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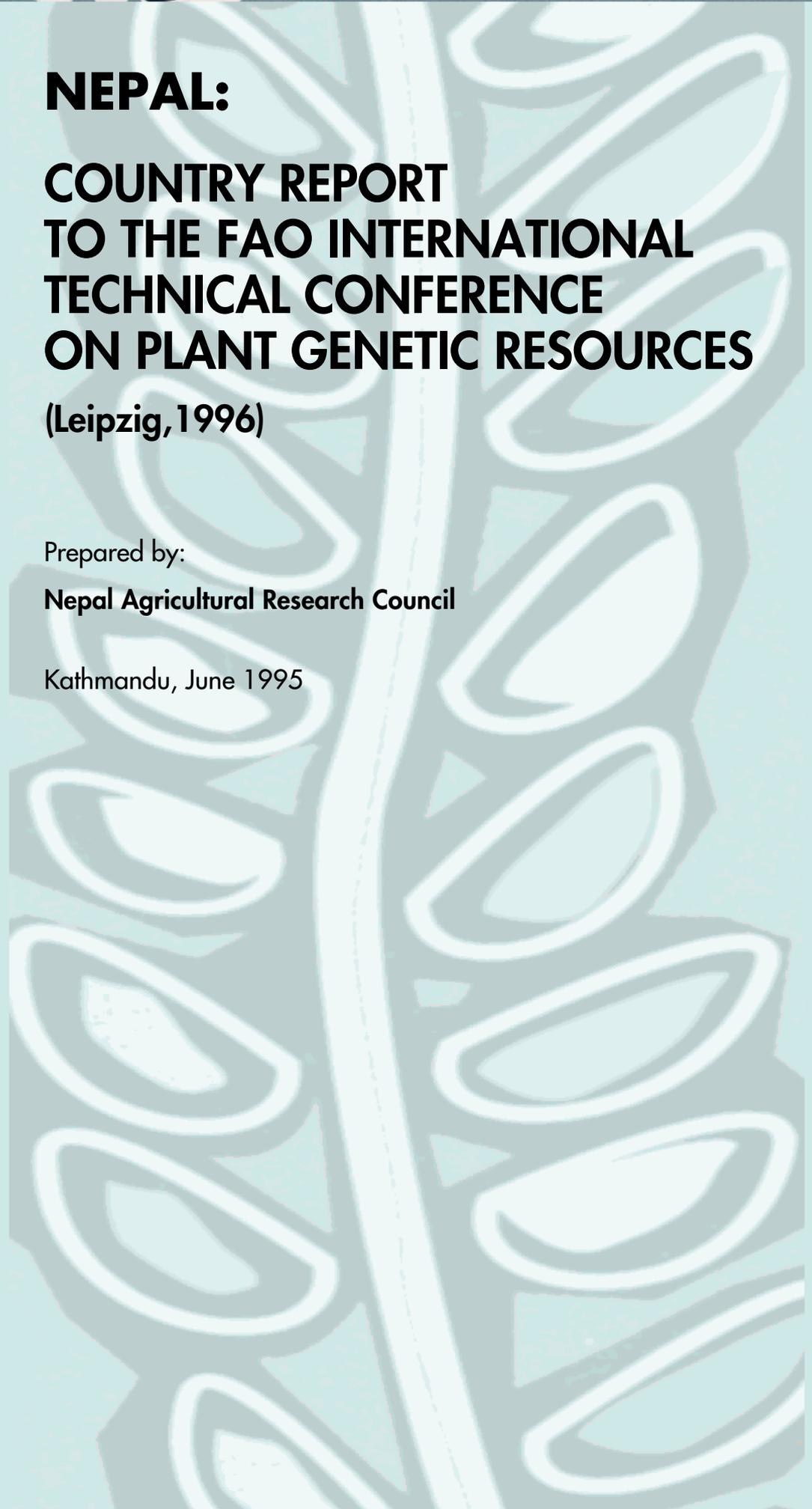
**COUNTRY REPORT
TO THE FAO INTERNATIONAL
TECHNICAL CONFERENCE
ON PLANT GENETIC RESOURCES**

(Leipzig, 1996)

Prepared by:

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Note by FAO

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CHAPTER 1

Introduction to Nepal and its Agricultural Sector

1.1 INTRODUCTION

Nepal is located between the People's Republic of China to the north and the Republic of India to the south, east and west; and lies on the Mid-Himalayan mountain section of Asia. It extends from 26°22' N to 30° 27' N latitudes and 80°4' E to 88°12' E longitudes. The kingdom is a small landlocked country situated at a distance of about 500 km. from the nearest sea. On an average, it extends 885 Km. from east to west direction and non-uniform mean width of 193 km. from north to south with total land area of 147,181 square kilometers.

The population was 9.4 million in 1961 which increased at the rate of 2.2 percent per annum and reached 18.46 million in 1991. It is estimated that population will increase to 33 million in next 20 years. Per capita income in the country was 170 US\$ in 1990.

1.1.1 Land use

Out of the total area of Nepal, about 42.5 percent is covered by forest, 26.6 percent is agricultural land, 11.8 percent pastures and the rest 19.1 percent is occupied by snow, lake, urban, roads, etc. The land use type is presented in Table 1. The land holding per household is 0.95 ha in 1991.

Table 1 Land use type

Type	Land (ha.)	Percentage
Forest	6,306,460	42.5
a. Forest land	5,618,052	37.8
b. Shrubs	688,408	4.7
Agriculture	3,954,915	26.6
a. Cultivated	2,968,017	20.0
b. Uncultivated	986,898	6.6
Pastures	1,757,345	11.8
Others (Snow, lake, urban area etc.)	2,836,322	19.1
Total	14,855,042	100.0

Source: The 8th Five year Plan, NPC, 1992.



1.1.2 Topography and physiography of Nepal

Traditionally, Nepal is broadly divided into the following three geographical belts (Figure 1):

- a. **Mountain:** It accounts for about 28 per cent of the total area and only a small proportion of the population. The agriculture is livestock based with little cropping. Conditions are extreme and food deficits are common.
- b. **Hill:** It accounts for about 55 percent of the total land area and around 38 percent of the agricultural land. The area is characterized by high ridges and steep slopes around numerous streams giving rise to many microclimates. The Hills account for about 50 percent of the population.
- c. **Terai:** It accounts for about 17 percent of the land area of the country, about 45 percent of the total population, over 55 percent of cropped area and around 60 percent of crop production. It is known as the granary of Nepal. Over 33 percent of the arable land is irrigated.

