



**SRI LANKA:**

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

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## FOREWORD

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Conservation of plant genetic resources for sustainable development has in the recent times assumed increasing national importance in Sri Lanka. Significant advances have been made in conserving and using the genetic resources of crop plants and forest species. The use of conserved materials in national crop improvement programmes and the development of improved cultivars which are used both in the country as well as in some other countries reflects the strength of our national PGR programmes.

I am particularly pleased that the Plant Genetic Resources Centre (PGRC) of the Department of Agriculture under the Ministry of Agriculture, Lands and Forestry is functioning as the national focal office in preparing the Country Report for the International Conference and Programme for Plant Genetic Resources (ICPPGR). I am personally aware that the preparation of this report necessitated the bringing together of large number of concerned scientists, planners and others to give effect to holistic nature of the national PGR programmes. Consequently the report reflects the outcome of the wide participation and inputs from the different sectors concerned with PGR activities in Sri Lanka. It is my hope that this document will stimulate further, the already vigorous activity in plant genetic resources that is developing in Sri Lanka by bringing in regional and international support through the auspices of ICPPGR of the FAO. I am confident that we will receive adequate support in our future undertakings.

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# CHAPTER 1

## Sri Lanka and its Agricultural Sector

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### 1.1 PHYSICAL CHARACTERISTICS

#### 1.1.1 Geography

The Republic of Sri Lanka, consisting of a main island and several small off-shore islands, is situated close to the south eastern corner of the Indian sub continent. The country lies in the Indian ocean between longitudes 79° 39' and 81° 53' East and latitudes 5° 54' and 9° 52' North. It covers a total extent of 65,609.8 Km<sup>2</sup>, consisting of 64,453.6 Km<sup>2</sup> of land area and 1,156.2 Km<sup>2</sup> of inland waters. The island has a maximum length of about 435 Km and its maximum width is nearly 225 Km.

#### 1.1.2 Physiography

Geologically, Sri Lanka shares with India, the South-Asian Tectonic plate, since the time of the breakup of the Gondwanaland. The separation of Sri Lanka from the peninsular India is believed to have occurred about 70 million years ago. Precambrian crystalline rocks forms the underlying geological formations in 90 percent of country. A narrow strip of miocene limestone extends from northern coast to over quarter of the north western coastal areas.

Considering the topography of the country, three distinct peneplains are discernible. The lowest of these, the flat lowland peneplain covers about 75 percent of the land consisting of the northern, southern halves of the country and the broad strip along east coast and the narrow strip along west coast. This first peneplain is referred to as the 'Low country' with the altitude rising from sea level to 300 m above mean sea level (msl). Towards the south central parts of the island, the land rises steeply on all sides and the second peneplain of 'Mid country' is identifiable from 300m to 1,000 m msl. Further inland the land rises very steeply to form the south central mountain massif with plateau like areas. This constitutes the third peneplain or 'Up country' (1,000 m - 2,500 m msl).



### 1.1.3 Climate

Climate features of the country are basically determined by the geographical location of the country in the equatorial belt and its position in the inter tropical convergence zone. The chief determinants of the climate in Sri Lanka are rainfall and temperature. The mean temperature is 27.5°C over low lands. The oceanic influence helps to reduce temperature in the lowlands by sea breezes. The temperature decreases at a steady rate of about 6.5°C for each 1000 metres rise and in the montane region the mean monthly temperatures varies from 13°C to 16°C with the night temperature occasionally dropping to around zero. Diurnal variation of temperature is well marked and the range increases with altitude as well as with distance from sea. There is only a small variation in mean monthly temperatures experienced throughout the year in most parts of the country.

The relative humidity varies generally from about 70 percent during the day to about 90 to 95 percent at night. In the dry areas these values are lower by about 5 percent.

The rainfall is of three types - monsoonal, convectional and depressional. The two monsoonal periods, the South west (May - September) and the North east (December - February) is responsible for major part of the annual precipitation. Local topography plays a major role in determining the rainfall distribution over the island. The South west monsoon provides rain mostly to South western quarter and the central high lands. The North east monsoon along with intermonsoonal depressional activity in October/November is stronger and produces rain through out the island. The other intermonsoonal period in March/April produces less rainfall. Based on the mean annual rain fall and its distribution, the country is classified into to three major climatic zones : Dry zone (1,250 mm - 1,525 mm), Intermediate zone (1,525 mm - 2,280 mm) and wet zone (2,280 mm - 5,100 mm). The dry zone experiences prolonged dry period from May to September with drought conditions prevailing from June to August. The presence of strong dry winds accentuates the harsh conditions during this period. Additionally the two areas in the North west and South east of the island receiving a mean annual rainfall of 890 mm - 1,250 mm and having a more prolonged and intense drought are classed as the arid zone.





### 1.1.4 Soils

Nine out of the ten major soil orders based on the USDA soil taxonomic system are distributed through out the country in a mosaic pattern. In the dry zone the predominant soil group is the well drained reddish brown earths in association with poorly drained humic gley alluvials and red yellow latosols. In the dry zone coastal areas non calcic brown soil with sandy regosols, alkaline and saline soils, and grumosols are found distributed in patches. In the wet zone red yellow podzolic soils form the major soil group with bog, half bog soils, and sandy regosols along the South west coast. The intermediate zone displays a transition from reddish brown earths to red yellow podsolic soils, with non calcic brown loam in patches (Panabokke, 1978).

### 1.1.5 Surface Drainage

The centrally placed mountain mass encircled by coastal plains provides for radial pattern of surface drainage to all rivers except the river Mahaweli. The 1700 km of coastline is laced with 103 river basins, which end as sand bars, deltas, lagoons, marshes and mangrove swamps.

### 1.1.6 Floristic regions and Agroecological zones

Taking the topography and the climate into consideration Wijesinghe (1984) recognised six bioclimatic zones to describe the distribution of natural vegetation in the country. These are the low and mid country wet zone, montane wet zone, montane intermediate zone, low and mid country intermediate zone, dry zone and arid zone. Subsequently Ashton and Gunatilleke (1987) through vegetational analysis identified 15 floristic regions in the country. The majority of the floristic regions falls in the wet and intermediate zones. (Figure 1). Superimposing the ecological parameters such as the climatic, topographic, edaphic, vegetational, cultural, land use, drainage and micro-climatic factors the major climatic zones have been subdivided into 24 agro ecological regions. (Figure 2). This classification is used to describe the distribution of crop plants and also in agricultural planning (Panabokke et al, 1975).



### 1.1.7 Demography

The population of Sri Lanka, according to 1993 mid year census is estimated at 17.6 million and the natural increase in population is estimated to be of about 1.2 percent annually. With a population density per km<sup>2</sup> of 273, Sri Lanka is among the densely populated countries of the world. The wet zone occupying just 24 percent of the country, is under great pressure because it is settled by 55 percent of the islands population. The country has a high literacy rate of about 88 percent.

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## 1.2 AGRICULTURAL SECTOR

The Sri Lankan society is predominantly agrarian. Although the country is moving towards industrialisation, the agricultural sector still continues to be an important sector in the economy of the country and contributes substantially to foreign exchange earnings and to GDP. The share of agriculture to the GDP is 21 percent in 1993. Economically active population in agriculture and related activities is estimated to be 51 percent. Therefore the prosperity of the country depend on the rational land use proper management of the soil and water resources and significantly on biodiversity including plant genetic diversity.

