaceae* (1), *Blechnaceae* (1), *Caprifoliaceae* (1), *Cicadaceae* (9), *Commelinaceae* (1), *Compositae* (1), *Convallariaceae* (10), *Convolvulaceae* (1), *Coriariaceae* (1), *Cornaceae* (1), *Crassulaceae* (2), *Cruciferae* (1), *Cupressaceae* (2), *Cycadaceae* (9), *Cyperaceae* (2), *Dennstaedtiaceae* (1), *Ericaceae* (2), *Euphorbiaceae* (15), *Gentianaceae* (2), *Gesneriaceae* (14), *Gramineae* (2), *Icacinaceae* (2), *Lardizabalaceae* (1), *Lauraceae* (1), *Leguminosae* (1), *Papilionoideae* (11), *Loganiaceae* (1), *Marantaceae* (1), *Marattiaceae* (2), *Moraceae* (1), *Myrsinaceae* (34), *Nartheciaceae* (1), *Nyssaceae* (1), *Oleaceae* (1), *Ophioglossaceae* (1), *Orchidaceae* (80), *Palmae* (6), *Pinaceae* (8), *Polypodiaceae* (1), *Ranunculaceae* (5), *Rubiaceae* (10), *Sapindaceae* (1), *Taxaceae* (1), *Taxodiaceae* (2), *Tetracentraceae* (1), *Theaceae* (8), *Thymalaeaceae* (1), *Verbenaceae* (2) and *Zingiberaceae* (with 6 species) (Annex 3).

However, due to its complicated topographical features, and because of the lack of both financial and technical resource, PGRFA in Vietnam, especially those in the high mountains and remote areas have not been adequately and systematically surveyed and inventoried. Recognizing the importance of a comprehensive study of PGRFA, the government of Vietnam has put in its national biodiversity vision to 2020 and 5-year action plan 2006-2010 a priority for survey and inventory of PGR in general, and of PGRFA in particular, in order to identify plant species that need to be conserved, and towards developing strategies for their conservation and development for sustainable use.

2.2 Conservation of Wild PGRFA in the Protected Areas

In the national biodiversity action plan approved in 1995 (1996 - 2005), crop relatives and wild plants of agricultural values were given high priority to be inventoried, protected, conserved and sustainably used. Since then, some efforts have been made and certain successes achieved. Protection of crop wild relatives and agriculturally valuable plants in natural protected areas has been somehow strengthened. The total number of natural protected areas increased, and according to IUCN classification system for reserves management, they are classified into 4 types.

1. 28 national parks with the total area of 957 330 ha
2. 18 nature reserves with the total area of 1 283 209 ha
3. 11 species/ habitat management protected areas with the total area of 85 849 ha
4. 39 protected landscapes or seascapes with the total area of 215 287 ha

The list of the national parks, their areas and target plants are given in Annex 4, and their location on the Figure 2.

One of the most important constraints to *in situ* conservation of crop wild relatives and wild plants with agricultural values is insufficient inventory and assessment of PGR diversity in the country. Indigenous knowledge has also not been well studied. Thus, various crops relatives or plants of agricultural values may have not been included in the list of plants to be protected and developed for sustainable use.

Another limitation is that only small number of natural protected sites was established despite of the country's largely diverse topographical, ecological and other natural conditions. Moreover, the existing sites have not been properly managed due to both technical and financial limits.

Poor databases development and documentation is also an important limitation. Information sharing is very limited between institutions involved.

FIGURE 2
Location of the national parks



2.3 Ecosystem Management for the Conservation of PGRFA and Crop-Related Biodiversity Outside the Protected Areas

Some research projects carried out during the last 10 years also set *in situ* conservation of crop wild relatives and wild plants of agricultural values outside the protected areas as one of their objectives. For example, the project for *in situ* conservation of native landraces and their wild relatives in Vietnam, funded by UNDP and technically supported by IPGRI, aimed to conserve globally significant agro-biodiversity of 6 important crop groups (rice, taro, litchi-logan, bean, citrus and tea), including their native landraces and wild relatives, at 11 sites in 7 provinces: Hai Duong, Hung Yen, Ha Tay, Cao Bang, Ha Giang, Tuyen Quang and Lang Son. Agro-biodiversity of these six crop groups was protected through mitigating their loss threats in the selected sites. The strategy was to promote sustainable community-based Plant Genetic Resources Important Zones (PGR-IZs). The project's activities involved: (1) establishing PGR-IZs; (2) promoting operation of PGR-IZs through capacity building, training, and removal of barriers; (3) doing targeted researches, information management and analysis in support for PGR-IZ establishment and operation; and (4) public awareness raising including training and dissemination of information.

Efforts were also spent for assisting farmers in disaster situations to restore agricultural systems. Farmer's participation in restoring agricultural systems has been also promoted through various activities of different projects implemented by local or governmental institutions with supports from different donors, including local and international organizations, governmental and national or international NGOs. Most significant were activities implemented under the project for recovery of watersheds near to Hoa Binh Hydroelectric Plant and the project supporting farmers in the flooded areas in the country's Central Coastal region to restore their agricultural systems. In the areas with high risk of biodiversity erosion, certain efforts have been given to raise awareness of communities in the importance of PGRFA diversity, crop diversification, and protection of threatened landraces and local cultivars. Activities focused on diversification of farming and cropping systems have also been undertaken under several projects. As consequence, in some locations the speed of monoculturing high yielding varieties, and of replacing traditional plants and local varieties with modern ones was significantly slowed down, while community awareness on related issues significantly improved.

Successes, nevertheless, were very limited and restricted to only few locations. Very often agricultural systems were under threats without being aware of or paid any attention for their protection/restoration, especially in the deltas of Hong and Mekong rivers and the Northeast areas where economical development, agricultural modernization and intensification and construction activities reach high speeds. In various cases, various valuable landraces have been long neglected and eventually lost or replaced by modern high yielding varieties (Annex 5). The following are the main reasons:

- Insufficient resource allocated for trainings, awareness raising and promoting participation of communities and local cadres.
- Insufficient supports provided to farmers; e.g. inadequate provision of genetic materials necessary for restoration of agro-systems after disasters.
- Inadequate study of PGRFA and agricultural systems.

