THAILAND:

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
Introduction to Thailand and its Agricultural Sector

Thailand is situated in mainland Southeast Asia in boundary of the Indo-Malayan peninsula. Provided with a sub-humid tropical climate regime, the precipitation and the temperature vary greatly from year to year. Sometimes cool periods and heavy rains appear due to the southeast and southwest monsoons and occasional typhoons from the South China Sea. Thailand is a small-sized country of about 320,700,000 rai (2.5 rai = 1 acre) which consists of reserved forests (136,200,000 rai), agricultural land (152,000,000 rai) and grasslands/wastelands (26,000,000 rai). Almost all of the agricultural land is used for growing rice (84,000,000 rai), field crops (51,500,000 rai), and fruit and plantation crops (16,500,000 rai). Eighty percent of the population is predominantly rural. Agriculture accounts for 70 to 80% of the economy of the nation. Rainfed agriculture comprises 84% whilst irrigated agriculture accounts for only 16% of the total growing land area. The economic crops of the country are rice, tapioca, para rubber, maize, sugar cane, sorghum, cotton, soybean, mungbean, coffee, pineapple, oil palm and ornamental flowering plants. The annual income from the export of 31 economic crops consisting mainly of rice, para rubber, tapioca, maize and sugar cane comes up to 11 billion Baht (25 Baht = 1 US $), plus 466 million Baht from orchids and other ornamental flowering plants.

The vegetation is divided into two main zones, namely the lower tropical rain forests and the upper tropical rain forests. The tropical rain forests spread over nearly all parts of the country but only appear in large areas in two parts, the east and the peninsula.

The lower tropical rain forests occupy peneplains and hill slopes of up to 600 m altitude. The forests are two-storeyed. The upper storey consists of gigantic tree, mostly *Dipterocarpus*, *Hopea*, *Shorea*, *Parashorea*, *Anisoptera*, *Dryera*, *Melanorrhoea* etc., while the lower storey is composed of *Talauma*, *Vatica*, *Antidesma*, *Aporosa*, *Aglaia*, *Croton*, *Syzygium*, *Calamus*, *Bambusa*, *Amomum* and several climbers.

The upper tropical rain forests cover slopes of 600 to 900 m altitude and also consist of two storeys. The upper storey is represented by great numbers of oak and allied species, e.g. *Quercus*, *Lithocarpus* and *Castanopsis*, and other species like *Pentacme*, *Podocarpus*, *Magnolia* and *Michelia*. The lower storey is dominated by *Antidesma*, *Baccaurea*, *Pinanga* and *Aglaia*.

Semi-evergreen forests: this forest type is three-storeyed. The upper storey consists of *Dipterocarpus*, *Hopea*, *Shorea*, *Afzelia* and *Ailanthus*. The middle storey is made up of *Chaetocarpus*, *Euphorbia*, *Irvingia*, *Vatica* and *Cratoxylum*. The lower storey is represented by smaller statured species like *Aporusa*, *Cleistanthus*, *Tarema* and *Knema*. Strangling figs are frequent, and epiphytes, mainly orchids and ferns, are sporadic.

Hill evergreen forests: these forests areas normally have cool weather and are places for water reservoirs. The flora consists of two storey and is dominated by magnolias, laurels, oaks, chestnuts and rhododendrons. The upper storey flora consists of *Quercus*, *Lithocarpus*, *Eugenia*, *Schima*, *Podocarpus*, *Cinnamomum*, *Calocedrus* and *Cephalotaxus*. The lower storey is represented by *Camellia*, *Acer*, *Tristania*, *Carya*, *Carpinus*, *pteridophytes, bryophytes, rhododendrons* and many orchid genera.

Deciduous forests: the vegetation is entirely deciduous. Trees shed their leaves during the dry seasons, occasionally causing forest fires. This forest type can be further subdivided into three main categories:

1. Mixed deciduous forests. This forest type occupies a wide range of elevation from 100 to 600 m in the central and northeastern parts of the country. Trees are abundant in several species of diversity, e.g. *Terminalia*, *Xylia*, *Lagerstroemia*, *Pterocarpus*, *Afzelia*, *Dalbergia*, *Dillenia*, *Milletia*, *Croton*, *Bauhinia*, *Shorea*, *Hopea*, *Syzygium* and many species of bamboo.