### 1.2.1 Land use

The total land area of Sri Lanka after leaving the area occupied by inland waters is only 6.44 million hectares. The land/man ratio is thus only 0.37 ha/person. According to the Third Land Commission Report, after allowances are made for forest cover, steep and barren lands, urban and rural dwellings etc., about 2.5 million hectares (nearly 39 percent of the total land area) is available for further settlements and agricultural production. The per capita crop land is so small as 0.14 ha. Bulk of this land is rainfed and is in the dry zone systematic land use planning is thus vital in the in the management of natural resource base for agricultural development. Competition for land is severe among the sectors using it. The major land use sectors are agriculture, forestry, wildlife and animal husbandry.



## The present status of land use in Sri Lanka is estimated as follows:

ha (mill.)	use
0.83	plantation crops,
0.83	paddy,
0.19	highland annual crops,
0.08	minor plantation crops,
1.73	natural forest cover,
0.10	forest plantation,
0.50	grasslands.

The land use statistics obtained from Sri Lanka/Swiss Remote Sensing Project indicates that of the total land area, 25 percent is under permanent agriculture, 20 percent is classified as sparsely used croplands, 12 percent occupied by homesteads, 16 percent under grasslands, scrublands, marshes etc. and nearly 27 percent under forests. The major plantation crops are tea, rubber and coconut. Spices such as cinnamon, cardamoms, black pepper, cloves, and nutmeg are grown in minor plantations. These crops constitute the export agricultural crops. Food crops such as paddy, vegetables, legumes and fruits forms the domestic agricultural crops. The wet zone of Sri Lanka is the most intensively cultivated zone with 67 percent of the area under permanent agriculture. Presently Sri Lanka is exporting limited quantities of vegetables and fruits to the west Asian markets.

### 1.2.2 Agricultural systems

The main agricultural sub sectors in Sri Lanka are as follows :

1. Domestic or non plantation agriculture.
2. Plantation agriculture.

### 1.2.3 Domestic Agriculture

Domestic agriculture represents the efforts of the rural people in cultivating food crops. The non plantation domestic sector in Sri Lanka is really a small holders (small farmers) sector. About 1.8 million farm families are engaged in this sector. An understanding of the physical structure of the farms is necessary to get an idea of the cropping and farming systems of this sector. The basic land elements are the valley bottom, slope and the ridge. The valleys are shallow in the dry zone, deeper in the mid country and deepest in the up country. Traditionally the valley bottom is referred to as the 'low land' and



elements of slope and ridge as 'upland' or 'highland'. In the allocation of land for agriculture both lowland and upland are included in a single land holding or farm. A part of the upland is separated physically as the homestead and home garden. The lowland is cultivated with rice in a tract of holdings belonging to the village, upland is used for other cereals, legumes, vegetables and the home garden on which a range of fruits and vegetables are grown. Of the total extent cultivated in this sector about 31 percent constituted paddy lands in the lowland, 38 percent was highland and about 31 percent was in the home gardens. The size of the holdings averages 0.72 ha in the wet zone and 1.2 ha in the dry and intermediate zones.

The diverse agricultural eco-systems in this sub sector are:

1. Paddy under major irrigation schemes.
2. Paddy under minor irrigation schemes.
3. Rainfed upland paddy cultivation.
4. Rainfed lowland paddy cultivation.
5. Rainfed cultivation of other food crops.
6. Irrigated farming of other food crops.
7. Terrace farming in mountain slopes.
8. Tank bed cultivation in seasonally dry tanks (reservoirs).
9. Shifting cultivation.
10. Home gardens.

About 60 percent of the total agricultural production is directly rainfed and is tied down with the vagaries of climatic conditions. A cyclical occurrence of droughts and floods have been recorded in the country: drought conditions every four years and floods every ten years.

There is an increasing trend towards monoculture especially with regards rice cultivation and problems of pest and disease epidemics, agrochemical pollution etc. are on the rise. The cultivation of rice is as old as the history of Sri Lanka and still continues to be the single largest crop. The rice culture is enmeshed in the Sri Lankan culture deeply and even today the President of the country participates in ceremonies related to sowing and harvesting of paddy. There are an estimated 0.835 million hectares of paddy land, which are held in about 1.6 million holdings. Since the 1970's the national rice production has increased dramatically. The main contributing factor to this increase were area expansion (32 percent) and improved seed/fertilizer technology (68 percent). Nearly 86



percent of the national demand for rice is met through local production annually.

Rainfed rice cultivation is practiced in the dry as well as the wet zones. As for the minor irrigated lands, there are about 3000 minor tanks and cultivation under minor tanks is the essence of rural agriculture in the dry and the intermediate zones. Paddy lands under major irrigation schemes give the highest yields in the country and hence is cultivated with the modern improved cultivars. In the upcountry rice is cultivated in terraces on slopes and are adapted to the cool climes.

The other food crops cultivated in Sri Lanka can be broadly classified as follows:

<b>Coarse grains</b>	Maize, sorghum and millets.
<b>Grain legumes</b>	Cowpea, green gram, black gram, pigeon pea.
<b>Oil seeds</b>	Sesame, groundnuts, soya beans.
<b>Vegetables</b>	Legumes, solanaceous spp., cucurbits, crucifers, leafy vegetables etc.
<b>Root &amp; tubers</b>	Cassava, sweet potato, yams, potato.
<b>Condiments</b>	Onions, chilli peppers.
<b>Fruits</b>	Pineapple, banana, papaya, mangoes, passionfruit, avocado and limited extent of other tropical and temperate fruits.

Most of the rice farmers are usually engaged in the production of other food crops. The other food crop cultivation helps to improve farm incomes, and improve nutritional status. Vegetables and fruits with high average yield ranging from 7 to 11 mt/ha when compared to national average rice yield of 3.5 mt/ha have a higher income generating potential. Bulk of the vegetables and fresh fruits are consumed locally. There is a very good potential for export generation in this sub sector.

A limited extent of tobacco and sugarcane are also cultivated annually. The cash value crops are cultivated on an intensive basis. The farmers have evolved inter cropping, relay cropping practices especially in the intensely cultivated



areas of Jaffna peninsula and Nuwara-Eliya in the up country highlands. Lift irrigation from rivers, reservoirs, wells etc. is practiced in some of the dry zone areas for cultivating other food crops.

Another system of agriculture practiced for generations especially in the central highlands, is the home gardens. This system is supported by rainfall. Farmers grow a mix of annuals and perennials mainly under a three tier canopy system. Livestocks are usually incorporated in this system and both plant and animal wastes are recycled. The farmers depend for their fruits, vegetables and even spices on the home garden system. It is also common to see a range of medicinal plants as components of this system. Spice gardens which dot the central highland is a modern version of the home garden and has become tourism related activity.

#### **1.2.4 Plantation agriculture**

Plantations are involved with large scale cultivation of perennial crop species such tea, rubber, coconut yielding products of economic value. Plantations are located in the low country wet zone, mid country, hill and the intermediate zone of the country.

Tea the major export plantation crop is grown on 221,836 hectares above the 610 metre contour where the rain fall is well distributed through out the year and exceeds 2000 mm. Districts of Kandy, Nuwara Eliya, Badulla and Ratnapura the key production centres. Rubber the second largest export crop is concentrated 197,856 hectares at altitudes of 150 m to 610 m. Coconut is planted on 416,423 hectares in the 'coconut triangle' comprising the districts of Puttalam, Kurunegala, Colombo and Kalutara. Spice and beverage crops are grown in much smaller scale. The crops cultivated in this category are cinnamon, black pepper, cloves, cardomom, nutmeg, citronella, arecanut, betal and beverage crops such as coffee and cocoa. The extent of land under these crops is estimated to be around 67,500 hectares in the mid country and low country districts of the country.