2.4 On-farm Management and Improvement of PGRFA

This is rather new activity area in the country, although Vietnamese farmers have long been being maintained, developed crop cultivars, and nowadays in the country the informal crop seed production and supply still account for about 80% of the total seed supply. Only after 1996, on-farm conservation of PGRFA started to enjoy some attention, expressed in 23 projects/activities conducted by 16 institutions with the participation of about 15 000 local cadres and farmers. Activities were focused on the following main objectives:

- **Strengthening Scientific Basis of on-farm Conservation of Agro-biodiversity** through 3 intermediate objectives:
 1. to support the development of a framework of knowledge for farmers' decision-making processes that influence *in situ* conservation of agricultural biodiversity;
 2. to strengthen national institutions' capacity for the planning and implementation of PGRFA conservation programs; and
 3. to broaden the use of PGRFA, and strengthen the participation of farming communities and other groups in PGRFA conservation.

Under several projects, farmers were also provided with technical assistance and incentives to do recovery, tests, pilots, propagation and development of improved other than rice crops' varieties, and as result many valuable traditional crop cultivars were not only maintained but also recovered and developed. For instance, a significant number of local rice, maize, vegetables and legume cultivars of special characteristics and high preference have been recovered and produced at large scale for meeting the increasing consumption requirements. Attempts were also made to study the traditional knowledge relating to on-farm conservation and development of PGR.

- **Promoting contribution of farming communities in *in situ* conservation of PGRFA, especially those in home gardens** through:
 1. documentation of species and genetic diversity in household gardens, and the biological, cultural and social factors governing the distribution and maintenance of this diversity;
 2. development of methods and approaches for home gardens to become a component of *in situ* conservation of agro-biodiversity; and
 3. development of "conservation through use" strategy as a complement to crop *in situ* and *ex situ* conservation.
- **On-farm conservation of rice genetic resources** through:
 1. collecting local and indigenous rice germplasm for conservation for preventing them from being lost due to agricultural modernization;
 2. creating initiatives for conservation and development of rice genetic resources by farming communities; and
 3. supporting farmers to conserve local rice varieties on their farms.

Only from Mekong River Delta, around 1 000 accessions of local rice cultivars were collected. After elimination of the duplicates, 812 ones have been conserved and evaluated by Can Tho University, of which 517 were re-introduced for cultivation and evaluation by farmers in different growth conditions. Farmers in selected areas were also supported to grow/conserv local rice varieties in their fields. As a consequence, various local cultivars have been not only conserved but also developed, and the "conservation through use" approach initiated.

- **Promoting community based on-farm management of plant genetic resources** through survey of agro-biodiversity in selected areas; restoration of diversity of different target species for environmental protection in different agro-ecological conditions; increase of species diversity in cropping systems; and diversification of cropping and ecological systems. Through facilitating communities to access traditional and local cultivars' seed sources as well as to exchange their indigenous knowledge, farmers' participation in conservation and utilization of PGR with low household economical values, but of high community benefits, was promoted. This could serve as the basis for *in situ* conservation and development of PGRFA, including also that of crops' wild relatives. Outstanding achievements were successful introduction of appropriate propagation methods for some fruit plants, and extension of improved cultivation techniques for some traditional cultivars. Farmers in the project's areas were therefore able to preserve and develop valuable genetic materials on their lands while could still improve their household income. Also, experimental-catalogue fields (Community Nursery) were established, where disease-free fruit plant rootstocks were produced and provided to farmers.

Despite the above mentioned achievements there are limitations of on-farm conservation and development of PGRFA in Vietnam, and the following are the most significant:

- The sites established for on-farm conservation and development of PGRFA are limited in number, un-diversified and not well sustainable;
- Limited efforts spent for capacity building and awareness raising for farmers, local cadres and institutions in related issues resulting in low-cost effectiveness and poor spreading/sustaining of the activities;
- Lack of supportive policy at national level making on-farm management of PGRFA hardly promoted;
- The government has recently paid increasing attention to *in situ* conservation and development of PGRFA, nevertheless due to various difficulties its actual resources spent for this is very limited. Farmers have not been given enough incentives and opportunities to access to training, awareness raising, information and experience sharing etc., and this is the main cause for their limited participation in *in situ* conservation and development of PGRFA.



2.5 Priorities for *in situ* conservation of PGRFA

1. Capacity building for scientists, local carders and community members;
2. Advocacy and awareness raising for all the stakeholders (policy makers, scientists, local carders, community)
3. Conducting systematical survey and inventory
4. Develop policies supportive *in situ* management of PGRFA and promoting the participation of communities;
5. Development of on-farm conservation and development sites for specialty local varieties of rice, maize and vegetables through promoting their production, consumption and commercialization. There are various rice cultivars of special quality and upland indigenous glutinous maize cultivars of mountainous minorities with specially good grain quality, and local vegetables of high nutrition values but have not been enjoyed much attention for their on-farm conservation and development. This can be a good "follow-up" of the project "Strengthening scientific basis of on-farm conservation of agrobiodiversity" which was successfully implemented with the support from IPGRI / SDC.
6. Establishment of *in situ*/on-farm conservation sites of specialty fruit plants: mandarin in Bac Kan and Lang Son; pomello in Doan Hung (Phu Tho), Dien (Ha Noi), Phuc Trach (Ha Tinh) and Nam Roi (Vinh Lonh); orange in Canh (Ha Noi) and Bo Ha (Nghe An); banana (chuoai Ngu) in Ninh Binh; and mango in Yen Chau (Son La)... These special fruits have economical, social and cultural values, but due to ignorance have been degraded and eroded.
7. Restoration of mixed home gardens in country sides, especially in Hong river delta where due to extremely intensive efforts to increase rice production for hunger eradication during the 80s most of traditional mix gardens were destroyed.

THE STATE OF *EX SITU* CONSERVATION



During the last 10 years *ex situ* conservation and development of PGR has enjoyed increased attention, and gained significant achievements; the number of collections increased and their management improved.

3.1 The Existing Collections

Since the formation of the national PGR network, each member institutions of the network has been mandated to be in charge for collecting and conservation of certain crop genetic resources; the Plant Resources Center has the responsibility to coordinate the network and maintain of the National Plant Genebank while the other 20 members are responsible for different crops. The total of about 40 000 germplasm accessions belonging to a. 300 crop species have been conserved *ex situ* in field, *in vitro* collections or seed collections.