2. Dry deciduous dipterocarp forests. The popular and official name is Pah-ten-rang. The predominant species belong to *Dipterocarpaceae*, with the predominant species as follows: *Dipterocarpus*, *Shorea*, *Xylia*, *Quercus*, *Dalbergia*, *Strychnos*, *Terminalia* and *Phyllocarpus*. Epiphytes are found such as *Dischidia*, *Hoya*, *Dendrobium*, *Bulbophyllum*, *Pyrrosia* and *Drynaria*.

3. Savanna forests. This forest type is actually grassland with plant species of medium height forming a very open stand, such as *Aporusa*, *Ochna*, *Glochidion*, *Feroniella* and *Carissa*. Many grass species are found, such as *Panicum*, *Sporolobus*, *Themeda*, *Erianthus*, *Arundinella*, *Imperata*, *Eriochloa* and *Eulalia*.

The hectarage of forest lands declined considerably due to past logging operations which at present have been stopped. Records from the Royal Forest Department in 1987 mentioned that there remained 149,000 km^2 of forest areas (20% of the total land area), while farm holdings accounted for 205,000 km^2 (40%), and others for 150,000 km^2 (31%). Loss of forest areas is estimated at 1,520,000 rai per year.

To produce good varieties or good seeds the germplasm may be obtained by collecting from the wild, or by introductions from foreign countries on exchange or purchasing basis when necessary. Today there is more progress in the production of good seeds, especially sexual seeds. Cooperation between the government and the private sector is underway, especially in the use of modern technologies. At present, the seeds produced by the government are limited in quantity. In general, seed supply relies on those stored by the farmers themselves or produced locally. For those crops produced asexually or by vegetative means, planting materials are produced by the government and the owners of the farms. These crops are rubber, tapioca, fruit crops, and ornamental and flowering plants. Plantation crops, on the other hand, have the added advantage of being propagated either by seeds or by asexual methods. These crops are cacao, cashew nut, coffee, tea etc.

In 1990 a big storm hit the farmers' fields in the south, destroying more than 10,000 rai of crop lands. Flood and drought frequently occur in the country, particularly in the Northeast. The government provides compensation in the form of seeds and fertilizers. Occasionally diseases and pest also attack the farmers' crops, for example the blast disease of rice and locusts in maize fields in the central region. It is the duty of the government to look after the farmers whenever calamities happen. The government has planned for policy for early warning for disease and pest forecast in the future.

CHAPTER 2
Indigenous Plant Genetic Resources

2.1 FOREST GENETIC RESOURCES

Thailand has approximately 15 different ecosystem types which span extremes of elevation and climate. Most natural forest areas are now within parks, nature reserves and other conservation units. The major problems facing these reserves are poor boundary demarcation, encroachment and poaching. Species diversity of plants is high; there are estimated at least 10,000 species of vascular plants, of which only 15% has been enumerated in the Thailand flora. No quantitative information is available on the population of plants. Utilization of the germplasm in research programmes has been done but only to a small extent. A lot of forest tree species are valuable sources of timber of commerce: *Dipterocarpus*, *Hopea*, *Shorea*, *Xylia*, *Sindora*, *Dalbergia*, *Lagerstroemia* etc. Populations of several commercial species have declined and are unable to regenerate themselves because of habitat destruction, illegal occupation of land and illegal exploitation of protected species. This includes for example *Dipterocarpus*, *Afzelia*, *Cotylobium* and *Intsia* which once occurred abundantly. Even self-sustaining natural populations of *Tectona*, *Vanda*, *Maxburretia* and *Kerriodoxa* are facing the same situation. The government is unable to prevent the exploitation of these species for basic subsistence needs of the local population.