In the recent times, sugarcane and cashew have entered the agricultural sector on a plantation basis. About 25 percent of the national requirements for sugar are presently met through local production. There is also a keen interest in the recent times to promote floriculture and fruits cultivation aimed at export markets. Orchids, anthurium and other foliages are being grown about 500 ha in the wet zone areas.





Government is also giving incentives for establishing commercial scale farms especially in the newly opened areas under the Mahaweli river diversion project. The crops targeted for this purpose are vegetables, melons and fruits such as mango, grapes, pineapple etc.

### **1.2.5 Sources of seeds and planting materials to the farmers**

The seed and planting material supply to the farmers are largely facilitated through the Department of Agriculture and are also met through their own seed supply, exchange from relatives and friends and the private sector. Until 1986, the Department of Agriculture was the sole institution responsible for the production and distribution of seeds in Sri Lanka. This system, especially for paddy was operated through secondary seed farm system in each of the Agrarian Service Centre area by selected contract growers. Presently apart from the Department of Agriculture, six co-operative societies, three private sector companies, US government assisted CARE programme and recently some farmer organisations are involved in seed production/distribution to farmers. The government institutes supply basic seeds and private sector, NGO and farmer organisations are given incentives to produce commercial seeds. A national level committee has been appointed to monitor this important aspect.

Private sector handles the importation and distribution of exotic vegetable seeds such as beet, cabbage, carrot, cauliflower, leeks, beans, lettuce etc. These seed materials are marketed after certification obtained from the Plant Quarantine Service and the Seed Certification Service of the Department of Agriculture, functioning under the Ministry of Agriculture, Lands and Forestry.

### **1.2.6 Agriculture Sector Directions**

Agriculture sector is presently facing challenges associated with the expanding market oriented open economy. The overall direction is towards achieving and maintaining self sufficiency with regards rice while diversifying other crop portfolios. Considerable attention is given by the Ministry of Agriculture, Lands and Forestry to increase the productivity per unit land, and raising on farm and off farm income opportunities to farmers. New technology options and various cost saving measures are implemented by the Department of Agriculture in this regard. Nearly 85 percent of the national rice requirement and over 90 percent of the vegetable requirements are met by the local production. Sri Lanka is also nearly self sufficient in the production of local fruits.



## CHAPTER 2

# Indigenous Plant Genetic Resources

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### 2.1 INTRODUCTION

Sri Lanka though a small island has been identified as one of the most biologically diverse countries in Asia (Braatz 1992). A remarkably high proportion of endemism is exhibited among its fauna and flora. The natural forests harbour many wild relatives of crop plants, medicinal plants and horticultural plants. Several attempts have been made to study and classify the indigenous biodiversity at the three recognised levels of biological hierarchy. While the ecosystem variations has been studied in relative detail, much more remains to be done with regards the species diversity within many taxonomic groups. The genetic diversity within species needs to be adequately studied and documented.

There are several factors which have contributed to the special features of the indigenous biological diversity. The country exhibits a wide range of topographic, climatic, edaphic and hydrologic variation. Another contributing factor is the island biogeography and its influence on the evolutionary history of the biota of Sri Lanka. The long history of agriculture in the country coupled with the farmers selection and cultivation of plant species over millennia, and traditional farming practices to suit the diverse agricultural ecosystems have all contributed to a rich agricultural biodiversity.

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### 2.2 ECOSYSTEM DIVERSITY

The major ecosystem diversities present in the country can be characterized under the forests, grasslands, coastal and marine, inland wetlands and the agricultural systems. The high level of ecosystem diversities exhibited in the country can be gauged from the identification of 15 floristic regions which describe the distributional patterns of natural vegetation and the demarcation of 24 agroecological zones which characterizes agroecosystem diversity. Major ecosystem diversities are outlined below.





The natural forest vegetation includes both closed canopy and open canopy forests. Nine major plant communities in relation to forests and four types for grasslands and one community type for mangroves have been identified (Figure 3). The main forest types are : 1) Tropical Thorn Forest (Arid zone), 2) Dry Evergreen Forest (Dry zone), 3) Moist Deciduous Forest (Dry zone), 4) Moist Semi Evergreen Forest (Intermediate zone), 5) Wet Semi Evergreen Forest (Intermediate zone), 6) Tropical Savannah Forest (Dry/Intermediate zone), 7) Tropical Wet Evergreen Forest (Wet zone), 8) Sub Montane Evergreen Forest (Wet zone), 9) Montane Temperate Forest.

The grasslands are classified as : (1) wet montane grasslands (wet patanas), (2) Dry montane grasslands (dry patanas), (3) Tamana and Talawa grass lands and the (4) wet villu grasslands.

The coastal and the marine systems consists of mangroves, salt marshes, sand dunes, mudflats, seagrass beds, lagoons and estuaries, coral reefs and the coastal seas. The inland wetlands are distinguished into flood plains, swamp forests, streams, rivers and ponds.

**The principal man made agricultural ecosystems consists of:**

1. irrigated lowland,
2. rainfed lowland,
3. rainfed upland,
4. rainfed and spring fed terraces,
5. home gardens,
6. dry zone lift irrigation systems,
7. shifting cultivation.

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## **2.3 PLANT SPECIES DIVERSITY**

Within a small island matrix, Sri Lanka has a rich floristic wealth. Over 3350 species of angiosperms have been described with about 23 percent of its flowering plants being endemic (Peiris 1975). The indigenous flora described by Abeywickrama (1987) are given below in Table 1.



**Table 1** *Number of Described Flora of Sri Lanka*

Group	No. of described species	Endemism (%)
Algae	896	NA*
Fungi	1920	NA
Lichens	110	35
Mosses	575	NA
Liverworks	190	NA
Ferns & fern allies	314	18
Gymnosperms	01	0
Angiosperms	3350	23

\* NA = Estimates Not Available

Sri Lankan flora exhibits a high degree of endemism across the different taxonomic groups. A large proportion (94 percent) of the endemics are distributed in the wet zone of South western and South central regions of the country. Sri Lanka is geographically close to the Indian subcontinent. Yet surprisingly the nearest ecological analogues of the Sri Lankan plant diversity have only been described in Western Malaysia, Seychelles and Madagascar (Ashton and Gunatilleke, 1987).

## 2.4 GENETIC DIVERSITY

The indigenous plant genetic resources of Sri Lanka resides in the natural ecosystems and in the diverse agricultural systems of the country. The genetic diversity of the natural flora is the least documented segment. Almost all the available information is confined to economically important agricultural crops and their wild relatives. However, an attempt is made to survey the available genetic diversity in terms of forest genetic resources, followed by a detailed account of the crop genetic resources of the country.

### 2.4.1 Forest Genetic Resources

The natural forest cover has declined from an estimated 84 percent of the total land area in 1881 to about 25 percent, according to mapping project conducted in 1992 by the Department of Forests, Sri Lanka (Wickramasinghe 1994). It has declined mostly in the wet zone where 11.3 percent remains forested as compared to the 23.2 percent in the dry zone. The per capita forest



cover is only 0.10 ha for Sri Lanka. Major factors causing this decline has been high population density, land alienation, forest clearance for agriculture, non sustainable timber extraction, informal encroachment of the forest lands etc.

The natural forest vegetation types broadly follow the different bioclimatic zones and floristic regions described earlier. Even within a bioclimatic zone, the habitat conditions change within short distances in elevation, temperature, rainfall, soils, drainage and topography. These micro-niche differences find parallel reflection in the occurrence of different species associations or complexes within a particular forest type.