Collections maintained by the National Genebank

In the National Genebank maintained by the Plant Resources Center, Vietnam Academy of Agricultural Sciences there are around 13 000 germplasm accessions of ca. 120 plant species maintained in seed, field and *in vitro* collections, including:

- more than 11 000 accessions of 83 orthodox seed crop species (6 423 of rice and other graminaceous, 1 937 legumes, 2 187 vegetables , and 725 others) conserved in the seed cold storage, in both long- and medium-term storage conditions.
- 1 700 accessions of 32 vegetatively propagated crops preserved in the field collections;
- more than 100 accessions of root and tuber crops maintained *in vitro*; and
- about 200 accessions of 22 local fruit trees conserved in the botanical garden.

It is worthy to note that most of the germplasm accessions maintained in the national genebank are with local origin and the majority of them no longer or very rarely occur in the production or in the nature. Detailed list of the *ex situ* collections maintained at the national Genebank is given in Annex 6a.

Collections maintained by the members of the National PGR network

There are a total of more than 30 000 accessions of about 150 plant species conserved by 20 member institutions of the National PGR Network, including both national basic collections and complementary collections.

The most important national basic collections include:

- Fruit plants: For the best effectiveness and outputs, fruit plants collections of different origins, Northern, Central and Southern, are correspondingly maintained *ex situ* by 3 institutions located in the North (Phu Ho Fruit Plant Research Center), Center (Phu Quy Fruit Research Center) and South (Southern Fruit research Institute in Long Dinh).
- The most important industrial plants collections of coffee, cacao, rubber and cashew are maintained by the Central Highlands Agro-Forestry Science and Technical Institute located in the Central Highlands (Tay Nguyen).
- Tea collection is maintained by Tea Research Institute.
- Mulberry collection is conserved by Viet Hung Mulberry Experimental Station and Lam Dong Agro-Forestry Research and Experiment Center.
- Maize collection is maintained by Maize Research Institute
- Tropical vegetables collections are maintained by the Agricultural Research Institute in the South
- Temperate vegetables collections are maintained by Da Lat Potato, Vegetable and Flower Research Center, Southern Agricultural Science Institute.

The detailed list of *ex situ* collections maintained by the National PGR Network is given in annex 6b. In addition, there are many supplementary collections of various plants maintained by the Network member institutions for crop breeding and different research purposes.

Together with the establishment of *ex situ* collections, more and more efforts have been spent for the characterization and evaluation of accessions, and the percentage of *ex situ* accessions characterized constantly increased. Collections of some main crops maintained at the national genebank (rice, beans, some vegetables) have 100% of accessions characterized. Also, at this genebank, a total of more than 10 400 accessions have been characterized in terms of 50–60 agro-morphological characters, and about 7 000 accessions preliminarily evaluated for some pest resistance/tolerance. This greatly facilitates their use and exchange.

The maintenance conditions of *ex situ* collections also constantly increased as a result of the successful application of different techniques. Since 1985, after the development of a national strategic plan for the conservation of biological resources, large effort has been spent for developing appropriate technology for the conservation and sustainable utilization of PGR. For each crop, depending on the plant biology, ecological and agricultural characters, different conservation techniques have applied/combined; for the conservation of orthodox seed crops, cold storage method is used, while for vegetatively propagated crops field collections is an option. Due to its high cost, *in vitro* conservation is used only for recalcitrant seed plants and vegetatively propagated crops which are difficult to be maintained in the field collections.

The most important shortcomings in sustaining the existing *ex situ* collections are:

- Improper management in terms of both documentation and material storage. Not rarely, accessions, and even whole collections, were reported to be lost due either to contaminations or negligence. Monitoring genetic variations and disease freedom is often poorly performed. Characterization of accessions has not been undertaken properly and systematically, and so their assessment for valuable characteristics. This, together with poor documentation and information management resulted in high numbers of replications within and between collections contributing to low cost-effectiveness of the conservation activities, and preventing effective use and development of materials conserved. In addition to a significant number of *ex situ* accessions reported as lost, a rather large number of others were stated as threatened. Due to various constraints, mainly limited budget and negligence, only small portion of them have been properly regenerated. Estimated, only at the National Crop Genebank about 3 000 accessions require urgent and moderately urgent actions for regeneration.
- Inadequate classification of existing collections into short-, medium- or long- term, and in working, active or core ones.

3.2 Collecting and Introduction

A significant number of activities have been undertaken for inventory and collecting of germplasm of such plants as rice, banana, cassava, sweet potato, yam, taro, citrus and so on. The total number of germplasm accessions collected during the last 10 year amounted to almost 20 000. This brought the number of the accessions maintained *ex situ* by the member institutions of the National PGR Network to around 40 000 (Annex 6a&6b). Especially, during 2000 -2001, under the National Seed Program, the Plant Resources Center alone collected more than 1 600 local varieties of 30 crop species. More recently, efforts are being to collect the crop germplasm from Son La Hydroponic Electricity Generation Station area. Estimated, about 3 500 – 4 000 crop accessions which are facing high loss risk in the area will be collected by the end of 2008.

Nevertheless, due to shortage of adequately trained technical staff, financial input and appropriate methodology and because of inadequate inventory and survey of PGRFA, collecting plans were not always good and certain activities not properly targeted, e.g. significant efforts were spent for collecting and conserving exotic introduced varieties while local cultivars, landraces and threatened materials neglected. Moreover, preliminary survey data also show that there are still a large number of threatened local cultivars (see also Annex 2) and their relatives which need to be urgently collected, conserved and developed *ex situ*; and the number of lost or difficultly found valuable landraces and indigenous cultivars constantly increased. This is true for all the cultivated plants, including such most important ones as rice and corn. The situation is even worse for legumes, taro, cassava, yam, many fruits and vegetables. Significant number of local vegetables rich in vitamins and proteins has been neglected and faced erosion threats. Similarly, various indigenous fruit plants with special morphology, test and nutritional values have not been studied and paid any attention for conservation and development. These invaluable genetic materials can easily be lost if no urgent attempts made.

A significant number of germplasm accessions of different plants were introduced from different sources:

- 38 tea accessions from China, Japan, Taiwan, India
- 500 rice accessions and 30 wild rice populations from IRRI and other countries
- 259 fruit accessions
- 300 maize from CIMMYT, Thailand, Cuba, Japan
- 240 sugarcane from India, Cuba, China, Taiwan, Barbados, Australia, US
- coco from South America,
- coffee from Ethiopia, Madagascan
- pepper from India

Recognizing the importance of *ex situ* conservation, in its 5-year national biodiversity action plan approved in 2007, the government of Vietnam set up a priority for further collecting and establishing of *in vitro*, field and seed collections of important crops' germplasm, including capacity building and facility up-grading for the institutions involved.