2.2 OTHER WILD SPECIES AND WILD RELATIVES OF CROP PLANTS

Many species which have not been domesticated are used extensively by the people. Some are widely planted in their original form and are taken directly from the wild. Several forestry species are obvious examples. Sources of timber and wood products such as *Dipterocarpus*, *Xylia*, *Lagerstroemia* and *Calamus* are of economic value. Ornamental palms such as *Maxburretia* and *Kerriodoxa*, some orchids like *Vanda* and *Paphiopedilum* are “hunted” from the wild for commercial purposes. Some wild species are of potential value as raw material for chemical and pharmaceutical industries. Contraceptive drugs have been obtained from wild plants, e.g. *Dioscorea* and *Costus*. Wild species constitute a gene pool for widening the genetic base and are sources of adaptation to stress conditions and resistances to diseases and pests. Amongst

the wild species of rice occurring in Thailand, namely *Oryza granulata*, *O. rufipogon* and *O. minuta*, the latter has been utilized satisfactorily in the yield improvement of cultivated rice.

Large scale production of some wild species, e.g. *Amorphophallus* and *Dioscorea*, as sources of carbohydrates and chemical drugs has recently been tried. Several species are also of high value, such as *Quercus*, *Lithocarpus*, *Castanopsis*, *Dialum*, *Diospyros*, *Tarenna*, *Amomum* and *Smilax*.

2.3 LAND RACES (FARMERS' VARIETIES) AND OLD CULTIVARS

Land races are major sources of genetic material for crop improvement. They are highly adaptive to conditions of primitive agricultural practices such as low level of cultivation, low soil fertility and environmental fluctuations. They are genetically diverse, variable and in equilibrium, and they are understood to differ in adaptation to soil type, time of seeding, date of maturity etc. Some examples of land races in Thailand are: Nan-mon, Lueng-pratiew and Jek-chiey of rice; Kaao-pode-tien of maize; Ooi-gai and Ooi-dam of sugar cane; and Kam-pan and Sam-pao-thong of durian. Old cultivars are also important as materials for crop improvement since they possess useful and usable genes which are sometimes needed. Farmers, however, do not keep them for their own sake. If any of them do not perform well, they are discarded. The government has to maintain them in genebanks either in the form of seeds or as living collections. Examples of old cultivars in Thailand are: Phra Phutthabat 5, Thai DMR 6 and Pakchong 1602 of maize; IS 8719 E 173 of sorghum; Keaw Yai of kenaf; Bo-ran, Thong-daeng and E-thui of durian; Nam-tan-gruad of rambutan; E-paen and E-chan of *Sandoricum koetjape*; and Nom-nong and Lueng-udom of rice.

The government has already planned for policies and measures in order to strengthen nature conservation, land reform and land use. It has also emphasized farming systems which should take into account land production capacity, and conservation of water and natural resources.

CHAPTER 3
National Conservation Activities

There is no national institute in Thailand which takes direct responsibility for plant genetic resources conservation. However, sharing of responsibilities and participation in the activities have been conducted. For agricultural crops, the Department of Agriculture has played an important role in terms of collecting, conservation and research. As well, the Royal Forest Department takes part in *in situ* conservation of forest genetic resources, while the Department of Medical Science assumes responsibility for medicinal plants. A National Sub Committee for Coordination of Research and Development on Plant Genetic Resources has been established. The Committee consists of 21 members from 17 institutes dealing directly with plant genetic resources. Working groups on plant genetic resources activities are created on a case-to-case basis.

3.1 *IN SITU* CONSERVATION ACTIVITIES

This activity is one of the functions of the Royal Forest Department, which takes responsibility for nature reserves, national parks, and legislation to protect and safeguard forest tree species. A total of 194 natural reserve areas has been established.

Recognizing the threat to valuable forest genetic resources, the Royal Forest Department in collaboration with the Danish Government in 1986 has taken steps to conserve *in situ* the best stands of *Pinus merkusii*. Reserve areas of about 100 ha have been established in Surin province in northeast Thailand. The area is actively managed and protected to allow for the natural regeneration of this pine species. As well, a large network of conservation areas, totalling 640 ha, has been set up in Ubon Rat Thani, also in the northeast, to safeguard the species. Efforts are under way to encourage understanding of the importance of the project among the local population. The project not only conserves valuable gene pool but also protects a number of associated tropical hardwood species and other components of the ecosystem.