In the tropical wet ever green forests of the low and mid country wet zone, four forest communities are recognised (De Rosayro 1951). The four communities display a continuum of floristic variation :

1. The *Dipterocarpus* community confined to the lowland mid elevations and dominated by *Dipterocarpus zeylanicus*. Associated species are *Vitex altissima*, *Chaetocarpus castanocarpus*, *Dillenia retusa*, *Dillenia triquetra*, *Myristica dactyloides*, *Semecarpus gardeneri* and *Shorea trapezifolia*.
2. The *Mesua - Shorea* community found at mid elevations in association with *Chaetocarpus castanocarpus*, *Palaquim petiolare*, *Mangifera zeylanica*, *Calophyllum tomentosum*, *Vitex altissima*, and *Myristica dactyloides*.
3. The *Camptosperma zeylanica* community in association with *Myristica dactyloides*, *Chaetocarpus castanocarpus*, *Syzygium neesianum*, *Dillenia triquetra* and *Palaquium petiolare*.
4. The *Vitex - Dillenia - Chaetocarpus - Anisophyllea* community occurring at lower elevations in association with *Cryptocarya wightiana*, *Calophyllum spp.*, *Syzygium neesianum*, *Bhesa zeylanica*, *Doona trapezifolia*, *Urandra apicalis*, *Doona congestifolia*.

In the montane wet zone the *Syzygium - Calophyllum - Gordonia - Michelia* association is conspicuous (Gunatilleke, C.V.S. et al, 1987). The most extensively developed forest formation in the country is the dry mixed evergreen forest in the dry zone. Two community associations can be recognised: The *Manilkara - Drypetes - Chloroxylon* association is common, and in the more humid areas *Alseodaphne - Berrya - Diospyros* association has been identified.

The lowland and mid country intermediate zone contain a small extent of natural forest now termed the intermediate evergreen forest. The species composition shows a transition between the wet evergreen and the dry mixed evergreen forests. In the arid zone the tree species found growing in patches are



*Manilkara hexandra*, *Salvadora persica*, *Dichrostachys cinerea*, *Acacia spp.* and shrubs such as *Carissa spinarum* and *Zizyphus spp.* (Koelmeyer, 1957).

Forest species threatened with extinction in Sri Lanka are listed in appendix 1. One of the local *Dipterocarp* facing extinction is *Vatica obscura*. It is unique since it is the only *Dipterocarp* found outside wet zone, in the eastern dry zone of Sri Lanka. This species was very common few decades ago but now is restricted to certain locations and is rare. The forest Department has come across numerous examples of "species impoverishment" which can eventually endanger their existence. In the dry zone, Ebony (*Diospyros ebenum*), Satin (*Chloroxylon swietenia*), Palu (*Manilkara hexandra*) Milla (*Vitex pinnata*), Halmilla (*Berrya cordifolia*) and Panakka (*Pleurostyliia opposita*) all of which are luxury timber species are fast dwindling. Popular species under threat in the wet zone are Hora (*Dipterocarpus zeylanicus*), Calamander (*Diospyrus quaesita*), Nedun (*Pericopsis mooniana*), Alubo (*Syzygium makul*), Hal (*Vateria copallifera*), Kirihebbiliya (*Palaquium petriolare*), Tawenna (*Palaquium rubiginosum*), Ubbériya (*Carallia calycina*), Uruhonda (*Urandra apicalis*).

Some of the forest species which have restricted distribution and require conservation measures are *Diospyros oppositifolia*, *Schumacheria angustifolia*, *Eugenia pedunculata*, *Syzygium fergusonii*, *Dichilanthe zeylanica*, *Atalantia rotundifolia*, *Mapania immersa* and *Cinnamomum sinharajaense*.

About 50 or more plant species have not been observed in nature in the recent years. This includes endemics such as *Cyathula zeylanica*, *Ellipanthus unifoliatus*, *Ceropegia elegans*, *Blumea angustifolia*, *Anaphalis fruticosa* and *Calamus pachystemonus*.

Of the flowering plants described (3,350 species), 480 species are considered threatened. Of these nearly half are endemic species (228 species). In the wet lowlands, over 90 percent of the woody endemics are threatened. Canes are another classic example of endangered species in Sri Lanka. There are ten species of rattan (*Calamus spp.*) reported in Sri Lanka. Of this seven species have restricted distribution, three are endangered and three more are liable to extinction. The small sized cane (*Calamus rotang*) found in the eastern dry zone areas and large sized canes (*Calamus zeylanicus*) in the wet zone areas are fast dwindling due to over exploitation.

There is also a growing threat to some indigenous species such as *Caryota urens* and *Cycas circinalis* which are being collected and exported. Of the lower plants, 28 percent of the ferns and fern allies are considered threatened. In addition to natural forests, nearly 124,000 ha. of forest plantations are



managed by the Forest Department. The trees planted and managed are the Conifers, Eucalyptus, Teak and Mahogany.

Apart from the forest species, the other natural vegetation types include grasses, inland aquatic vegetation, coastal and marine vegetation. The grasslands are found in all climatic regions. Dry montane grasslands are dominated by the grass *Cymbopogon nardus* and the wet montane grasslands are dominated by grasses of the genera *Chrysopogon*, *Pollinia*, *Garnotia* etc. *Dicotyledonous* herbs and Scattered trees are present among the grasses. In the dry zone grasslands occur in abandoned reservoir beds, and flood plains of rivers. The common inland aquatic vegetations are *Eichhornia Crassipes*, *Hydrilla verticillata*, *Nymphaea*, *Nelumbo* etc.

The other distinct type of natural vegetation is the mangrove vegetation whose distribution is mainly governed by hydrological and edaphic factors. Nearly six thousand hectares of mangrove forests are distributed along the coast of Sri Lanka in the inter-tidal zone. The river estuaries were rich in mangroves several decades ago. It is facing threat due to exploitation including the opening up of commercial shrimp farms. *Sonneratia apetala* is a rare endemic species. The dominant species are *Rhizophora spp.*, *Avicennia marina*, *Dolichandrone spathacea*, *Acanthus ilicifolius*, *Acrostichum aureum*. The fronds of *Nipa fruticans* are used for weaving mats and baskets. Tannin rich *Rhizophora* is used for dyeing as well as for making boats.

## 2.4.2 Medicinal plants

Sri Lanka has a long history of indigenous medicine which is dependent on medicinal plants. It is reported that medicinal plants are being used to treat for over 300 ailments in Sri Lanka. Among the indigenous flora over 30 percent are known to be of medicinal value. It has also been estimated that about 25 percent of the islands endemic plant species could be characterized within the category of medicinal plants. Species in high demand are *Rauwolfia serpentina*, *Saraca asoca*, *Strychnos nux-vomica*, *Capparis moonii*, *Withania somnifera*, *Coscinium fenestratum*, *Munronia pumila* which have been exploited heavily and are now rare in the wild.

Many weeds such as *Eclipta*, *Cyperus rotundus* and *Sida cordifolia* are extensively used in medicine. Plants like *Aerua lanata*, *Centella asiatica*, *Asteracantha longifolia* are collected from the wild for herbal tea preparations. Edible oils extracted from the seeds of *Madhuca longifolia*, *Garcinia morella*, *Dipterocarpus glandulosus*, *Canarium zeylanicum*, *Calophyllum inophyllum* are used in medical preparations. Fruits of plants such as *Phyllanthus emblica*, *Aegle*





*marmelos*, *Terminalia chebula* are in very high demand. Some of the other species providing material for traditional medicine are *Cymbopogon nardus*, *Ocimum sanctum*, *Solanum virginianum*, *Azadirachta indica*, *Woodfordia fruticosa*, *Ruellia tuberosa*. A list of important medicinal plants are given in Appendix 2.