3.3 Priorities for *ex situ* conservations of PGRFA

For strengthening *ex situ* conservation and development of PGRFA in the country, the following are considered as priorities:

1. Review and characterize all the *ex situ* collections and eliminate the replicates. Due to the lack of information sharing and of proper characterization and evaluation techniques, the accessions have not been properly described, characterized and classified (taxonomically). And thus, it is believed that there are large percentage of replicates both within and between collections. In order to increase the cost-effectiveness and to facilitate both the conservation and use of genetic resources, a comprehensive review of all the collections, proper characterization of accessions and elimination of replicates followed by clear assignment of duties among stakeholders is of great importance. This will also assist in setting up a good start for developing appropriate procedure/standards for *ex situ* conservation of different crop germplasm as well as for better planning of further collecting and conservation work.
2. Collecting of PGRFA from locations where PGRFA are facing great risks of erosion, such as construction sites of Son La and Cua Dat hydroelectric generation plants, and along Ho Chi Minh road. Both Son La (North mountainous area) and Cua Dat (in Central mountainous province of Thanh Hoa) have been recognized as having high diversity of plant genetic resources. On the other hand, along the Ho Chi Minh road, the speed of modernization and industrialization process constantly grows causing rapid erosion of biodiversity, among which PGRFA. Other areas such as Red river delta, Mekong river delta and Con Dao island, where the industrialization is being under high speed, are also of important priority. Thus if not urgently collected PGR in these locations will soon be permanently lost, and this will be a great loss for the present and future generations.
3. Collecting and conservation of hybrid rice and maize varieties and parental lines. *Ex situ* conservation is the only option for the conservation these valuable genetic materials containing valuable gene/s useful for crop improvement.
4. Development and application of software(s) for analysis of morphological traits towards definition of duplicates/ assessment of diversity among accessions maintained at the National Genebank.



THE STATE OF USE

PGR can be effectively conserved only when their utilization promoted, and thus conservation and utilization of this valuable natural resource can not be separated from each other, thus during the last 10 years, national efforts have also been spent to facilitate the sustainable use of PGRFA. The main achievements and limitations in this aspect are briefed below.

Characterization and evaluation of germplasm accessions were expanded. The effort however were focused mainly on the morphological characters, while such traits as resistance/tolerance to abiotic and biotic stresses, and product quality enjoyed insignificant attentions. Because of various factors such as limitations in financial resource, lack of appropriate equipments and well trained staff, a rather large portion (a.30 %) of all accessions maintained *ex situ* have not been properly characterized, and only a little number of accessions evaluated in term of the most important agricultural characters such as grain/seed quality, resistance to some pests and tolerance to drought. Moreover, in many cases, characterization and evaluation data were not properly documented and systematized. The collections rather well characterized account for only a small portion of the existing ones, and belonging to the most important crops, namely rice, banana, cassava, and sweet potato. Improper characterization and evaluation cause difficulties in the classification existing collections, as well as in expanding the number of core collections.

Enhancement and broadening of genetic base enjoyed increased attention. Genepool of many important crops, such rice, potato, sweet potato, banana and citrus have been enriched with newly created and introduced genetic materials. These include variants, mutants, hybrid combinations and introduced exotic germplasm. Obsolete crop varieties have also been studied for possibility of using them in breeding programs. Application of biotechniques such as gene transfer, embryo rescue, pollen culture, *in vitro* mutation/variation and selection...also helped broaden genetic base of different crops, notably rice, cotton and sugarcane.

The number of crop breeding projects increased over time with involvement of growing number of both national and local institutions, and both biotechniques and traditional methods were used in crop varietal development. Each year over 1 000 germplasm accessions from *ex situ* collections were provided for plant breeding purposes. Under several projects, community participation in crop varietal development have been promoted. Most notable achievements were obtained with rice. In some locations, notably in Hai Hau district of Nam Dinh province, Ky Son and Da Bac districts of Hoa Binh province, in Can Tho and so on farmers were trained in this crop hybridizing, evaluation, propagation, and production and storage of seeds for next seasons. They were also trained in, and successfully practiced, techniques of elite plants' selection and population improvement for recovery of degraded traditional rice cultivars. Similar achievements were also obtained with other crops such as beans, taro and some fruits trees in Ninh Binh, Nghe An, Hai Hung, Hung Yen etc.

As a result, promising lines or varieties were obtained and tested in diverse growth conditions, and many of them developed into new commercial varieties. During the last 10 years hundreds varieties of different crops were developed and certified, and many other varieties/lines were recovered, selected and tested towards their large scale production. Also, some local plants and varieties have been recovered, propagated and re-introduced into production. For example, a glutinous rice cultivar, Nep Tu Le with special values such as specific aroma and good test have been recently recovered and re-introduced to production. This is true for other local cultivars of rice, notably Tám Thơm, Nàng Hương, Nếp Cẩm, Nàng Thơm Chợ Đào, Nanh Chồn...; fruit plants such as pomelo of Diễn, Phúc Trạch, Đoan Hùng, Nam Roi, Buoi Da Xanh, mandarin of Canh, orange of Bố Hạ, and other traditional plants. Some nurseries called "community nurseries" were established under certain projects where disease free rootstock of fruit plants are produced and provided to local farmers.

Nevertheless, improving the crop seed production and supply systems is still problematic in Vietnam due to numerous factors, notably the lack of an reliable and restrict seed certification procedures and of appropriate policies, improper management, inappropriate subsidies, and inadequate participation. Although farmers have been provided with some supports to produce seeds but this was restricted only to few main crops and several locations, and local seed producers and communities often face difficulties in selling their seeds as bigger producers normally have more advantages.

Crop diversification was expanded. In the battle against food shortage during the 1980s – early 1990s, monocropping of high-yielding varieties of rice and some other main food crops were dominant in all the areas. However, during the last 10 years, diversification of crop production and cropping systems has enjoyed significant attention. Certain attempts were spent for collecting, recovering and re-introducing of local crop varieties and landraces. Also, studies were carried out in order to promote the production of some neglected plants/varieties, including both local and exotic introduced, such as local or specialty varieties of rice, mango, beans, maize, vegetable, mandarin, pomelo, litchi..., and plants such as strawberry, taro, grape and different local vegetables. In many locations the proportion of agro-production other than rice greatly increased during the last 10 years or so. Moreover, in several areas, such as in some communes of Hanoi suburb, Huu Lung (Lang Son), Hung Yen, Hai Duong, Ha Giang, Nho Quan (Ninh Binh), Yen Chau (Son La) and Ha Tay different vegetables, maize, soybean, species, mandarin, orange, pomelo ... and even such introduced crops as potato, strawberry and grape, have become ones of the areas' most important plants.