There are at least 40 experimental stations under the network of 20 research centres of the Department of Agriculture. These centres and stations have

contributed to *in situ* conservation of genetic resources by reserving patches of land for the natural growth of wild species. On-farm conservation of land races and traditional varieties is normally conducted by the farmers themselves and also by the government.

3.2 *EX SITU* COLLECTIONS

There are two principal genebanks in Thailand, namely the National Rice Seed Storage Laboratory and the National Genebank.

The National Rice Seed Storage Laboratory, located at the Rice Research Centre, was established in 1980 through a grant from the government of Japan. The cold storage facilities of the Laboratory not only keep rice seeds under short, medium and long term conservation, but also facilitate the handling and processing of field crops and coarse grains. Separate rooms of several sizes of at least 4 m^3 were constructed to serve as laboratory units and other purposes. At least 10,351 accessions of 78 species are maintained in the genebank.

The National Genebank was established in 1985 through a contribution from IBPGR to serve as a storage network. The storage capacity is about 40,000 to 50,000 accessions of orthodox seeds. The genegank is under the responsibility of the Thailand Institute of Scientific and Technological Research (TISTR). The genebank puts emphasis on maize, okra, some legumes, *Capsicum*, grasses, and some fast-growing trees like *Leucaena*. There are at present 4,000 accessions conserved in the genebank.

The expense of running the genebanks during the course of maintenance and processing is usually high. The electricity cost in the National Rice Seed Storage Laboratory, for example, is around 100,000 Baht (US$ 4,000) per month. However, the government sees it as a worthwhile activity.

Collections in several government institutes automatically belong to the government if established by authorization of the National Research Council. The collections contain indigenous materials of the country's major crops of which some are replicated elsewhere.

The indigenous collections are considered to be the most important materials for plant breeders.

Main users of the materials in the genebanks are researchers in the national institutions, and farmers. Private companies and plant breeders from other national and international agricultural research centres also use some of the materials in the genebanks.
Accession inputs are collected mainly from domestic exploration, institutional collections and introduction. Materials also received from the CGIAR centres, international centres or other national program on exchange basis. The collections are not definitely the true representative of the diversity existing in the field and in the natural habitats. Maintenance procedure is considered acceptable and adequate for the purpose.

Collecting activities are planned according to crop priority set according to the status of the species, i.e. whether endangered, threatened or rare. Collecting programmes are planned, but occasionally opportunistic collecting is done in remote areas. Sometimes materials are also obtained from rural markets.

3.3 STORAGE FACILITIES

Collections are kept in genebanks, which are able to maintain the materials all the time. Seed materials are maintained in airtight glass jars, plastic bags, paper bags or in zinc cans under vacuum. The materials are conserved in short term storage (15^{o} C, 60% RH), medium term storage (5^{o} C, 60%RH) and long term storage (-10^{o} C, 60%RH). We are not sure if the storage conditions comply with internationally recommended standards.

Base collection material, is maintained over the long term. The base collection material is not duplicated for safety in another genebank. The curators of the genebanks are responsible for viability testing and for regeneration of the material.

Curators are able to transfer material quickly after receipt to recommended storage conditions. Normally, it does not take over a day to process an incoming sample. Curators adopt a scientifically based set of priorities for processing incoming material. There is however a temporary backlog of unprocessed material.

There is still space available in the storage facilities (short, medium and long term). Materials can be transferred to other genebanks if we are on the verge of reaching full capacity. We store materials for other genebanks in the country. If there is spare capacity, we would be willing to store material for

other countries on the basis of an agreement. Since we have two genebanks with adequate capacity, we have not considered the option of negotiating an agreement with another country, a CGIAR centre, or through an international body to store our plant genetic resources on our behalf.