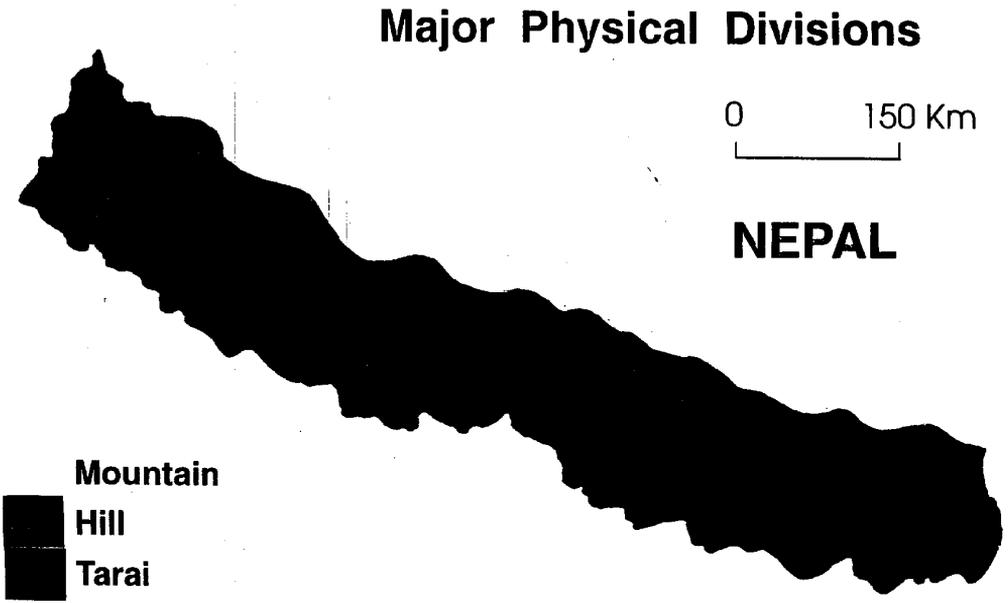
1.1.3 Climate

The climate in Nepal varies from sub-tropical to alpine within a short distance due to tremendous variation in topography and altitude (60 to 8,848 m). These factors along with direction of mountain slope have created numerous micro-environments. Alpine, cool temperate, warm temperate, sub-tropical and tropical climates prevail in Nepal.

The snow line lies on around 2,500 m in winter and 4,000 m in summer. Snow rarely falls below 1,500 m altitude. On shaded north, snow remains considerably longer than on south facing slopes. The average annual rainfall is estimated as 1,600 mm, about 80% of which falls between June to September. The mean annual precipitation ranges from nearly 200 mm in rain shadow area near the Tibetan plateau to 4,600 mm along the southern slopes of Annapurna mountain range. Most of the winter rainfall occurs during December to February. Total number of rainy days varies from 24 to 181 days. Annual sunshine hours vary between 922 to 2,820 hours. The recorded maximum temperature during the summer varies from 25°C to 46°C and the recorded minimum temperature during the winter varies from - 26°C to nearly freezing point in the crop growing areas. Winter, spring, summer and autumn seasons, each of three months prevail in the country.



Figure 1. Major Physical Divisions of Nepal





1.1.4 Soils

The Terai soils are characterized by 20 to 30 cm thick, friable, generally dark brown top soil over a light yellow or brown loamy subsoil. Soils are mostly acidic, well drained, clay loams or silty loam in texture. Sandy soils occur in the lower part of Siwalik range, which vary in degree of porosity and poor slope stability. Soils of the upper part of this range have developed on either sedimentary or metamorphic rocks. In steep and very steep dissected areas, the soils are usually eroded and stony. Soils of the river valleys have developed on a series of alluvial deposits and lacustrine sediments. Soils of Hills have developed primarily on igneous and metamorphic rocks. The soils are shallow, stony and rocky. The glacial soil group is found in the Himalayan region. The nutrient content of these soils is generally poor. The soils of east Nepal is acidic in nature and it goes on decreasing to western Nepal with some specific exceptions.

1.2 NEPALESE AGRICULTURE

Farming is mainly of subsistence type and yield per unit of land is very low. Owing to limited irrigation facilities, Nepalese agriculture is excessively dependent on the mercy of monsoon. Agricultural crops grown in Nepal are popularly divided into two groups - food crops and cash crops. About 82% of the total land is allotted to food crops. The important food crops of Nepal are paddy, maize, wheat, millets, and barley. Among them, the most important is paddy which occupies 55% of the total land devoted to food crops. About 80% of paddy is produced in the Terai region. Maize, millet and potato are basically hill crops. On the other hand, leading Cash crops which occupy 18% of the total arable land include sugarcane, jute, tobacco, tea, cotton, cardamom, fruits, etc. Most of these crops are produced in Terai. Lentil, pea, cowpea, soybean, green gram, blackgram, chickpea, etc. are the important legume crops and mustard, rapeseed, linseed, groundnut, etc. are popular oilseed crops. In fruits, *Citrus*, apple, walnut, mango, banana, peach, plum, pear, etc. are common. Different cole crops, cucurbits, solanaceous, legumes and leafy plants are used as vegetables. Fodder, spices and agro-forestry crops are also commonly cultivated. The area and production of different food crops are present in Table 2.



Table 2 Area and production of crops (area in hectare and production in 1,000 metric tons.)

Crop	Area*	Prod.*	Area**	Prod.**	Area***	Prod.***
Cereal Crops						
Paddy	1,455	3,502	1,412	3,223	1,262	2,585
Maize	758	1,231	754	1,205	775	1,291
Wheat	593	836	571	779	614	765
Millet	208	232	198	229	202	237
Barley	30	28	30	28	30	28
Sub-total	3,044	5,829	2,965	5,464	2,883	4,906
Cash Crops						
Oilseed	156	92	155	88	165	94
Potato	84	738	85	733	87	733
Sugarcane	32	1,106	37	1,291	38	1366
Sub-total	272	1,936	277	2,112	290	2,193
Pulses	-	-	262	155	262	155
Total	3,316	7,765	3,504	7,731	3,435	7,254

*: 1990/91;

**: 1991/92;

***: 1992/93

Source: Agricultural Statistics of Nepal, Ministry of Agriculture (1993/94).

1.2.1 Farming system

Agriculture is characterized by mixed farming system in which crops and livestock are interdependent. Depending upon the agro-ecology and their household needs and priorities, farmers grow different crops and raise different livestock complementary to each other.

In general, crop production dominates farming systems and contribute about 75% of the agricultural output. Hill farming systems are limited to river valleys and terraced slopes. Broadly, the hill comprises two land types, Khet and Bari land. Khet land refers to lowland which is bonded and can be flooded to grow rice. Khet land has better production potential than bari land. In bari land, maize based cropping pattern is popular. Finger millet is often relayed with maize. In khet land, rice-based pattern predominates. In Terai, low land and upland are two types of land. Two to three crops are grown in one year at hills and Terai while, at Mountain high hills mostly one crop is cultivated. Most of the farmers grow fruits and vegetables and keep animals as well as birds for the purpose of self-dependent and sustainable farming.