Monocropping of rice or some food crops however still occur in large land areas, and the reasons for this include:

- undeveloped market system; and little and unstable market demands for products other than rice;
- poorly developed post harvest processing and difficulties facing storage of agro-products other than rice;
- lack of good varieties of crops other than rice; and
- customs of culturing rice or some other plants as the main and stable food crops.

Production and use of local and specialty crop varieties were promoted. In order to diversify crops and agricultural systems, development and commercialization of under-utilized crops and species is another important option. As mentioned before, there are various crops and plant species of high potential values but under-developed and utilized, however during the last 10 years promoting their development and commercialization has been of insufficient concern. This is because of the lack of appropriate long-term plans/strategies and visions, and also of suitable policies. While farmers focused their attention mainly on the plants that bring them immediate and clearly foreseen income, scientists are in short of resources to carry out researches and demonstrations to farmers the benefits of growing under-utilized plants. In addition, there is very limited good quality seed source of these plants; institutions did not spend their limited budgets for production of, and trade in, low demanded seeds. Marketing of under-utilized crops' products is also of great difficulties, requiring not only time and effort but also significant financial inputs.

Another attempt to diversify cropping patterns and system is to develop markets for local varieties and 'diversity-rich' products. In parallel with the development and open-market orientation of the country's economy, there are increasing in-door demands and export opportunities for products of high or special quality of local varieties. This is an advantage for developing new markets for local varieties. As said, Vietnam territory comprises diverse ecological areas, from the Northern mountainous area to the Mekong River Delta, each with specific climatic, land and cultivation conditions, and thus has its own crop specialties. According to information presented at Conference on geographical instruction held by EC-ASEAN Cooperation Program on Intellectual Property Rights (ECAP II) in Hanoi on November 15-16, 2005, there are at least 150 agricultural products from different provinces of Vietnam which can be considered for being protected as geographical origins or names. However, up to now, there is only a small number of above mentioned have their names of origin protected, the handful rest remains unregistered. Only 2 crop product of Vietnam have been recognized as having geographical instruction and origin protection overseas, including Moc Chau Tea (2001) and Buon Me Thuot Coffee (2005). Some other are on the way or planned to be registered, including:

1. Blue Dragon fruit from Hoang Hau, Binh Thuan province
2. Hoang Gia Nam roi Pomelo
3. Tam Binh Van Xuan Orange
4. Lo ren Star apple (vu sua)
5. Hau River Hoa Loc mango
6. Sohafarm Rice
7. Luc Ngan litchi
8. Long Khanh Rambutan (chom chom)
9. Giang Chau Mangosteen (mang cut)
10. Cai Mon Chin Hoa Durian (sau rieng)
11. Cai mon durian
12. Cho Lach Ben Tre longan
13. Lai Thieu mangosteen
14. Ninh Phu grape
15. Go Cong water melon
16. Da Xanh pomelo



Other 3 products, Lang Son anise, Doan Hung grapefruit and Hai Hau aromatic rice (lua Tam) are also expected to be recognized as having geographical instruction and protected name of origin .

In country trade mark have been given to some products such as rice of Tam Thom, Nep Tu Le, Nang Huong...varieties; pomelo fruits of Nam Roi and Doan Hung cultivars, mandarin of Duong Canh landrace and so on.

Indigenous knowledge relating to PGRFA has also been somehow studied in some projects sites for use in promoting PGRFA conservation, use and for crop seed production.

Priorities for promoting the sustainable use of PGRFA

For overcoming the above mentioned constraints to promote the use of PGR, the following priorities:

1. Promote participation of communities and local institutions in seed production, seed supply and in agro-product marketing and commercialization of local varieties. This is very important in Vietnam as the informal seed supply system has been playing the dominant role in the seed supply in Vietnam, and the local varieties have never been covered by the formal seed supply.
2. Develop post harvest technology for plant products, especially those of local varieties and traditional plants, such as litchi, longan, banana, and taro.
3. Evaluate accessions of rice, maize, citrus and legumes in drought and saline tolerance and resistance to the most important pests. This is of great importance to enhancing their use and development for a sustainable agriculture.
4. Development of neglected and under-utilized plants such as local vegetables (luffa, some brassica, amaranth), root and tuber crops (taro, yam, canna and kudzu), starchy plant (arenga), and fruit trees (citrus, star apple, grape, strawberry, blue dragon).
5. Development of a database on the relationships between the genotype-morphology - origin of the crop accessions maintained in the national genebank.
6. Development of an indigenous knowledge relating to PGR conservation and use database.
7. Development of markets for local varieties and specialty products, including registration of geographical origin and name.

THE STATE OF NATIONAL PROGRAMS, TRAINING AND LEGISLATION



5.1 National Programme and Networking

From early 50s, efforts were already paid to collecting, characterization and preservation of genetic germplasm of several major crops in Vietnam. Nevertheless, due to various reasons the activities were constantly interrupted and only since 15 years ago, after the issue of the National Regulations on Genetic Resources Conservation in 1987, the nation's attention spent for its PGR conservation and sustainable use steadily increased.

In 1994, the project for strengthening of the national PGR program in Vietnam was successfully completed, and the first national workshop organized for this purpose. As outputs of this workshop the national network for PGR coordinated by the PGRC, Vietnam Agricultural Science Institute, was established; recommendations for the government to develop relevant policies on PGR proposed; a national action plan on PGR developed; and especially the importance of conservation and sustainable use of PGR widely recognized.

Following this workshop, various activities have been undertaken to realize the national action plan, and the government supports for this significantly increased. In 1995 the first National Biodiversity Action Plan was developed with a special focus on PGR, and in 1996 the Plant Genetic Resource Center of Vietnam Agricultural Science Institute was established with a mandate to implement relevant activities and to coordinate the National PGR Network towards the effective conservation the nation's PGR. The National Network is now comprising 21 member institutions locating throughout the country and assigned for different crop germplasm conservation (annex 7).