3.4 DOCUMENTATION

The collections in the genebanks are not well documented, although we do have computerized data bases. Information accompanying the samples are passport data, indigenous knowledge and breeders' records. Agronomic evaluation information is not integrated into the documentation system. About 50% of the material is documented. There is no correlation between the quality of the documentation and the use of the samples. Information is made available to users in the form of computer printouts, letters, and by allowing users to come and consult registers. Networking with other genebanks to exchange data on a regional or crop basis is actively done. Experience has shown that this activity is worthwhile.

Documentation of *in situ* collections is not adequate. The major problems identified with *in situ* collections are deforestation and over-exploitation for basic subsistence needs of the local population. Legislation and control measures should be put in place, and such efforts would be cost effective.

There are some technical problems in documenting samples of wild relatives, e.g. determining whether plants are hybrid or wild, tracing parental status, as well as the general lack of taxonomic expertise.

Some documentation records have been duplicated in different buildings, and updating of the duplicated documentation records is done occasionally.

3.5 EVALUATION AND CHARACTERIZATION

The national programme makes clear distinction between the processes of characterization and evaluation of germplasm samples. these two processes are carried out by curators of the collections. Mostly IBPGR/IPGRI descriptors, whenever they are available, are followed with modification. Farmers are not involved in the evaluation of the collections.

About two-thirds of the national collection has been characterized using international descriptors. Some have been evaluated in the place of storage. About one-half of the collection has been evaluated at the locality of the genebank. The evaluation includes biochemical data, physiological responses, reaction to diseases and pests, and nutritional quality.

Some of the characterization and evaluation data have been provided to the users of the samples. the data resulting from the evaluations carried out by users of the samples are not returned to the genebank. No provision of such data is made to the users of the germplasm. To foster good relationship and cooperation, evaluation data are provided to other genebanks from where materials were obtained.

It is cost-effective, at least at the technical level, to conduct systematic evaluation of the material in the world's genebanks. One purpose of evaluation is to weed out duplicate materials and those with undesirable characters. The expenditures incurred in maintaining these two types of materials cannot be justified, since only some genebanks support the maintenance of germplasm and only to a limited extent. It is expected that international collaboration can achieve a better result, and FAO should take a leading role in fostering such collaboration. The regional approach, rather than the global, is the preferred approach. The crop-based approach should be conducted on a case-to-case basis, for example in the evaluation and characterization of materials held *in situ*.

3.6 REGENERATION

Usually, regeneration is carried out on the accessions when they approach the end of their viability. The genebanks in the country have facilities for regeneration of most types of materials they hold, and would prefer not to keep materials that they could not regenerate under our conditions. We are not completely satisfied that the regeneration procedures currently used maintain the genetic character of the original samples. Contamination is difficult to prevent, and the selective elimination of important variation is a problem.

Regeneration is usually carried out or supervised by curator or qualified plant breeders. There are not enough land, facilities, labour, and budget to insure that all necessary precautions are taken to maintain the genetic integrity of the materials. The size of the sample used for regeneration in some crops is sufficient to avoid genetic drift. We have not been faced with the difficult

choice between regenerating material less often and using smaller samples. Only one generation of the same accession is maintained in the genebank. Fresh and old materials of the same accession are normally not combined.

CHAPTER 4
In-Country Uses of Plant Genetic Resources

A lot of the genetic resources from the collections were frequently used as materials for research and breeding projects during the past three years. For example, in field crops such as maize, sorghum, soybean, groundnut, castor bean, cotton, tapioca, sugarcane, mungbean, jute and sesame, about one-half of the accessions were used.

There are approximately 40 scientists, excluding those from the private sector, using the genetic resources. About two-thirds of plant genetic resources samples used in commercially related activities within the country come from national collections. The major external sources are FAO and research centers. From 20 to 30 species maintained in the genebanks have not been used fro in country projects. There is no reason to expect that they would be used in the future; their maintenance in the genebanks is for the purpose of saving them from danger. Farmers have access to genetic resources through government institutes and private companies, depending on what crops are maintained by which agencies.