1.2.2 Contribution of agriculture to national economy

Agriculture is the most dominant economic activity of the Nepalese people. It provides employment to more than 81% of the total labor force of the country. About 12.5% of export earning come from agriculture sector and provide 23.7% raw materials to agro-based industries. The contribution of agriculture to GDP in 1984/85 was as high as 51%. However, the contribution has decreased to 42% in 1993/94.

1.2.3 Seed supply system

The AIC is the main supplier of seed in public sector. Seed or planting material of the industrial crops, cotton, sugarcane, tobacco, tea and coffee are handled by the relevant industrial organizations. NARC research stations, commodity research programmes, Agriculture Botany Division and Agronomy Division are responsible for the development of the varieties and production of breeder and foundation seeds. The area covered by improved varieties of different crops are presented in Table 3. Altogether, 248 varieties of cereals, legumes, cash crops, fruits and vegetables have been released for cultivation.

Table 3 *The area covered by improved varieties of crops*

Crop	1970-71	1980-81	1985-86	1990-91
Rice	5.7	25.2	46.0	46.0
Maize	2.6	34.4	40.0	40.0
Wheat	43.1	97.0	94.0	90.0
Citrus	3.0	3.0	4.0	5.0
Apple	100.0	100.0	100.0	100.0
Mango	60.0	70.0	75.0	80.0
Vegetables	10.0	15.0	20.0	20.0
Potato	20.0	30.0	35.0	40.0
Pasture & Forage	2.0	3.0	4.0	5.0

Source: Thapa and Koirala (1992).

The private sector in Nepal includes the seed producers, seed traders and the distributors, buying and selling seeds and the farmers who grow and multiply seed for their own use or for sale to traders or for local informal interchange. The formally traded sector accounts for less than 5 percent of an annual seed requirement. In the vegetable seed sector, nearly half of the estimated high value less volume seed requirement is probably commercially handled by formal channels with the private sector share estimated at four fifths. About



1600 tons of wheat, 200 tons of paddy, 70 tons of maize and 40 tons of vegetable seeds were handled by AIC in 1992/93.



CHAPTER 2

Indigenous Plant Genetic Resources

The country is rich in genetic diversity of flora because of extreme variation in altitude, complex topography and varied climatic conditions. It is estimated that more than 7,000 vascular plant species are present of which 370 species are endemic and 700 species are medicinal plants. Altogether, 5,500 species have been collected, identified and preserved in the National Herbarium at Godavari, Lalitpur. The total number of edible species is estimated to be more than 500 belonging to about 70 families. There are about 200 cultivated species, which belong 150 genera of 50 families.

Hindukush Himalaya is regarded as a secret heaven of potential medicinal herbs. Out of 2,000 medicines used in Indian subcontinent, more than 1,500 are of plant origin.

2.1 FOREST GENETIC RESOURCES

The country wide status of the important species is not available. However, the data on natural forest and plantation in the country will give glimpse on the forest resources.

The changes in land use, especially from forest to agriculture and degradation of forest, has affected the status of PGR in the country. Forest area declined at an annual rate of 0.4% from 1978/79 to 1984/85. In Terai, annual rate of deforestation is estimated to be 3.9%. All of the deforested lands were not converted to agriculture, some remained as degraded forests and grasslands.

The sustainable management of natural forest is still a viable option. Natural regeneration in the degraded forest could restore back the species with relatively less investment compared to the plantation. The research carried out by the Forest Research and Survey Center on various silviculture options on the degraded *Shorea robusta* forests of the Terai and Siwaliks and the *Schima/Castanopsis* forests of the middle hills could be useful in the protection and management of the degraded forests. Community forestry management program is effective in managing natural forest, plantation and reducing degradation. It helps the conservation of PGR.



A systematic survey on the evaluation of the threatened species has not been carried out. A general observation shows that some of the valuable timber species are already endangered. As for example, *Dalbergia latifolia* (Rosewood), a valuable furniture wood has already disappeared from the terai and are now found scattered along the foothills of the Siwaliks. The natural stands of *Dalbergia sissoo* is fortunately still found in Nepal. A tree improvement program has been initiated for *sissoo* and also for *latifolia* through the FORESC and Tree Improvement Project of DOF. Endangered medicinal and aromatic plants are listed in Table 4.

Table 4 Endangered medicinal and aromatic plants

Botanical Name	Family
<i>Aconitum bisma</i> (Buch.-Ham.) Rap.	Ranunculaceae
<i>Alstonia scholaris</i> (L.) R.Br.	Apocynaceae
<i>Cordyceps sinensis</i> (Berk.) Sacc.	Hypocreaceae
<i>Dactylorhiza hatagirea</i> (D.Don) Soo	Orchidaceae
<i>Picrorhiza scrophulariflora</i> Pennel	Scrophulariaceae
<i>Podophylum hexandrum</i> Royle	Berberidaceae
<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz.	Apocynaceae

Source: KMTNC. Endangered plants of Nepal.

2.2 WILD RELATIVES OF CROP PLANTS

Crop improvement activities rely on genetic diversity available in the crop species. Landraces and wild relatives contains the genetic diversity. Wild relatives of various crop plants are still available (Table 5). These crop species are at the verge of extinction because of the population pressure, deforestation and overgrazing.

The temperate fruits available in the forest are *Malus* spp., *Pyrus* spp., *Prunus* spp., *Vitis*, *Walnut*, *Rubus*, and *Persimmon*. These species are commonly used for rootstock purpose. Wild *citrus* growing in forest are citron, rough lemon, narayani, karnakhatta, pummelo and sour orange. Tropical horticultural crops which are still in wild stage are baer (*Zizyphus zuzube*), custard apple, badher (*Ficus* spp.), mango, *Phyllanthus*, jiju tamarind and others. Wild fruits used for human consumption, are *Morus* spp, barberry, chestnut, sapota, olive, fig, black currant, raspberry, cherry and lapsi (*Choriaspondias axillaris*).



There are variety of yam, ferns, amaranths, bamboo and other leafy vegetables still in wild condition. Aromatic leaves of cinnamon are collected and exported to India for flavour purposes. It has not been domesticated so far.

2.3 LANDRACES (FARMERS' VARIETIES) AND OLD CULTIVARS

Landraces are still popular because of their special attributes and suitability to farming system.