Other national programs and plans relating to PGRFA conservation and sustainable use are:

- Agenda 21 on sustainable development
- National Strategy for the Environmental Protection upto 2010 and vision to 2020
- Strategy for the Management of Natural protected areas
- National Action Plan for Promoting the Control of Trading wild plants and animals, 2001 - 2010
- National Action Plan for the Conservation and Protection of Submerged and Marine lands
- Project for planting of 5 million hectares of forests
- National Action Plan to Combat Desertification, 2002-2010, adjusted for the period 2006-2010 with the orientation up to 2020.

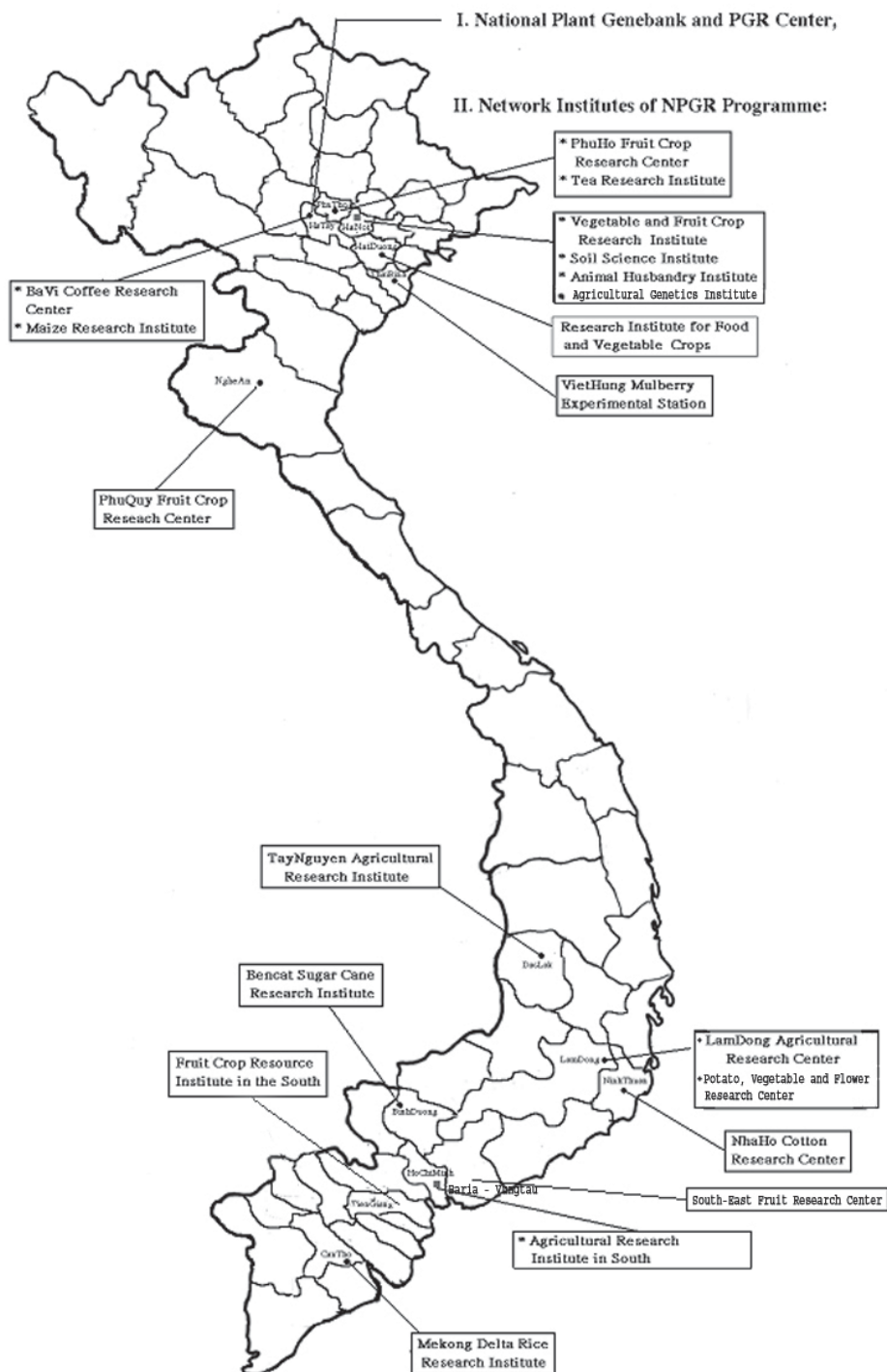
Recently, in 2005, aiming at more effective conservation of the country's PGR, the Government of Vietnam decided to found Plant Resources Center as an up-gradation of the former Plant Genetic Resources Center of Vietnam Agricultural Science Institute. Plant Resources Center (PRC) operates as an autonomous institution under Vietnam Academy of Agricultural Sciences (VAAS) with a mission to study, collect, conserve, exploit and use the national plant resources. The Center's responsibilities, as defined by the Ministry of Agriculture and Rural Development, are as below:

1. To develop and implement national R&D programs and projects, and long-term, five- year and annual plans, for the conservation of plant resources.
2. To conduct researches, including also target-oriented fundamental ones, and realize technological and scientific services for the followings:
 - maintenance and development of the National Plant Genebank, including collecting and maintenance of genetic materials in the seed genebank, *in vitro* genebank, field genebank and ADN bank; evaluation, documentation and provision of information and genetic materials for research, crop production and plant breeding purposes;
 - development of strategies and approaches for the conservation, exploitation and use of plant resources. These approaches involve/combine biotechnology, plant physiology, seed technology and informatics technology;

- conservation of plant resources through their use; development and sustaining of *in situ* conservation sites;
 - study of the agro-biodiversity, including the evolution and dynamics of plant genetic diversity.
3. To coordinate the National PGR Network, and to conduct cooperative R&D and training activities with other national and local institutions.
 4. To develop and realize international cooperation in research, technology transfer, scientific exchange and training in areas related to plant resources.

FIGURE 3

Location of the National PGR Network member institutions



Improving the information management and sharing is another attempt to strengthen the national program and network. Although certain attempts were made before, the implementation of this GCP/RAS/186/JPN project's activities for the establishment of the NISM-GPA was the first effective step towards constructing a comprehensive information system for PGRFA in the country. Before this project's implementation, no information system for PGRFA existed in the country; most stakeholders poorly manage data by different means irrelevant for sharing and systematized; and information exchange was not at all promoted. As said above, this is one of the important obstacles for promoting PGRFA conservation and sustainable use. Under this project, some equipments have been provided to key stakeholders for information gathering, analysis, compilation and reporting. Through using the "Common Tables" and Reporting Formats provided by the project, data collected can be better standardized, systematized and managed. Also, the roles and responsibilities of stakeholders have been clearly defined to ensure the successful establishment of the NISM-GPA.