4.1. CROP IMPROVEMENT PROGRAMMES AND SEED DISTRIBUTION

The coordinated subcommittee on plant genetic resources is one of the 23 subcommittees under the responsibility of the Committee on Agriculture and Biology of the National Research Council. The function of the subcommittee on plant genetic resources is to act as coordinator for genetic resources activities of the institutes concerned. Research and breeding activities fall under the aegis of the Department of Agriculture, and the objectives of the activities are to improve local varieties, adapt imported germplasm to local needs, and to introduce specific traits to recommended varieties. The ultimate objectives of plant breeding programmes in the country are as follows: to increase production, to widen the genetic base of crops and reduce crop vulnerability, and to diversify production systems. The breeding programmes are all focused primarily on meeting food needs, self-sustainability for the rural poor, and increasing export opportunities.

The amount and quality of scientific plant breeding currently being undertaken in the country are to some extent adequate to meet national needs and goals. A few constraints exist, such as market price, oversupply etc. Plant breeding activities are conducted primarily by government-funded programmes. Private and foreign companies conduct activities using their own fund and labour.

The products on in-country crop improvement are made available to farmers easily and conveniently. The varieties produced by national plant breeding activities are valuable to subsistence, semi-commercial and commercial farmers. Farmers are involved, to some extent, in plant breeding activities and variety evaluation. Improved varieties are available to most farmers. There are no constraints to seed production and distribution, except perhaps those due to inadequate and uncoordinated transportation of planting materials.

4.2 USE OF FOREST GENETIC RESOURCES

There are national programmes for better forest seed production such as seed production gardens of teak, teak seed improvement, seed production of fast-growing trees, and seed improvement of economic tree species.

4.3 BENEFITS DERIVED FROM THE USE OF PLANT GENETIC RESOURCES

The country's breeding programmes for yield and quality improvement derive direct benefits from its indigenous plant genetic resources. In rice, for example, if farmers grow only approved varieties throughout the country, they could obtain higher income totalling to 4,803 million Baht per year. There are some indirect benefits derived from collaboration and from introduced material from foreign institutions, such as acquiring know-how for joint venture research, and shortening the time required in the development of new improved varieties. There are no benefits derived from the use of non-indigenous material held in the genebanks.

4.4 IMPROVING PLANT GENETIC RESOURCES UTILIZATION

The following can be considered the main achievements of plant genetic resources activities: improving commercial plant production, and generating technology or products of technology in improving plant production. However, we are not satisfied with the relationship between genetic resources conservation and crop improvement and utilization systems. Constraints which retard adequate utilization of plant genetic resources are technical and/or funding support on part of crop improvement researches.

The indigenous materials are regarded as the most valuable component of plant genetic resources, and they are potentially even more valuable in the long term. Efficient and proper management could be done to make them more profitable in the short term.

Assistance for both *in situ* and *ex situ* conservation facilities, germplasm characterization and evaluation, documentation, and training to upgrade technical expertise are needed to improve plant genetic resources utilization, preferably from developed countries in the form of grant or aid.

CHAPTER 5
National Goals, Policies, Programmes and Legislation

5.1 NATIONAL PROGRAMME

Plant genetic resources activities are organized into a national programme. It is an integrated and government-funded programme, sponsored by some ministries and research institutions. The national programme covers conservation and use of plant genetic resources. Commercial firms and non-government organizations are involved to some extent, e.g. by giving their views and ideas and by advising the government.

The goals and objectives of the government in maintaining genetic resources are to manage and utilize the material effectively. These are integrated with national plans for sustainable development thorough the Sub-committee for Coordination of Research and Development on Plant Genetic Resources. To implement the Convention on Biological Diversity regarding plant genetic resources is to follow the agreement which is not contrary to law and legislation of the country.

The national committee oversees the direction of activities and policies. The activities and policies would be coordinated through the coordinated subcommittee on plant genetic resources.

There are no rules and regulations exactly for appointment of the chairman or the head of the programme. Normally, the appropriate officer equivalent to Director or Deputy Director General from government institutes would be appointed by the Secretary General of the National Research Council. The abolition of the position could be decided by the Secretary General of the National Research Council.

The head of the institute recommends the annual programme and budget for plant genetic resources to the Budget Bureau. The programme does not have its own budget line. The government is not formally committed to providing a secure level of funding from year to year.