Table 5 Wild species of cultivated food crops

Botanical name	Common name/ English name
<i>Oryza nivara</i> Sharma et shastry	Wild rice
<i>O. rufipogon</i> Griff	Wild rice
<i>O. officinalis</i> Wall ex. Watt.	Wild rice
<i>O. granulata</i> Nees et Arn. ex. Watt.	Wild rice
<i>O. sativa f. spontanea</i> Roschev.	Wild rice (Weedy Rice)
<i>Eleusine indica</i> (L) Gaertn.	Crab grass/Wild finger millet
<i>Fagopyrum dibotrys</i> (D. Don) Hara	Wild buckwheat
<i>F. cymosum</i> (Trev.) Heisn.	Wild buckwheat
<i>F. megacarpum</i> Hara	Wild buckwheat
<i>Atylosia cazanifolia</i>	Wild arhar
<i>Rumex nepalensis</i> Spreng.	Wild spinach
<i>R. hastatus</i> D. Don.	Wild spinach
<i>R. acotosa</i> L.	Wild spinach
<i>Abelmoschus moschatus</i> Moench.	Wild okra
<i>Colocassia antiquorum</i> Schott.	Wild colocassia
<i>Amaranthus viridis</i> L.	Pigweed (Without thorn)
<i>A. spinosus</i> L.	Pigweed (With thorny)
<i>A. blitum</i> L.	Pigweed
<i>Fumaria vaillanti</i> Loisel. (F. paviflora Lam.)	Wild carrot
<i>Allium wallichii</i> Kunth.	Wild garlic
<i>A. hypsistum</i> Stearm.	Wild garlic
<i>Pyrus pashia</i> Buch. Ham. ex. D. Don	Wild pear
<i>Prunus nepalensis</i> (Ser.) Stud.	Wild cherry
<i>P. cornuta</i> (Wall. ex. Royle) Stud.	Wild apricot
<i>Malus baccata</i> (L.) Borkh. var. himalaica (Maxim.) Schneider (Pyrus baccata L. Senu FBI)	Wild apple



Botanical name	Common name/ English name
<i>Musa nepalensis</i>	Wild banana
<i>Vitis lanata</i> Roxb.	Wild grape
<i>Mangifera sylvatica</i>	Wild mango
<i>Duchesnia indica</i> (Andr.) Focke (<i>Fragaria indica</i> Andr.)	Wild strawberry
<i>Saccharum beghalensis</i> Retz. (<i>S. arundinaceum</i> Hook. f.)	Wild sugarcane
<i>S. longisetosum</i> (Andress.) Narayanswami ex. Bor.	Wild sugarcane
<i>S. spontaneum</i> L.	Wild sugarcane
<i>S. munja</i> L.	Wild sugarcane
<i>Nicotiana glauca</i>	Wild tobacco
<i>N. plumbaginifolia</i> Viviani	Wild tobacco

Farmers grow many traditional rice varieties like 'Kalanamak' (good taste and fine grain), 'Jumli Marshi' (cold tolerant), 'Gamadhi' (religious value) and Ghaiya (upland variety). Old cultivars of rice (CH-45 and Taichung 176); wheat (Lerma 52, Lerma rojo 64 and Pitic 62) and Maize (Khumal yellow) are still maintained by farmers.

Pharping pear is popular among farmers in Kathmandu valley. It is high yielding with large fruit size and long storage life. Dhankuta mandarins have excellent taste, size, and long storage life. Local limes of Tehrathum are large in size and rich in juice content. It can be cultivated up to the elevation of about 1,500 masl. Local banana varieties, 'Malbhog' and 'Siukera', have higher market price. The 'Malbhog' variety has good flavor and sweet taste. Both the varieties are grown under rainfed condition.

In vegetables, the traditional varieties of Broad leaf mustard is grown in mid/high hills. It is a leafy vegetable common in Nepal. Pyuthane radish has red skin color and sweet taste. The root portion is large. Cherry tomatoes grown in mid hills are suitable for pickles. They are acidic in nature and tolerant to high rainfall.

Potato, the staple crop of high hills is cultivated in different climate and seasons. 'Bhotange yellow', 'Shyaufade', 'Khumulade', 'Kathmandu local', 'Thakali red', 'Jumle red', 'Khadapeli' and 'Jhure' are landraces of potato.

Popular Aromatic spices are cardamom, ginger, and garlic. Turmeric is grown for the use of yellow powder in vegetable. Large cardamom is indigenous, which is popular in eastern Nepal. Similarly, ginger is one of the cash crop grown in mid hills. Chilies varieties 'Jire' and 'Akbare' are grown in the kitchen garden. They are highly pungent in nature.



Traditional agro-horticultural crops have great significance in income generation and creating production employment. Mandarin growers of Khoku village of Dhankuta are dependent on this crop. Farmers do cultivate maize as an intercrop, but the main source of income is from the sale of the mandarin fruits. They purchase the staple crops by the earnings of the fruit. In Ilam, farmers grow cardamom in their land where other food crops can not be grown.



CHAPTER 3

National Conservation Activities

Conservation of PGR had been initiated by Saints, rulers and hunters. Saints were primarily interested in conservation of forest from religious point of view whereas rulers and hunters aimed at hunting of wild lives for their entertainment.

Introduction and selection of crop species have been carried out since ancient times. The popular crops like maize, wheat , potato, tobacco, coffee etc. were introduced and now are well adapted. Fruits, vegetables and flowers were introduced by Rana families and maintained in their private gardens.

3.1 *IN SITU* CONSERVATION ACTIVITIES

Establishment and management of national parks and wildlife reserves in different physiographical regions are helping *in situ* conservation of all major forest types. Religious forests have been protected by people. The management of natural *Shorea robusta* forest in the Terai and Siwalik zones helps regeneration and conservation. Similarly, the management of pine, other conifers and hardwood forest of the mountains contributes in the PGR conservation. The countrywide inventory of the forests are carried out at every 10 to 15 years interval. This could be used to monitor changes in major forest types.

In situ conservation is a new concept in agro-horticultural crop species. Efforts have been made for conservation of landraces and wild relatives of crop species by government agencies. Landraces have been maintained by farmers over time and space. However, *in situ* conservation has not been prioritized.

3.2 *EX SITU* COLLECTIONS

Collections of indigenous germplasm are regular activities of DOAB. Collected germplasm specially orthodox seeds are stored in a genetic seed house. The composition of National collections are mainly landraces. The



main users of these materials are the breeders and researchers. There is no national gene bank in the country. Altogether 8,383 accessions of about 64 crop species have been preserved (Table 6).

Table 6 Status of germplasm preservation

Crop category	Accession number
Cereals	4,959
Grain Legumes	2,686
Oilseeds	427
Vegetables	299
Industrial Crops	7
Others	12
Total	8,383

In vitro conservation of vegetatively propagated crops like potato, citrus, banana is being done in tissue culture laboratory of NARC and NHPL laboratories.

The introduced and indigenous fruit crops are being preserved in different horticultural farms/stations of DOAD/NARC (Appendix 1). Tropical fruits specially mango, litchi and guava have been maintained at Sarlahi Horticultural Farm. Temperate apple, peach, pear and plum have been conserved at Horticulture Station, Kirtipur and Mustang. *Citrus* species have been conserved at Horticultural Research Station, Dhankuta.