### 2.4.3 Ornamentals

Ornamental species are also at risk from exploitation especially the orchids. Of the 170 species recorded in Sri Lanka 99 species are rare, 07 are vulnerable and 13 species are facing the danger of extinction. Some of the species which are endangered are *Dendrobium heterocapum*, *Ispea speciosa* and *Rynchosstylis retusa*. There are several other native ornamental species such as *Nelumbium*, *Jasminum*, *Nerium*, *Hibiscus* etc. which show appreciable diversity.

### 2.4.4 Wild types and relatives of crop plants

The floristic diversity of 227 species of wild relatives of crops in Sri Lanka has been identified to date in an on going survey. These species which are of agrihorticultural importance, generally occur as members of disturbed climax communities within the major vegetation types. Open canopy forest areas, secondary forests, disturbed grasslands and shrub jungles are rich in these plants. However, the relatives of fruit plants are largely associates of semi ever green, intermediate and wet evergreen forests. The number of wild species of agri-horticultural importance identified so far for the different crop groups are indicated in Table 2.

**Table 2 Wild types and relatives of crop plants in Sri Lanka**

Crop group	No. of wild species
Cereals	30
Legumes	17
Vegetables	39
Oil seeds	03
Fruits	90
Fibre crops	06
Root & Tubers	16
Spices & condiments	16
Others	10
<b>Total</b>	<b>227</b>



The wild relatives recorded for the different genera are summarised below. The numbers given in parentheses indicate the number of species. The data obtained is from an ongoing survey. (Balendira, 1994).

### 1. Cereals

*Coix* (2),  
*Digitaria* (2),  
*Echinochloa* (4),  
*Eleusine* (2),  
*Hygroryza* (1),  
*Leersia* (1),  
*Oryza* (5),  
*Panicum* (3),  
*Paspalum* (4),  
*Pennisetum* (2),  
*Setaria* (4).

### 2. Legumes

*Atylosia* (4),  
*Canavalia* (1),  
*Dolichos* (2),  
*Lablab* (1),  
*Macrotyloma* (2),  
*Mucuna* (2),  
*Trigonella* (1),  
*Vigna* (4).

### 3. Vegetables

*Abelmoschus* (4),  
*Aerva* (1),  
*Alternanthera* (1),  
*Amaranthus* (2),  
*Asparagus* (1),  
*Basella* (2),  
*Bryonopsis* (1),  
*Cardiospermum* (1),  
*Chenopodium* (1),  
*Celosia* (1),  
*Centella* (2),  
*citrullus* (1),  
*Coccinia* (1),



### 3. Vegetables

*Ctenolepis* (1),  
*Cucumis* (1),  
*Cycas* (1),  
*Dregea* (1),  
*Enulia* (1),  
*Erythrina* (1),  
*Ipomoea* (1),  
*Lasia* (2),  
*Solanum* (8),  
*Trichosanthes* (2),  
*Woodfordia* (1).

### 4. Root and Tubers

*Alocasia* (3),  
*Amorphophallus* (1),  
*Canna* (2),  
*Colocasia* (2),  
*Cyathea* (1),  
*Dioscorea* (6).

### 5. Oil seeds

*Sesamum* (2),  
*Mentha* (1).

### 6. Spices and condiments

*Ailanthus* (1),  
*Alpinia* (1),  
*Amomum* (1),  
*Brassica* (2),  
*Cinnamomum* (3),  
*Curcuma* (2),  
*Elettaria* (1),  
*Kaempferia* (1),  
*Myristica* (1),  
*Tamarindus* (1),  
*Zingiber* (2).

### 7. Fruits

*Aegle* (1),  
*Annona* (3),





## 7. Fruits

*Antidesm* (1),  
*Artocarpus* (2),  
*Carissa* (2),  
*Chrysophyllum* (1),  
*Citrus* (7),  
*Dialium* (1),  
*Drypetes* (1),  
*Diospyros* (1),  
*Elaeagnus* (1),  
*Elaeocarpus* (7),  
*Euphoria* (1),  
*Feronia* (1),  
*Flacourtia* (2),  
*Garcinia* (6),  
*Grewia* (6),  
*Madhuca* (3),  
*Mangifera* (2),  
*Manilkara* (2),  
*Mimusop* (1),  
*Musa* (2),  
*Nephelium* (1),  
*Podademia* (1),  
*Phyllanthus* (8),  
*Phoenix* (3),  
*Punica* (1),  
*Psidium* (1),  
*Rubus* (2),  
*Salacia* (1),  
*Spondias* (2),  
*Syzygium* (4),  
*Ziphus* (5).

## 8. Fibre crops

*Boehmeria* (1),  
*Corchorus* (2),  
*Crotalaria* (3).



## 9. Others

*Bixa* (1),  
*Borassus* (1),  
*Caryota* (1),  
*Cassia* (1),  
*Ixora* (1),  
*Lentinus* (Mushroom) (1),  
*Polygonum* (1),  
*Saccharum* (1),  
*Vetiveria* (2).

The above list does not represent a complete picture of crop wild relatives in Sri Lanka. It serves to show the range of diversity available. Recent advances in plant biotechnology has enhanced their value immensely. The most common use of wild species has been to incorporate pest and disease resistance to modern cultivars. But there are numerous other traits which remain untapped. There is an urgent need to have a better understanding of the genetic diversity component of these resources to serve as a basis for developing programmes for their conservation and use.

### 2.4.5 Crop genetic resources

The twelve "regions of diversity" of cultivated plants as proposed by Zeven and de Wet (1982) include Sri Lanka in the Indo-Burma Mega Centre of cultivated plants.

Ecological diversity, island biogeography, cultural diversity, the geographical location of the country in the transoceanic east-west route coupled with antiquity of agriculture of the country, have played a major role in the evolution of a rich genetic diversity in several crop plants and their wild progenitors and relatives.

Sri Lankan agriculture has been also enriched by introduction of several crop plants of economic importance since historical times. The introduced types depending on the time introduction and the areas of introduction also exhibit a build up of secondary eco-genetic diversity. Thus the current crop gene pool consists of indigenous crop plants, wild and weedy relatives and the well adapted introductions from all over the world.



**Crop species that exhibit genetic diversity are as follows:**

### **Cereals**

Rice (*Oryza sativa*),  
Finger millet (*Eleusine coracana*),  
Little millet (*Panicum sumatrense*),  
Kodo millet (*Paspalum scrobiculatum*),  
Foxtail millet (*Setaria italica*),  
Proso millet (*Panicum miliaceum*).

### **Legumes**

Green gram (*Vigna radiata*),  
Black gram (*Vigna mungo*),  
Horse gram (*Macrotyloma uniflorum*),  
Velvet bean (*Mucuna pruriens*),  
Lima bean (*Phaseolus lunatus*),  
Rice bean (*Vigna umbellata*),  
Yard long bean (*Vigna unguiculata*),  
Hyacinth bean (*Lablab purpureus*),  
Sword bean (*Canavalia gladiata*).