Our plant genetic resources collections are protected by legislation or by a national decree. We see a need to some extent to change the legal status of the collections or of the genetic resources programmes to increase their security.

The national programme and other plant genetic resources activities are important to national food security. Since the national coordinated subcommittee on plant genetic resources is composed of 20 members from 19 institutes concerned, it is a centre for coordination in terms of information, research and study, and development and utilization of plant genetic resources. It assists to solve problems and identify future needs.

5.2 TRAINING

The national programme is not adequately staffed with trained personnel. Limited budget, no recruitment and low opportunity are the main constraints to obtaining good, well-trained staff. Staff at B.Sc. and postgraduate levels are urgently needed.

There are staff trained in the fields of statistical sampling, seed science, agronomic evaluation, taxonomy, plant breeding and data management. There is expertise to conduct training in data collection, character scoring, data management, agronomic evaluation, plant breeding and seed science. There are no institutions in the country offering relevant courses in plant genetic resources. International input would be needed to get such courses started. There would be enough demand in the next five years to make in-country courses viable. The country could offer regional courses in some aspects of plant genetic resources at B.Sc. level. Training programmes in plant genetic resources that are available in the country meet some of the ranges of national needs. On a theoretical basis, the trained personnel could gain knowledge and understanding but in some cases on a practical basis, he or she could not gain much more direct experience relevant to the national needs, for example proper management of facilities and equipment care.

The broader agricultural community has the opportunity to learn something about genetic resources. National Policy-makers understand why the country has a plant genetic resources programme. Normally, men and women are equally involved in training programmes at all levels. Most of the country's ethnic groups are involved, specifically in the traditional system. Training policies give advantage to some of these groups but only to a small extent.

Staff turn over is not too rapid to allow the genetic resources programme to benefit fully from the investment in staff training.

5.3 NATIONAL REGISTRATION

There are two laws concerning with plant and plant parts. Plant Quarantine Law deals with import and export of plant, plant part and other material with regard to diseases, insect, and other plant pests. Seed Law or Plant Varieties Law deals with plant varieties, seeds and planting materials and also conserved plant species to comply with CITES. Under Plant Varieties Law, seed quality is set at minimum standard but seed certification is still voluntarily. Plant Variety Registration and Plant Variety Certification are also voluntarily. Seed company can sell seed or planting materials to farmer any plant varieties if it comply with minimum seed quality standard.

The government provides incentives to farmers for the conservation of traditional varieties, through public relations to raise the awareness regarding the loss of valuable genetic resources, and by assisting in the management of on-farm conservation.

The country abides by the regulations of CITES, and has also imposed regulations as embodied in the Seed Act and the Plant Quarantine Act. In general, there is no problem of availability of pant varieties to farmers.

Intellectual property rights (IPR) legislation regarding Plant Variety Protection is now under revision to put it in line with current world situation, it does not affect the genetic resources programme directly except for commercial benefit for parental lines of new protected varieties. The effects of IPR legislation on the genetic resources programme of the country are not well understood and new implications are still coming to light.

Exchange of plant genetic resources for crop improvement is open to negotiation. Government is now preparing the country regulation on the accesses to biological diversity to comply with the convention on Biological Diversity.

5.4 OTHER POLICIES

There are incentives for production and marketing of improved varieties as certified seed. Market price guarantee, supply of water and chemicals are credits and subsidies for the provision of agricultural inputs and outputs.

These do not influence farmers' choices of planting materials, and no impact on the conservation and utilization of plant genetic resources.

National plant genetic resources programme staff or other PGR experts are not involved directly in the planning of major agricultural development projects. The projects are appraised or monitored for their impact on the conservation and utilization of plant genetic resources by senior agricultural scientists and economists as well as policy makers.

CHAPTER 6
International Collaboration

UNCED

Thailand was among the countries that adopted Agenda 21. Regarding the implementation of Chapters 14G and 15, the country has adopted, since 1991, the concept of sustainable agriculture for food development.