The degraded forests which could not be regenerated naturally have been brought in to plantation program; the example is plantation of *Delbergia sissoo*, along with exotic tree species in the Terai and the *Pinus roxburghii*, *Alnus nepalensis* and many other hardwoods in the Hills.

Plant explorers from abroad have collected PGR since 1938. The collected landraces have been preserved at international gene bank (Table 7).

Table 7 Nepalese germplasm preserved at international gene banks

Nepalese germplasm conserved	No. of species	No. of accessions
NBPGR, New Delhi	2	101
Chiba University and NIAR, Japan	74	2,052
CIMMYT, Mexico	2	175
IRRI, Philippines	1	1,488
AVRDC, Taiwan	13	498
NIAR, Japan	54	6,889
USDA, USA	66	1,809



3.3 STORAGE FACILITY

At present a prefabricated cabin with space of approximately 20 sq. m. with 5°C and 45% RH is available for preserving orthodox seeds. Generally, plastic containers and paper envelopes are used for seed storage. One stand by generator is available. Physical facilities for processing, cleaning, drying, sealing, packing etc. are not available. So, it is difficult to keep the seeds in a viable condition for a longer period.

In the genetic seed house base collections can not be maintained due to lack of facilities. The collected samples are sun dried and usually takes two months to process the samples prior to storage in the seed house.

Realizing the richness of genetic diversity in Nepal and its importance in agriculture, a full phase national gene bank is essential. Nepal would negotiate to store its genetic resources with other institutes based on mutually agreed terms. Botanical gardens, arborators and conservatories are maintained for medicinal and horticultural plants. These programs have to be further strengthened.

3.4 DOCUMENTATION

All the information regarding collection, characterization, evaluation have been documented manually in registers. Information is not published in a catalogue or cards, but disseminated through annual reports, technical papers and visit of users to the facilities. Computer data base management has been started recently.

3.5 EVALUATION AND CHARACTERIZATION

Evaluation and characterization of food crop species (Table 8) have been done by the commodity programs and PGRU staff using IBPGR/IPGRI descriptors. The evaluation and characterization data of barley, buckwheat, finger millets, amaranths and grain legumes have been published.



Table 8 Evaluation and characterization of germplasm

Crop	Accession no.	Remarks
Rice	680	
Soybean	216	
Lentil	146	
Broadbean	35	
Colocassia	48	Not preserved
Barley	322	
Buckwheat	184	
Finger millet	713	

Screening of rice germplasm against *Pyricularia oryzae* is being done at Khumaltar. Physical facilities are not available for the systematic evaluation of the germplasm for biochemical and genetic finger printing. Such studies could be undertaken in collaboration with international institutes. However, the facilities should be developed in the country itself. National program should play a leading role in collaborating with international institutes for characterization and evaluation at molecular level.

3.6 REGENERATION

Self pollinated crops have been regenerated on regular basis. Monitoring for viability have been started from 1994/95. Adequate facility like green house, net house etc. are not available to undertake satisfactory regeneration of cross pollinated crops.

3.7 FOREST GENETIC RESOURCES

Nepal has established a network of protected areas extending over a million hectares. Forest genetic resources have been conserved in National parks and wild life Reserves and gene conservatories established in different part of the country. DPR is involved in R and D activities of genetic resources:

Ex situ conservation of Forest genetic resources have been done in RBG, NPWR and 6 other conservatories. A total of 2,500 accessions are being conserved in the form of living plants and seeds in RBG. The exchange of



CHAPTER 4

In-Country Uses of Plant Genetic Resources

Nature and extent of genetic diversity in gene pool determine the success of crop improvement. PGR provides basic raw materials to plant breeders and these resources are valuable only if they are utilized for the betterment of mankind. In Nepal, plant breeders have successfully selected superior landraces and blended the landraces in crop breeding schemes as well.

4.1 USE OF PGR COLLECTION

PGRS supplies national collections to commodity research programmes for utilization in crop improvement activities. Number of accessions made available to research programmes have been mentioned in Table 10.

Table 10 Supply of Germplasm to Commodity Programmes

Crops	No. of acc. supplied	Remarks
Sesame	41	NORP, Nawalpur
Niger	24	..
Linseed	12	..
Mustard	129	..
Broad leaf Mustard	19	..
Sarson	24	..
Buckwheat	58	HCRP, Kabre
Amaranths	49	..
Fox tail millet	11	..
Rice	235	RARC, Parwanipur
Blackgram	70	GLRP, Rampur

The exchange of seeds among farmers is the most common practice for the dissemination of varieties. The concept of community seed banks has not been realized yet.

Utilization of PGR in present day crop improvement programs would increase the crop production and productivity. Efforts in crop improvement activities have generated a series of high yielding varieties adapted to existing



cropping system (Table 11). Inadequate number of plant breeders is the major constraint in PGR utilization.

Table 11 Utilization of landraces

Crop	Variety/ Strain	Parents	Main character	Year rel.
Rice	Khumal-2	Jarneli /Kn-16-361- BLK-2-8		1987
	Khumal-4	IR 28/ Pokhrel Masino		1987
	Palung-2	BG94-2/ Pokhrel Masino		1987
	Chumrong Khumal-5	Local selection Pokhrel Masino /Kn- 1B-361-BLR-2-6		1991 1990
Maize	Hetauda composite	Exotic X Local		1973
	Ganesh-2	Exotic X Local		1989
	Manakamna-1	Exotic X Local		1987
	Rampur-2	Exotic X Local		1989
Barley	Solu uwa	NB 1054	Blast resistant	1990
Fingermillet	Okhale-1	Local cultivar from Okhaldhunga	Blast resistant	1980
	Kabre Kodo-1	NE 6401-26		1990
Chickpea	Trishul	Local cultivars from Nepal		1979
	Dhanush	-do-		1979
Lentil	Sindur	Local selection (LO-111-25)		1979
Pigeonpea	Bageswori			1991
	Rampur rahar			1991
Cauli- flower	Kathmandu Local			1994
Radish	Pyuthane rato			1994
Asparagus bean	Khumal Tane			1994
	Sarlahi Tane			1994
Eggplant	Sarlahi green			1994
Cucumber	Kusle	Local selection		1994
Sponge gourd	Kantipure			1994



Crop	Variety/ Strain	Parents	Main character	Year rel.
Broad leaf mustard	Khupal broad leaf			1989
	Marpha broad leaf			1994
	Khupal rato pat			1994

Note: Bold entries are local landraces.

4.2 CROP IMPROVEMENT PROGRAMMES AND SEED DISTRIBUTION

Agriculture research in Nepal started in early 1950's. Varietal improvement then was based on collection of local germplasm and their evaluation for agronomic performance.

Since, the inception of National crop improvement programmes emphasis has been given for utilization of landraces and introduction, testing and recombination of exotic germplasm for increasing production and productivity to attain self sufficiency in food production and generate income and productive employment. Beside increasing production, the plant breeding activities emphasize on widening crop genetic diversity to avoid vulnerability to diseases. Different national commodity research Programmes (RRP, HCRP, MRP WRP and GLRP) have greatly contributed towards increasing production and productivity of basic food crops.