5.2 National Legislation

Together with the national organizational network, certain effort has also been spent for the development of some legal framework. Nevertheless, up to the present, no separate legal document governing PGR conservation, exploitation and use has ever been issued. Instead, PGR have just been covered by different regulations, decrees and laws on biodiversity conservation and/or environment protection as below:

- Provisional Regulations on Genetic Resources Conservation issued in 1987
- Law on Forest Protection and Development promulgated, adopted in 1991 and amended in 2004
- National Plan for Environmental Protection (1991 - 2000) approved in 1991
- Law on the Environmental Protection adopted in 1993 and reviewed in 2005
- First and second National Action Plan on Biodiversity developed in 1995 and 2007, respectively
- Decree on Seed Management issued in 1996
- Regulations on the Conservation of Genetic Resources by the Ministry of Science and Technology issued in 1996
- Law on Natural Resources adopted in 1999
- Decree on Plant Variety Protection in 2001
- Regulation on International Exchange of PGR in 2001
- Ordinance on Crop Seed Management, 2004
- Law on the Biodiversity: is being developed.

Although each of these legal documents somehow covers PGR, they are not strong enough for effective promotion/regulation of PGR activities in the country. Moreover, the issue of genetic germplasm exchange/access and sharing of benefits raising from PGR use has been almost not included in the current legal documents. Thus, for better effectively conservation and sustainable use of its PGR, the country will need to develop strong national legislations on PGR. This is of even increased urgency when the country's membership of the WTO officially approved. In addition, much more afford need to be spent for raising awareness of both communities and policy-makers so that they can better participate in PGR conservation and sustainable use, including development of appropriate national policies and legislations.

5.3 Capacity Building and Awereness Raising

Capacity of institutions involved have been strengthened, their facilities improved, and so their contribution to PGR conservation and development. Although there are still shortcomings, the activities by different institutions have been much better coordinated in a common network, and consequently overlapping and duplications largely reduced. Workshops and meetings were organized for information sharing and exchange; trainings and consultations provided for capacity building of institutions involved. The number of scientists/technicians trained up in related areas was significantly increased, and the types of training and education diversified. Except at universities and colleges, staff has been given with training opportunities at research institutes, through training workshops and study tours. Scientists from the PGRC, Vietnam Agricultural Science Institute, have also delivered trainings to targeted groups. Moreover, there is a plan set up for including in some universities and colleges the study discipline of PGR conservation.

Nevertheless, due to inadequate budget and training facilities, both training/education quality and quantity remain insufficient to meet the actual requirements for well educated and trained staff. To partly overcome this problem, staffs have been encouraged to take opportunities to study abroad. Still however, as already mentioned, there is an



important shortage of well-trained staff for implementing successfully all the activities necessary for the country's PGRFA conservation and sustainable use.

Together with recognition of the importance of socialization of the PGRFA conservation and development, efforts for raising public awareness on the related issues, especially through implementing projects for promoting *in situ* and on-farm conservation, as already mentioned above (see also Annex 14). Also, workshops and training course organized under the GCP/RAS/186/JPN project significantly contributed to promoting public awareness in the country for PGRFA conservation and sustainable use. This is the reason that although the participation of communities, and of provincial and district institutions has somehow been improved limited public awareness and participation remain still a great constraint to most PGRFA activities.

The main cause for this is the limited effort and concern spent for community trainings and awareness raising. Very limited number of forums were organized on the related issues, and no trainings at all offered to farmers and communities; up to now most of the awareness raising activities were carried out under projects funded by foreign donors, there is no sustainable and strong national projects for this aspect. Also, very few information, education an communication (IEC) materials were produced and introduced/distributed to the public. Moreover, the PGR issues have been very limited mentioned on both the central and local governmental mass communication channels.

Inadequate study and use of indigenous knowledge for PGRFA conservation is another important cause. This is not only problematic for public awareness raising, but in many cases also an obstacle for implementation of many other activities, as already mentioned before.

5.4 Recommendations/priorities

The following recommendations and priorities have been set up by the Stakeholders for institutions and capacity building:

1. Systematically study of indigenous knowledge and the current role of farming communities in management, conservation and development of PGRFA. This is of vital importance for designing appropriate and feasible strategies, plans, programs, projects, and policies promoting the conservation and sustainable use of PGRFA. In Vietnam upto now indigenous knowledge has not been much studied and systematized.
2. Socialize PGRFA conservation through production and distribution of IEC materials, such as leaflets, videos, CD, and through addressing the issues on mass communication channels (e.g. once a week).
3. The National PGR Network to frequently organize workshops/seminars, each with special focus on certain crop/s or issue/s so that participants can better share information and experiences.
4. Production of a journal on PGRFA; at the beginning it can be in the form of newsletter published once every 3-4 months; and gradually upgraded to a monthly journal.
5. Organize short training courses, e.g. twice a year, for people involved in PGRFA conservation, use and development.
6. Propose the government to adopt supportive policies and to issue legal documents governing PGRFA conservation and sustainable use.
7. Complete and launch the NISM-website
8. Clear designation of duties among members of the national network on PGRFA and stakeholders, especially for the *ex situ* conservation of different crops, followed by good networking and coordination. This is of special importance for Vietnam to effectively spend the country's limited budget allocated for PGRFA.
9. Development of the structure of a national information system on PGRFA and a monitoring and warning system for loss of PGRFA. This has become an urgent task for Vietnam, as upto now not any system has ever developed while the erosion threats to PGRFA constantly increase.
10. Recommend the government to increase its budget for PGRFA conservation

THE STATE OF REGIONAL AND INTERNATIONAL COOPERATION



Since 1994, when the country's participated the International Convention on Biodiversity the regional and international cooperative activities in the area of PGR have been steadily promoted.