FAO global system

Thailand is a member of the FAO Commission on Plant Genetic Resources. The country joined the commission with the wish to communicate and interact with the world on socio-economic and commercial affairs, particularly on cooperation and assistance in plant genetic resources activities.

CGIAR

The CGIAR centres have made contribution to the national genetic resources programmes by providing both technical assistance and plant varieties for cropping programmes. Support comes both from centre-based staff and those in the region. National Staff have received training from CGIAR centres, most often through in-service training, sometimes from attendance at training courses. It is impossible, and the reasons are understood and appreciated, for the centres to provide all the assistance that we seek. Experts and direct contracts are the major mechanisms for communication between the national programme and the CGIAR centres. They are suitable to a certain extent to ensure good collaboration and prevent duplication of functions. CGIAR scientists stationed or working in the country make contribution to the national programme.

IPGRI should be the coordinator and supporter of plant genetic resources programmes through satellite offices.

Regional research centres

Our country has relationship with the Asian Vegetable Research and Development Centre (AVRDC). Our views on the role of CGIAR centres also apply to regional centres. The association of our government with regional centres is important in determining collaboration at technical and scientific levels. The centres are important to the success of the relationship.

Regional intergovernmental initiatives

These initiatives foster cooperation in PGR activities and strengthen PGR programmes in the region. There is potential for a regionally integrated plant genetic resources programme through the Regional Cooperation in Southeast Asia on Plant Genetic Resources (RECSEA-PGR). Good examples are the RECSEA-PGR and IPGRI initiatives on regional documentation and on-farm conservation of plant genetic resources.

Bilateral intergovernmental initiatives

Thailand has several bilateral agreements on plant genetic resources with other countries. The agreements set up a collaborative relationship among countries in the region. There are also some agreements with private companies. The agreements on plant genetic resources are as follows:

Organizations	Programmes
ACIAR	Pigeon pea
AVRDC	Vegetables
CGPRT	Coarse grains, pulses, root and tuber crops
CIAT	Cassava, field bean
CIMMYT	Maize, wheat
CIP	Potato
ICRISAT	Groundnut, sorghum, pigeon pea
IITA	Legumes
INTSOY	Soybean
IPGRI	Plant genetic resources
IRRI	Rice
JICA	Soybean
PCRST	Groundnut
R.F.	Rice, maize, wheat, sorghum
US/OFA/ECA	Rice, Soil
USOM/STEM	Rice, field crops

CHAPTER 7
National Needs and Opportunities

The needs for plant genetic resources activities is as the following:

1. **Research aspects:**
   - **a.** Make inventory of important species and intraspecific variation.
   - **b.** Study and conserve endangered and threatened species.
   - **c.** Determine strategies for access to genetic resources.
   - **d.** Use of indigenous knowledge for plant genetic resources.

   The fact is that the loss of indigenous knowledge about traditional stocks as older farmers die and younger ones lack knowledge of useful species.

2. **Networking:**
   - **a.** Network the system of *in situ* and *ex situ* conservation.
   - **b.** Duplicate the material to conserve elsewhere
   - **c.** Exchange of information among institutions.

3. **Documentation:**
   - **a.** Information on PGR should be stored in computerized system and should be linked together.
   - **b.** Previous data and information on PGR should be made available e.g. by computerized manner.
   - **c.** Exchange of information at regional level perhaps in RECSEA.

4. **Training aspects:**
   - **a.** At B.Sc. level
   - **b.** At post-graduate level
   - **c.** At technical level

CHAPTER 8
Proposals for a Global Plan of Action

For a global plan of action, we would like to propose as follows:

- Identify and designate *ex situ* conservation sites to optimize expenditures. And identify and assess a global safety collection control e.g. perma frost area like svalborg.
- Set up an international task force to study infra-species, species and eco-system diversity e.g. determining the extent, making an inventory.
- Study and set up on-farm conservation i.e. by taking into account cultural differences, determining scientific factors: genetic, sociological, economic etc.
- Develop and/or strengthen national, regional and global networks: crop network, information exchange etc.
- Develop a system of germplasm exchange e.g. through national sovereignty, intellectual property rights, and including farmer's rights and coordination through an international body.