The agriculture in Nepal is monsoon dependent. The crop production in normal season is adequate to meet national needs. However, under stress conditions the production falls below the national target. Hence, plant breeding activities have to be directed towards breeding for stress environment. The number of plant breeders currently working in crop improvement is inadequate to meet national needs and goal. Additional positions for plant breeders should be created in crop research programmes and opportunities for training and post graduate studies be provided in order to strengthen the utilization and management of PGR.

All plant breeding activities are being carried out by the government support. Private companies are yet to start with such activities. AIC, supplies seeds of improved varieties to farmers through dealers, cooperatives and other agencies. Private companies are largely involved in seed distribution of vegetable crops. The role of private companies in introducing hybrid maize,



cabbage and tomato seeds is significant. The capabilities of public and private sector in seed production and distribution have to be strengthened.

The farmers are not directly involved in plant breeding and variety evaluation. However, pre-released varieties are tested in on-farm trial where farmers are involved in selecting varieties suitable to the environment. They also maintain seeds of landraces and improved varieties for their use.

4.3 USE OF FOREST GENETIC RESOURCES

Non-timber forestry plant genetic resources have been in use for many years. Medicinal and aromatic plants are used as traditional medicine. The herbal nurseries established in different locations have encouraged the farming of these crops. It has helped propagate endangered medicinal plants like *Rauwolfia serpentina* through people participation.

List of Cultivated Herbs of Commercial Value

Atropa belladonna
Valeriana wallichii
Mentha arvensis
Cymbiopogon winterianus
C. martlinii
C. flexuosus
Matricaria chammomille
Occimum basillium
Tagetas minima
Cinnamomum glaucesence
Chrysanthemum cinerifolium
Vinca rosea
Rauwofia serpentina
Crocus sativus
Mentha piperita

The tree plantation program in the Government and private lands is successful in forest management. The seeds or vegetative cuttings are collected and grown in forest nurseries. The nurseries are mainly owned by district level forest offices and projects. They provide seedlings to private enterprises and farmers. Recently, farmers or their community also maintain nursery.



In the lowlands, *Dalbergia sissoo* is prime timber species followed by *Eucalyptus*. In mountains the major tree species planted in the public land are *Pinus roxburghii*, *Pinus patula* (exotic pine), *Alnus floribunda*, *Michelia champaca* and *Juglans regia*. The tree seed centers established in three development regions of Nepal with assistance from DANIDA provide training for tree selection, seed collection, handling and storage.

4.4 BENEFITS DERIVED FROM THE USE OF PGR

The benefits are derived by farmers who grow landraces under sub optimal environment. Germplasm have been shared through joint exploration with international institutes and friendly countries. Introduced varieties have been tested and utilized in plant breeding activities. The elite varieties suitable to local environments have been released and recommended for general cultivation. The protocols for sharing benefits derived from use of germplasm based on mutually agreed terms with international institutes and friendly countries have to be developed.

4.5 IMPROVING PGR UTILIZATION

Mother nature has provided tremendous genetic diversity in agro-horticultural crops, medicinal plants and forest species. PGR have provided food, cloths and shelter to the growing population since ancient times. Medicinal plants are being exploited to meet the national needs as Ayurvedic medicines and exported to foreign countries. *Acacia catechu* is being utilized for extracting **Catechin**. Paddy and wheat straw and *Eulaliopsis binnata* are being utilized in paper industries. Orchids and cut flowers are exported.

Conservation and utilization of plant genetic resources have not received due priority in national policy. Both conservation and utilization program have been constrained by inadequate human resources, infrastructure and funding. The future of the country will depend on sustainability of agricultural productivity. In this respect plant genetic resources will provide the base for future development.

Safe environment has become essential component in sustaining life supporting system. An integrated approach with conducive common policies on PGR is essential for the purpose. Utilization of plant genetic resources can



be improved substantially when national priorities are directed towards strengthening national crop research programmes. Characterization and evaluation of germplasm at agronomic/biochemical levels are important to support crop improvement programmes. These could be achieved by developing collaborative programs with international institutes. The donor assistance is required to develop in-country capabilities.



CHAPTER 5

National Goals, Policies, Programmes and Legislation

Government policy is to attain self sufficiency in food production, income generation, create off-farm employment, and support agro-based industries. Commitments for sustainable use of natural resources to protect environment and conserve forest for the betterment of Nepalese people, are apparently visible in the policy.

5.1 NATIONAL PROGRAMME

Nepal Agricultural Research Council and Department of Agriculture Development under Ministry of Agriculture and Department of Forest, Department of National Parks and Wildlife Conservation, Forest Research and Survey Centre and Department of Plant Resources under Ministry of Forest and Soil Conservation are involved in conservation, use and management of Plant Genetic Resources.

Farmers have maintained landraces for their use since time immemorial. NGOs, commercial farms and farmers' organization are not involved in the conservation of Plant Genetic Resources.

The conservation of Forest Genetic Resources has been emphasized in master plan of forestry sector. Research and Development on tree improvement has been given preference. The government has the policy to discourage harvesting or cutting of trees and banned the export of timber since last two decades. Biodiversity profile study Project has been undertaken to assess Forest Genetic Resources (non-cultivated species).

Nepal has signed the convention on Biological Diversity 1992 and is a member of FAO commission on PGR. National workshop on PGR conservation, use and management held in November, 1994 assessed the present status of PGR and suggested future plan of actions for its conservation. The workshop recommended the need of establishing National Plant Genetic Resources System and National Coordination Committee for the conservation and sustainable use of PGR.



5.2 TRAINING

Staff deployed in Plant genetic resources activities are not adequate and they have not been trained in conservation, gene bank management, seed health, molecular characterization etc. In order to establish a national PGR system trained staffs in all the disciplines is a primary requirement. In-country training program on PGR is not existing. Institute of Agriculture and Animal Science and Institute of Forestry do not have courses on Plant Genetic Resources.

5.3 NATIONAL LEGISLATION

Realizing the importance of Plant quarantine to prevent introduction and spread of pests and diseases in the country, HMG/N became a member of International Plant Protection Commission for South East Asia and Pacific region in 1966. Plant Protection Act was passed in 1972 and Plant Protection regulations has been enforced throughout the country in 1974. Exchange of germplasm including *in-vitro* materials is allowed without much delays on the process.

The existing rules and regulations on plant quarantine are adequate for the movement of germplasm. However, the implementations of these rules and regulations have to be intensified to prevent any pests from different sources.

There is no legislation to protect the collected crop genetic resources and germplasm in wild status. However, in forestry sector, endemic and endangered species are protected.