### **Vegetables**

Egg plant (*Solanum spp.*),  
Cucurbits,  
Snake gourd (*Trichosanthes spp.*),  
Bitter melon (*Momordica spp.*),  
*Coccinia spp.*,  
Cucumber (*Cucumis sativus*),  
*Cucumis melo*,  
Bottle gourd (*Lagenaria siceraria*),  
Okra (*Abelmoschus spp.*),  
Jackfruit (*Artocarpus*),  
*Amaranthus spp.*,  
Ceylon spinach (*Basella alba*),  
*Centella spp.*,  
*Alternanthera spp.*,  
*Celosia argentea*,  
*Ullucus tuberosus*,  
Plantain (*Musa Ipomea*),  
Moringa,  
*Sesbania*.



## Root & tubers

*Dioscorea* spp.,  
*Colocasia* spp.,  
*Alocasia* spp.,  
*Xanthosoma* spp.,  
*Canna* spp.,  
*Solenostemon*,  
*Amorphophallus* spp.

## Oil seeds

Sesame (*Sesamum indicum*),  
Castor (*Ricinus communis*).

## Spices and condiments

Turmeric (*Curcuma domestica*),  
Ginger (*Zingiber officinale*),  
Cardamom (*Elettaria cardomomum*),  
Black pepper (*Piper nigrum*),  
Cinnamon (*Cinnamomum verum*),  
Chilli pepper (*Capsicum* spp.),  
Cloves (*Eugenia carophyllata*),  
Citronella (*Cymbopogon nardus*),  
Tamarinds (*Tamarindus india*),  
Betel (*Piper betel*).

## Fruits

Melons (*Citrullus lanatus*),  
Banana (*Musa*),  
Papaya (*Carica papaya*),  
Mango (*Mangifera indica*),  
*Citrus* spp.,  
Guava (*Psidium guajava*),  
Durian (*Durio zibethinus*),  
*Syzygium* spp.,  
*Annona* spp.,  
Jak fruit (*Artocarpus heterophyllus*),  
Wood apple (*Limonia acidissima*),  
Cashew (*Anacardium occidentale*),  
*Aegle marmelos*,  
*Garcinia indica*,  
Pomegranate (*Punica granatum*),  
*Phyllanthus emblica*.



### 2.4.6 Extent of prevalent diversity

Different agro-ecological regions of Sri Lanka hold rich diversity in both cultivated and wild relatives. Of the cultivated crops in the country, rice exhibits a very wide range of rich diversity. Work done at the International Rice Research Institute identifies Sri Lanka as one of the geographical origin for useful traits (Jackson et al, 1993). Most outstanding are the cultivars with broad based resistance to the Brown planthopper and tolerance to salinity and adverse soil conditions. Ethnobotanical surveys conducted among the farmers have drawn attention to many other qualities and traits. Many of the indigenous food crops are reputed for their nutritional and medicinal or "health food" qualities.

Limited evaluations conducted to date, reveal sources of resistance to pests and diseases among the vegetable germplasm. Among the other cereals, drought tolerance trait is significant. There are large number of indigenous fruit plants which remain underutilized. Sources of resistance to pests have been identified among the legumes. A concerted and systematic effort is needed to unlock this valuable genetic resource for their economically important traits.



## CHAPTER 3

# National Conservation Activities

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### 3.1 INTRODUCTION

The sustainable use of plant genetic resources has been central to the sustenance of the people of Sri Lanka since historical times. The multiple values of these resources were used in different ways according to needs. Since the 1950's and with increase in populational pressures, there has been a progressive erosion of the biodiversity in Sri Lanka. The economic development activities such as irrigation schemes, agricultural expansion, urban development etc. made heavy demands on biodiversity and directly and indirectly aggravated the depletion of the genetic resources. Until the advent of the green revolution crop genetic diversity was an inherent feature of the traditional crops.

The quest for more productive crops to satisfy the demands of the increasing population set in motion the erosion of the crop genetic base. In considering the strategies to conserve biodiversity and promote its sustainable use the underlying socio-economic causes of the biodiversity loss need to be addressed. The choice of conservation strategy or a combination of strategies applied however is basically determined by the composition of a given gene pool. Broadbased community participation is encouraged to sustain the momentum generated with regards conservation of plant genetic diversity.

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### 3.2 INSTITUTIONAL SUPPORT FOR PLANT GENETIC RESOURCES CONSERVATION

In Sri Lanka the national plant genetic conservation activities are largely formulated and implemented through the government agencies functioning under the Ministry of Agriculture, Lands & Forestry. Many other government agencies contribute to PGR activities either with regards their specific mandate crops or in an advisory capacity (Table 3).



**Table 3 Government Sector Institution Concerned with PGR Activities**

Ministry	Department	Organisations	PGR Categories/Activities
Agriculture	Agriculture	Plant Genetic Resources Centre	Plant Genetic Resources of Agricultural importance
Lands Forestry		Botanical Gardens	Ornamentals/rare species
	Forests		Forest Genetic Resources
	Export Agriculture		Spices and beverage crops
	Wildlife Conservation		Wildlife including forests
	Livestock & Animal Husbandry		Pastures, Forages
Plantation crops	-	Tea Research Institute	Tea
		Coconut Research Institute	Coconut
		Rubber Research Institute	Rubber
Indigenous Medicine	Ayurveda	Bandaranayake Memorial Ayurvedic Research Institute	Medicinal Plants
Environment	-	Environment Division	Policy on Biodiversity Issues
		Central Environment Agency	National Conservation Strategy
Science, Technology & Human Resources Development	-	NARESA	Advisory group



**Department of Agriculture** is responsible for the national programme on crop genetic resources. The Plant Genetic Resources Centre (PGRC) specifically established for this purpose in 1989 leads the programme. Management of the Botanical Gardens and Plant quarantine functions also come under the purview of the Department of Agriculture.

**Forest Department** is responsible for the conservation, management and utilization of the natural forests in the country. While the **Department of wildlife conservation** is in charge of the management of the national parks and other categories of protected areas. Department of Export Agriculture maintains living collections of spices and beverage crops. Pasture and forages are maintained by the Department of Livestock and animal husbandry.

The other government agencies which contribute to the national conservation activities are as follows:

1. **Ministry of Plantation Crops:** The Tea Research Institute, Rubber Research Institute and Coconut Research Institute maintain germplasm of their respective mandate crops. A programme on conservation of medicinal plants has been initiated by the Bandaranaike Memorial Ayurvedic Research Institute.
2. The Ministry of Environment co-ordinates all policy matters related to environment which includes biodiversity issues. Natural Resources, Energy and Science Authority (NARESA) functions in an advisory capacity.

Apart from the above government organisations, there are around 800 community based NGO who are active in environmental conservation programmes.





### 3.3 CONSERVATION APPROACHES

In the national genetic resources conservation programmes, the two basic genetic resources conservation approaches of *in situ* and *ex situ* conservation are being used as mutually complementary strategies. The composition of the genepool and associated biological factors are used to determine the appropriate method or a combination of methods suitable for the particular genepool.

#### 3.3.1 *In situ* conservation

**Forest genetic resources.** The programmes in *in situ* conservation are carried out through the legally established protected area networks which are scientifically managed for the conservation of particular eco-systems and the genetic diversity contained within the systems. Sri Lanka has one of the oldest and extensive networks of protected areas, extending to over 14 percent of the land area. Most of the protected area network (9053 km<sup>2</sup>) comprises of 3 Strict Nature Reserves, 3 Nature Reserves, 12 National Parks and 51 Sanctuaries established under the Fauna and Flora Protection Ordinance and managed by the Department of Wildlife Conservation. The remainder (1,178 km<sup>2</sup>) consists of Sinharaja National Heritage Wilderness Area, 40 National Man and Biosphere reserves (MAB), and 14 Conservation forests which are managed by the Forest Department.