6.1 Cooperative activities

Various cooperative activities, both bilaterally and multilaterally, with international organization, foreign organization, NGOs were conducted for promoting the conservation and sustainable use of PGRFA in Vietnam:

- With the International Plant Genetic Resource Institute (IPGRI) and Swiss Agency for Development and Cooperation (SDC) in strengthening of scientific basis for *in situ* conservation of agricultural biodiversity on-farm with rice, finger millet, taro, mungbean, large cardamom and sesame as the target plants.
- With IPGRI in studying the contribution of home gardens to *in situ* conservation of PGR in farming system;
- With Asian Development Bank (ADB) and IPGRI in conservation and utilization of mango, litchi, citrus diversity;
- With Asian Vegetable Research and Development Center (AVRDC) in conservation and utilization of indigenous vegetables for improved nutrition of resource-poor households;
- With SIDA, IGRC and DGIS in community biodiversity conservation;
- UNDP/GEF in *in situ* conservation of landraces and their wild relatives in Northern Vietnam;
- IUCN in compilation of agrobiodiversity projects in Vietnam;
- Japan National Institute of Agricultural Research (NIAR) and JICA in rice diversity;
- CROCEVIA in agrobiodiversity;
- With Biodiversity Use and Conservation in Asia Program (BUCAP) in use of the farmer field school in promoting the community based PGR conservation and development;
- With Centro Internazionale Crocevia (CIC) in on-farm conservation of local aromatic rice and fruit diversity;
- With INIBAP in inventory, collecting and conservation of banana germplasm;
- With CIAT in establishing *in vitro* collection of cassava collection;
- With VLIER in collecting of local fruit varieties in Red river delta;

Almost 750 crop germplasm accessions were collected, including about 151 banana, 28 mango, 25 litchi, 188 citrus and over 500 indigenous vegetable. Over 500 indigenous vegetable varieties were transferred and maintained in AVRDC collections. A total of 254 varieties of 15 indigenous vegetable species were characterized in terms of 60 characters according to common forms developed by AVDRDC. *Citrus*, mango and litchi collections were preliminarily characterized. Enzyme profiles of 55 local rice varieties were analyzed. Information sharing and exchange was greatly promoted when standard data forms and application software were used. Elite individual plants were identified to use as mother plants for rapid propagation, including 19 litchi, 12 mango and 34 *citrus* plants. *In situ* conservation sites of local rice, citrus, taro, mango, cardamom, litchi, longan... varieties have been established. Capacity of staff members of the Plant Resources Center and the National Network member institutions was improved through their participation to international workshops, meetings and cooperative activities.

Under international cooperative projects, some equipments items were also provided to the Plant Resources Center and other member institutions of the National PGR Network, most notably the equipments required for the molecular and biotechnology study.

6.2 Participation in the international programs and agreements

As a member country of the UN CBD, Vietnam's participation in the implementation of the Global Plan of Action for the Conservation and Sustainable Use of PGR for food and agriculture was mostly through its contribution to the conduction of the project GCP/RAS/186/JPN entitled "The Implementation of the Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture in Asia and the Pacific". Within the framework of this project, a national information sharing mechanism has been established, the current status of PGR activities in Vietnam accessed, and the most important priorities set up for the safe conservation and sustainable use of Vietnamese PGR. Also the PGR related information and data have been better managed and shared among the local stakeholders as well as with international network.

Vietnam also entered UPOV, and GAAT and TRIP in 2006 just before its membership of WTO, and has been prepared to participate in the International treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

The country also ratified the Convention on the Climate Change and The Convention to Combat Desertification and signed the Kyoto Protocol.

Besides, the country has also participated the Ramsar convention on the Important Submerged areas since 1988, the CITTES since 1994, the Paris Convention on the world's cultural heritage since 1987, the Cartagena Protocol on the Biosafety since 2004.

6.3 Shortcomings and Major Needs to Improve International Collaboration

The following are the main shortcomings of the international cooperation in the field of PGRFA during the last 10 years:

- The number of international cooperative projects remained small, and the projects are not diversified; most of the projects activities were focused on the PGR survey, collecting and *in situ* conservation.
- The achievements in training were also limited, the number of staff members trained in technical aspects related to PGR conservation and sustainable use was small and can not meet the actual requirements of the Center.
- Limited linkage and information sharing between cooperative projects caused poor sustainability of the projects impacts.

The major needs are as below:

- Cooperation in the evaluation of local crop germplasm accessions in order to identify the valuable genes coding for resistance to drought, saline, pest tolerance, specific quality...
- Cooperation in characterization of crop collections in order to eliminate the replicates and establish of core collections
- Cooperation in developing policies supportive to the PGRFA conservation and sustainable use, especially the community-based activities and access and benefit sharing (ABS) mechanisms.

ACCESS TO PGRFA AND SHARING OF BENEFITS RAISING OUT FROM THEIR USE, AND FARMERS' RIGHTS

The aspects of sharing benefits raising out from the use of PGRFA has not enjoyed much attention. Upto now, although there are some legal documents somehow covering PGRFA management, not any ever mention on their access and benefit sharing. Nevertheless, as upto now the access and benefit sharing is somehow realized as more than 80% of the seed supply is deduced to the informal system where farmers and communities themselves produce, manage and exchange crop seeds, and thereby they can somehow realize their ownership on the local and inbred varieties.

With the country's entry to the WTO and its participation to UPOV, the situation will change, and farmers will face great difficulties in realize their ownership on the PGR. This requires the country to develop a legal framework to ensure the faire and equal sharing of benefits and promoting the realization of farmers' rights over PGR.



CONTRIBUTION OF PGRFA MANAGEMENT TO FOOD SECURITY AND SUSTAINABLE DEVELOPMENT

As said above in Chapter 4, the use of PGRFA has been promoted during the last 10 years; the production of valuable local germplasm and varieties have been promoted and thereby contributed to the diversification of cropping systems and to improving livelihood of farmers. Also, germplasm accessions and recovery, re-introduction and increased production of local varieties of such crops as vegetables, taro, rice and fruits with important values have been recovered and re-introduced. All this greatly contributes to food security and sustainable development of the country.

ACKNOWLEDGEMENTS

We would like to express our sincere thanks to FAO for provision invaluable support so that this work could be completed. We also are deeply grateful to Bioversity International, Swiss Agency for Development and Cooperation (SDC), Asian Development Bank (ADB), Asian Vegetable Research and Development Center (AVRDC), SIDA, IGRC and DGIS, UNDP/GEF, IUCN, Japan National Institute of Agricultural Research (NIAR), JICA, CROCEVIA, Biodiversity Use and Conservation in Asia Program (BUCAP), Centro Internazionale Crocevia (CIC), INIBAP, VLIER, ACIAR and other international and foreign organizations and NGOs for their valuable cooperation and assistance in strengthening our national PGR activities and programs.