A number of **Forest Acts and Legislation** have been promulgated in an effort to protect FGR of the country. The synopsis of such Acts and Legislation is given below:

1. The Private Forest Nationalization Act 1956

- Nationalized private forest as an attempt to protect national forests from free access.

2. The Wildlife Protection Act 1958

- Protect wildlives (thereby protecting FGR) through the establishment of six hunting reserves in the Terai and one in the mid mountain.



- 3. Forest Protection Special Act 1968**
 - Empowered the forest officials with police and quasi-judicial power.
- 4. Forest Products Sales and Distribution Rules 1971**
 - Facilitate and provide a legal basis for sales and distinction of forest products. (However the objectives were not met because of complexities prevailing in this act.)
- 5. National Parks and Wildlife Conservation Act 1973**
 - Provided a legal base to conserve flora and fauna. Empowered the government to declare any area as a protected area and prohibit any activities harmful to forest flora and fauna.
- 6. The Wildlife Conservation Regulation 1975**
 - The Royal Nepalese Army was deputed for law enforcement in all parks and reserves.
- 7. The Panchayat Forest and Panchayat Protected Forest Rules 1978**
 - Brought for the first time a concept of decentralization in forestry. Local governing bodies (Panchayat) were allowed to grow forest in the degraded land for their own use.
- 8. The Panchayat Protected Forest Rules 1978**
 - Invited communities to improve the existing degraded forests.
- 9. The Leased Forest Rules 1978**
 - Allowed barren lands or highly degraded forests to be leased.
- 10. The Private Forest Rules 1984**
 - Permitted individuals to grow and own forests provided such forests are duly registered (with the government).
- 11. The Forest Act 1993**
 - Also called as Community Forestry Act 1993, which involves the local communities in managing and utilizing forest resources through people participation. Allows handing over certain national forests to the community.
- 12. Buffer Zone Management Act 1993**
 - Provides legal status to buffer zones around protected areas.

Besides these Acts and Rules, the signing of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1994 and endorsing the policy of National Conservation Strategy in 1988 indicate the



commitment of the government to conserve ecosystem and forest genetic resources of Nepal.

Action plan meeting on appropriate policy on PGR in regards to CBD was held in April, 1995 to discuss policy issues related to our commitment in CBD. Legislation on germplasm exchange and joint exploration activities has to be drafted.

5.4 OTHER POLICIES

PGR experts are involved in the planning of crop improvement projects. The impact of these projects on the conservation and utilization of PGR has not been taken into consideration during project appraisal, monitoring and evaluation.

AIC provides a premium payment to farmers for the production of quality seeds. Credit support and subsidies are available for the agricultural inputs. These supports encourage farmers to adopt improved technologies in their fields. Their impact is clearly visible in the form of genetic erosion.

5.5 TRADE, COMMERCIAL AND OTHER INTERNATIONAL AGREEMENT

Government Policies in trade and commerce encourage to create a sustainable export in the favor of indigenization. Unrestricted export of medicinal plant species lead to gradual loss of these resources. The export of timber has been banned to protect forest genetic resources.



CHAPTER 6

International Collaboration

6.1 UNITED NATIONS INITIATIVES

Nepal has adopted the agenda 21 of UNCED. Following steps have been undertaken to implement chapter 14G (Conservation and sustainable utilization of Plant Genetic Resources for food and sustainable agriculture) and Chapter 15 (Conservation of Biological Diversity):

- Biodiversity profile study project has been initiated to assess the status of forest biodiversity.
- Biodiversity Action Plan has been launched.
- National Workshop on Conservation, Use and Management of PGR (November 1994) and Action Plan Meeting on Appropriate Policy on PGR in regards to convention on Biological Diversity (April, 1995) were organized.
- A project to conserve Plant Genetic Resources is being developed.
- Nepal is a new member of FAO Commission on Plant Genetic Resources to discuss the issues on PGR conservation, use and management in the international forum.

The interdependence of the present day world in the process of development demands regular interaction among member countries interested in conservation and utilization of biodiversity . Creation of "international fund" is essential to protect the vast natural resources of global interest. Nepal will be benefitted by such international efforts.

FAO has provided technical and financial supports in enhancing production and productivity of agro-horticultural and agro-forestry crops.

6.2 INTERNATIONAL AGRICULTURE RESEARCH CENTRES

International Agriculture Research Centers have played a definitive role in boosting up the national crop production and productivity. Elite lines/varieties generated by IRRI, CIMMYT, ICRISAT, ICARDA, and CIP



have been extensively tested under different agro-ecological zones of Nepal. High yielding varieties with resistance to biotic/abiotic stresses have been selected and released for general cultivation. The collaborative activities between national programs and IARCs have been effective in exchange of germplasm, testing of advanced breeding lines/varieties, providing on-job training, visits/exchange of scientists, conservation of germplasm and supply of research reports, newsletters, special bulletins and books. CGIAR Centers have generously supported national programmes since last three decades. However, the level of support for training is declining. Visits/exchange of scientists and on-job training of research workers should be enhanced. These centers should play a leading role in supporting the developing nations for use of recent advances in biotechnology and their application in crop improvement.

IBPGR/IPGRI has been successful in creating awareness of PGR conservation, use and management among national scientists and policy makers. It has supported the national programme by providing on-job training, supplying newsletters/ descriptors/ special bulletins/books and cosponsoring national workshops on PGR. IPGRI should continue to support in establishing national PGR system, formulating national policy on PGR, upgrading technical capabilities and attracting donor in establishing national facilities for conservation.

6.3 REGIONAL RESEARCH CENTRES

AVRDC has generously supported vegetable development program by supplying breeding lines of vegetables, providing on-job training and technical bulletins. The regional centers should continue to support national programmes. The developing countries need support to enhance technical capabilities in R and D of PGR.

6.4 REGIONAL INTERGOVERNMENTAL INITIATIVES

SAARC collaborative activities on crop improvement programs have encouraged the exchange of elite lines/varieties, visits/exchange of scientists and participation in regional workshops. Necessary steps have to be undertaken for the continuity of such activities. Meetings of counterpart



scientists on PGR have also been organized, however, the progress has yet to be made in joint activities to meet the regional needs.

National PGR Coordinators' meetings of South Asian Countries have been regularly organized by the initiative of IPGRI. Regional training, activities on exploration, data base management and exchange of information through news-bulletins are the major suggested activities to be carried out.

6.5 BILATERAL INTERGOVERNMENTAL INITIATIVES

Nepal do not have a bilateral agreement on PGR activities with any country. The cooperation in crop improvement activities has been of great significance in enhancing agricultural production and productivity. The technical and financial assistance extended by Japan, India, USA, Germany, UK, Switzerland, etc. have helped the nation in developing the national agriculture system. Such cooperations need to be extended in building national capabilities in conservation and sustainable use of PGR.