A comprehensive, scientific and systematic survey is presently underway in all natural and near natural forests including grasslands and mangroves. This survey is known as the National Conservation Review (NCR). The longterm objective of NCR is to assess the biological diversity being represented in the existing protected area networks and define a minimum set of sites necessary to conserve the available diversity.

**Wild relatives of crops.** The indigenous genepool of medicinal plants, wild types and wild relatives of crops are found mainly in the wild. The candidates targeted for *in situ* conservation are:

1. Fruit crop genetic resources;
2. Species with recalcitrant seeds;
3. Wild relatives of rice, legumes and spices;
4. Medicinal plants.



This list is preliminary as there is inadequate data available to assess the status of infra-specific variability of these wild relatives.

PGRC has initiated a long term study to monitor and assess the prospects for conserving wild relatives of crops *in situ* in the Yala National Park. Ecogeographic surveys to determine the distribution of particular species, patterns of infra-specific diversity, habitat conditions, companion species, extent of habitat disturbance through grazing etc. are being conducted. Changes in populational structure over time are continually monitored. The study aims to determine the minimum requirements for conservation of these species.

**On farm conservation of Landraces.** Till the early 1960's farmers were the custodians of the complete range of genetic diversity available in the landraces of the traditional cultivars. By the early 1980's especially with regards to landraces of rice, almost 90 percent has been replaced with modern cultivars. Today PGRC genebank holds more traditional rice cultivars and genetic diversity than that are available with the farmers. Still there are pockets of area where farmers maintain landraces for their various direct and indirect benefits of:

1. Consumptive use value with regards to quality characteristics, local food preparations etc.
2. Productive use value such as medicinal value, marketability for premium quality etc.
3. Non consumptive use value for suitability for particular eco-systems, cultural values etc.
4. Option value in maintaining the landrace components to face future uncertainties in agricultural, environmental and socio-economic systems.
5. Existence value of these resources which are concerned with spiritual, socio-cultural aesthetic factors.

However in the present socio-economic context the suitability of "On farm conservation" as a viable strategy for maintaining crop genetic resources needs to be evaluated scientifically. Answers needs to be obtained for key questions concerning the:

1. General issues relating to the concept, nature, scope, distribution of sites etc.
2. Genetic issues concerning the genetic consequence of on farm conservation, the factors which lead to genetic changes in population, the suitability for maintaining broad genetic diversity. Concern is more about



the understanding the loss of genetic diversity than loss of varieties per se and how to maintain this diversity through landraces.

3. Socio-economic and environment factors with regards traditional farming systems through which crop genetic diversity can be conserved and also enhanced. The feasibility of establishing "community seed banks" also needs to be studied.

Preliminary discussions have been initiated with some of the community based NGO to start a pilot project in this regard. Ethno botanical studies on traditional farmer methods of preserving seed materials, of keeping seed moisture low, and preventing damage from pests are also being carried out.

**Home garden system.** Home gardens are commonly found in many rural areas of Sri Lanka. The size of the gardens vary from 100 m<sup>2</sup> to about 1000 m<sup>2</sup>. As altitude increases the home gardens become smaller with greater density of plants and plant species and lower diversity. A well defined plant association and canopy structure that reflect a variety of complementary functions are displayed in the system. At the outer perimeter coconut and fruit trees predominate and canopy is progressively reduced with the planting of spice crop trees. Vegetables occupy the inner perimeter. Near the well or open drainage areas indigenous yams are grown. Medicinal plants are frequently grown under shade. Ornamental plants mostly occupy the front garden near the house.

For several perennial fruit crops such as Banana, Mango, Jak, Citrus, Avocado, Mangosteen, Durian, Rambutan, Guava, Papaya the bulk of the genetic diversity is still conserved through this system. Trees for fuelwood also from part of this self sustaining arrangements. Home gardens constitute valuable system for conservation of genetic diversity. Nevertheless the importance of home garden for genetic resource conservation has still not been widely recognised and little inventory work done.

### 3.3.2 *Ex situ* conservation

Sri Lanka implements a strong national programme on *ex situ* conservation of genetic resources especially with regards to plants of agri-horticultural importance. This programme has been accelerated during the past decade. Most common methods used at present for *ex situ* conservation and the corresponding plant genetic resources categories to which these methods are applied are given below in Table 4.



### 3.3.3 Plant Genetic Resources Centre

A facility for conservation of plant genetic resources was a long felt need of the Department of Agriculture. The centre was established in 1989 with the assistance of the Japan International Co-operation Agency (JICA) under its grant aid scheme. Since the inception the centre was also supported by a JICA Technical Co-operation Programme specifically for the provision of long term and short term Japanese experts, training opportunities for national scientists in Japan and for procuring equipments. This programme which was initially agreed for 5 years was subsequently extended for additional 2 years in recognition of the progress made and was completed by the end of March

**Table 4 Ex situ Conservation Methods**

Methods	Plant Genetic Resources categories	Organisations
Seed genebank	All crop plants and their wild relatives which produce orthodox seeds	PGRC
In vitro genebank	Vegetatively propagated crops	PGRC
Field genebank	Vegetatively propagated crops, tree crops, plants that produce recalcitrant seeds, medicinal plants and spice trees	PGRC, HORDI, BMARI, CRI, RRI, DEA
Botanical Gardens	Tree species, ornamentals, medicinal plants,	BG
Arboretum	Forest trees	FD
Cryopreservation	Vegetatively propagated crops and seeds (Experimental stage)	PGRC



1995. The operational costs for running the centre including salaries, wages, other miscellaneous expenditure are fully supported by Government of Sri Lanka funding.

PGRC mandate is to ensure that the genetic diversity of food crops and other economic species is adequately collected, conserved, evaluated, documented and made available to the breeders and researchers. The main functional components of the programme structure in this regard are:

1. Exploration, Collection and Introduction.
2. Multiplication, Characterization and Evaluation.
3. Conservation.
4. Documentation.
5. Public awareness programme.

These programmes are backed by research activities related to *in vitro* culture, seed conservation, genetic diversity and germplasm enhancement.

### **3.3.4 Exploration, collection and introduction**

Exploration and collection programmes are planned by taking into consideration the extent crop diversity available and the degree of genetic erosion experienced. The collection missions for crops are undertaken in consultation with the different crop breeders and the agricultural extension staff of the Department of Agriculture. Exploration programmes for wild relatives of crops are carried out with participation of the staff of the Forest Department and that of the wildlife conservation. The information obtained during collection missions are being collated and investigations on genetic diversity assessments are being carried out.

### **3.3.5 Collection strategies**

The centre undertakes both multi crop/area specific and crop specific collection missions. Priority is afforded to need based collection programmes to feed the adaptive research and crop improvement programmes. Until recently there was a gap in collecting activities with regards the perennial fruit crops. Concerted efforts are presently being carried out to fill this gap.

During collection missions the sampling frequency is mainly determined by the ecological diversity and patterns of distribution. Random sampling over predetermined intervals are used to make a representative collection. For wild



and weedy types, clustered sampling is carried out. Sample size depend on the population type and varies from 30 plants to 60 plants per site. Wherever necessary, herbarium materials are also collected. A preprinted field collection form is used to record field data.

Foreign introductions are obtained through bilateral MOU's established with other national systems. Germplasm requests are also fulfilled through germplasm and information exchange programmes with the different IARC and also through FAO seed exchange unit.

### 3.3.6 Germplasm collection status

The status of national collection as at the end of January 1995 is given in Table 5. Over the last 6 years 11,205 accessions covering 150 plant species have been assembled.