CHAPTER 7

National Needs and Opportunities

Opportunities

The foothills of the Himalayas are considered as the cradle of flowering plants. Altogether 7,000 species of flowering plants have been identified, out of which 370 species are endemic. Genetic diversity in agricultural, horticultural, medicinal, ornamental plants and forest tree species are exhibited in their cultivated and wild habitats. Traditional farming system in diversity physiographic areas have helped maintain the crop diversity.

The agriculture policy of HMG/N favors the development of agriculture sector to maintain self sufficiency in food production through crop diversification. The existing crop diversity provides ample opportunities to meet the present needs and aspirations of future generations. All these provide a sound basis for conservation and utilization of genetic resources.

National needs

- Establishment of a National PGR system and a high level nodal Committee and functional committee with powers to secure funding and human resources development to implement national policy on PGR.
- Development of infrastructure for *ex situ/in situ/in vitro* conservation, regeneration, characterization, evaluation and documentation.
- Development of human resources and national capabilities to undertake national PGR activities.
- Inventorizing and cataloguing of genetic diversity.
- Formulation of national legislation for access to PGR and their exchange in relation to convention on biological diversity.
- Development of in-country capabilities in biochemical and molecular characterization of PGR.
- Strengthening varietal development programmes to enhance utilization of genetic resources.
- Promote and encourage exchange of technical information and data base on PGR among national and international scientists.



- Create national awareness among young generations at school/university level through appropriate educational programmes on importance of biodiversity and its conservation.
- Involve farmers, NGOs, school children, private sectors in conservation programmes.
- Record the indigenous knowledge on farming practices and use of medicinal herbs in Ayurvedic treatment.

Urgent needs

- Establishment of national PGR facility to conserve genetic resources.
- Formulation of national legislation on PGR.
- Development of national PGR system.



CHAPTER 8

Proposals for a Global Plan of Action

- Assist national programmes in developing their capabilities in conservation and utilization of plant genetic resources so that developing countries secure full benefits of their valuable assets.
- Ensure that the earlier collections which are being conserved at international gene banks are made available to national programmes upon request as well as the benefits arising out of these germplasm be shared by the country where the collection had been made.
- Encourage exchange and visit of scientists to IARCs for undertaking joint characterization, evaluation and utilization of PGR.
- Create international fund to assist PGR programmes in conservation and sustainable use of biological diversity in order to minimize destruction of natural habitats and genetic erosion.



APPENDIX 1

Institutes Involved in PGR Activities

A. Nepal Agriculture Research Council

1. Division of Agriculture Botany, Khumaltar, Lalitpur - leading role in conservation of crop genetic resources
2. National Rice Research Program, Parwanipur
3. National Wheat Research Program, Bhairahawa
4. National Maize Research Program, Rampur
5. National Oilseed Research Program, Nawalpur
6. National Hill crops Research Program, Kabre
7. National Grain Legume Research Program, Rampur
8. National Sugarcane Research Program, Jitpur
9. National Tobacco Research Program, Belachapi
10. National Potato Research Program, Khumaltar
11. Horticulture Research Station, Pokhara/ Tarhara/ Dhankuta/ Nepalganj

B. Department of Agriculture Development

1. Division of Horticulture, Kirtipur, Kathmandu
2. Division of vegetable, Khumaltar, Lalitpur
3. Horticulture Farm, Daman/Marpha/Solukhumbu/Sarlahi/Sindhuli/Dolkha/Panchkhal/Godawari/Kirtipur/Trisuli/Mustang/Palpa/Jumla/Dailekh/Baitadi/Humla/Chitwan

C. Department of Plant Resources

1. National Herbarium and Plant laboratory, Godawari, Lalitpur - leading role in conservation of medicinal plants
2. Herbal conservatory, Hetauda/ Daman/ Tistung, Makwanpur

D. Forest Research and Survey Center, Babar Mahal, Kathmandu

E. Department of Wildlife Resources and National Parks

- Wildlife Reserves:
 - Koshi-Tappu Wildlife Reserves
 - Parsa Wildlife Reserves
 - Shivapuri Wildlife Reserves
 - Dhorpatan Wildlife Reserves
 - Royal Shuklaphant Wildlife Reserves



Department of Wildlife Resources and National Parks

- National Parks:
 - Royal Chitwan National Park
 - Sagarmatha National Park
 - Langtang National Park
 - Rara National Park
 - Shey-Phoksundo National Park
 - Khaptad National Park
 - Royal Bardia National Park
 - Makalu Barun National Park

- Conservation Area:
 - Annapurna
 - Makalu Barun

F. King Mahendra Trust for Nature Conservation, Jawalakhel, Lalitpur

G. Tribhuvan University

1. Institute of Agriculture and Animal Science, Rampur
2. Institute of Forestry, Pokhara
3. Research Centre for Applied Science and Technology, Kirtipur



Abbreviations

AIC	Agriculture Inputs Corporation
AVRDC	Asian Vegetable Research and Development Centre
CBD	Convention on Biological Diversity
CGIAR	Consultative Group for International Agriculture Research
CIMMYT	International Maize and Wheat Improvement Centre
CIP	International Potato Centre
DANIDA	Danish International Agricultural Development Agency
DOF	Department of Forest
DOAB	Division of Agriculture Botany
DOAD	Department of Agriculture Development
DPR	Department of Plant Resources
FAO	Food and Agriculture Organization
FGR	Forest Genetic Resources
FORESC	Forest Research and Survey Centre
GDP	Gross Domestic Product
GLRP	Grain Legume Research Programme
HCRP	Hill Crops Research Programme
HMG/N	His Majesty's Government (Nepal)
IARCs	International Agriculture Research Centres
IBPGR	International Board for Plant Genetic Resources



ICARDA	International Centre for Agricultural Research in Dry Areas
ICPPGR	International Conference and Programme for Plant Genetic Resources
ICRISAT	International Crops Research Centre for Semi Arid Tropics
IOF	Institute of Forestry
IPGRI	International Plant Genetic Resources Institute
IRRI	International Rice Research Institute
KMTNC	King Mahendra Trust for National Conservation
masl	Meter Above Sea Level
MRP	Maize Research Programme
NARC	Nepal Agriculture Research Council
NBPGR	National Bureau of Plant Genetic Resources
NGOs	Non Governmental Organizations
NIAR	National Institute of Agro-biological Resources
NPC	National Planning Commission
NHPL	National Herbarium and Plant Laboratory
NORP	National Oilseed Research Programme
NPWR	National Parks and Wildlife Reserves
PGR	Plant Genetic Resources
PGRS	Plant Genetic Resources Section
PGRU	Plant Genetic Resources Unit
RARC	Regional Agricultural Research Centres
RBG	Royal Botanical Garden



RRP	Rice Research Programme
SAARC	South Asian Association for Regional Cooperation
Spp	Species
UNCED	United Nations Conference on Environment and Development
WRP	Wheat Research Programme