An assessment of the reported diversity available in the country and the crop diversity already surveyed and assembled by PGRC reveals that wild relatives and fruit crop components are under-represented in the PGRC collection systematic collection programmes are being planned to fill this gap. The status germplasm collection by category is given in Table 6.

Nearly 65 percent of the assemblage consists of indigenous landraces and introductions amount to about 13 percent of the collection. The main sources of introduction are IRRI, Philippines; ICRISAT, India; AVRDC, Taiwan; CIP, Peru; CIMMYT, Mexico; MARDI, Malaysia; and FAO Seed Exchange Unit, Rome. A total of 3144 accessions amounting to 28 percent of the total

**Table 5 Germplasm collection status by crop group**

Crop group	N° Species	N° Accessions	% collection
Rice	02	3,809	34.0
Other cereals	09	785	7.0
Grain legumes	14	1,907	17.0
Vegetables	52	2,927	26.1
Spices & condiments	09	500	4.5
Fruits	16	363	3.2
Root & Tubers	07	309	2.8
Oil seeds	03	180	1.6
Medicinal plants	12	21	0.2
Wild relatives	26	308	2.7
Others	-	96	0.9
<b>Total</b>	<b>150</b>	<b>11,205</b>	<b>100</b>





collections have been distributed to institutions abroad. Major recipients are IRRI, Philippines; NIAR, Japan; NBPGR, India; ICRISAT, India; AVRDC, Taiwan; and also universities in UK, USA and Kenya.

**Table 6 PGRC Germplasm collection status by category**

Category	Accessions	%
Indigenous landraces	7,194	64.2
Improved varieties & breeding lines	2,210	19.7
Wild & weed	308	2.7
Introductions	1,493	13.3
<b>Total</b>	<b>11,205</b>	<b>99.9</b>

In addition to the collection missions conducted solely by PGRC/DOA Scientists, several collaborative missions have been undertaken locally with the participation of scientists from other countries and also IARC's. The list of these missions are given in Table 7.

### 3.3.7 Genebank facilities

The basic facilities consists of a 25,000 accession capacity genebank, seed laboratory, germination testing room, seed drying and packing area. The cold storage is designed with 16 prefabricated walk-in type refrigerators each with storage capacity of about 16 m<sup>3</sup>. The walk-in type refrigerators afford an energy saving type of storage conditions. Emergency generator takes over power supply in case of main line power cut. Additionally, an airconditioned and dehumidified room is available for temporary storage and batching of

**Table 7 Collaborative collection missions**

Participating organisation	Number of missions	Crops
IRRI	8	Rice & wild relatives
ICRISAT	3	Millets, legumes and their wild relatives
AVRDC	1	Vegetables
NIAR	6	Multi crop
NBPGR	2	Okra and Egg plants





incoming germplasm for processing and incorporation into genebank. The storage conditions under which the seed collections are being maintained are given in Table 8.

Seed drying is carried out using Munters drying chambers operating at 20°C and 15% RH. Seed viability criteria for entering germplasm into storage is maintained at 85% viability level. Viability control of the stored accessions is exercised through viability control samples established for each crop species. Viability of stored accessions are tested once in 5 years. Rejuvenation standard is set at 85 percent viability level. Control samples are established in the storage cubicles to check the moisture leakage, if any, into stored cans over the years. Samples are taken once a year and seed moisture tested. Awns, if present, are removed from seeds during processing to prevent damage to the containers

**Table 8 PGRC Seed Storage Conditions**

Collection Type	Storage			Type of	
	Seed Moisture %	Temp. °C	Relative Humidity	Container	Sealing
Base	5-7	1°C	45-50	Tin cans coated with anti-corrosive film, lids lined with rubber gasket	Hermetic seal
Active	5-7	5°C	45-50	Triple laminated aluminium foil	Heat seal

especially the aluminium foil bags. For cross pollinated crops the accessions size is 6000-8000 seeds. In the case of self pollinated crops 4000 seeds are kept.

For each accession, depending on the amount available the materials are filled serially into three cans each with a volume of 100 ml for the base collection. Active collection for each accession is bagged serially into four aluminium foil bags. The amount kept in the active collection varies according to seed size, 1000 seed weight etc. Accordingly, the active collection seed weight in storage per accession varies from 100 gms (small seeds) to 500 gms (large seeds).

Generally, germplasm received in the genebank, are 'batched' according to order of the receipts and are immediately transferred to the airconditioned



short term store maintained at 160°C and 40% RH. The processing is done sequentially according to batch number. There are exceptions to this normal procedure. Poor storers like soyabeans, onions etc. are processed early as soon as samples are received. Seed material of the vigna species are liable to infested with weewils and borers and hence these materials are also given preference over others in processing and are incorporated into genebank as early as possible. During harvesting season when multiplication receipts to the genebank are large, the incoming samples stay in the short term room for about 2 months. Extra effort however is made to clear the backlog early as possible.

Every effort is made to obtain the required accession size from a single multiplication cycle. At times it becomes necessary to follow two or even three multiplication cycles. However the materials from different multiplication cycles are never bulked together. They are separately 'bagged' or 'canned' and the containers are labelled 00 for original collections, 01 for first multiplication and 02 for materials from the second multiplication cycle.

The PGRC rice germplasm is duplicated at the International Rice Genetic Resources Centre at IRRI. Active collections are also being maintained at the cold room facilities established at RARDC, Bombuwela, RARDC, Makandura and RRDI at Batalagoda.

Presently the base collection at PGRC does not conform to seed storage temperature of -180C recommended by the IBPGR expert committee on genebank standards. Proposals have been made to donor agencies to help establish a minimum of two modules capable of operating at -180C and under low humidity levels.

### **3.3.8 *In vitro* Storage**

Vegetatively propagated root and tuber crop germplasm and fruit crop germplasm amounting 309 accessions are maintained as *in vitro* cultures under minimal growth conditions. Research is underway to perfect methodology with regards cryogenic storage.

### **3.3.9 Field Genebanks**

Vegetatively propagated fruit crops, recalcitrant seeded crops, root and tuber crops are maintained as field collections. The Department of Agriculture has



been maintaining live collections of these crops for a long time. However in the recent years efforts are being directed to organise these collections systematically into field genebanks for maintaining diversity. The field genebank sites are being located in farms which come under the purview of the Horticultural Research and Development Institute (HORDI) and Field Crops Research and Development Institute (FCRDI) of the Department of Agriculture in the various agro-ecological zones of the country. The specific agro-ecological requirements of these different crop are fulfilled through this arrangement. Additionally, since the field genebanks are sited in research farms the use of the conserved materials are also promoted. The PGRC co-operates with these institutes in conservation and management of the databases centrally. The field location of genebanks and the crop responsibilities are



**Table 9 Field Genebank facilities**

Institute	Location	Agro-ecological zone	Crop species			
HORDI	Gannoruwa	Mid country Wet zone	Citrus spp. (23)			
			Guava (2)			
			Avocado (19)			
			Jak (2)			
			Mango (21)			
			Banana (9)			
			Rambutan (2)			
			Durian (1)			
			Anona (3)			
			Sweet potato (71)			
			Cassava (110)			
			Dioscorea spp. (29)			
			Colocasia spp. (6)			
			Xanthosoma spp. (8)			
			Alocasia spp. (1)			
			Canna spp. (2)			
			Solenostemon spp. (19)			
				Bandar-wela	Up country Intermediate Zone	Citrus spp. (13)
						Mango (15)
			Guava (3)			
			Passion fruit (1)			
			Pears(3)			
			Banana (4)			
			Apple (2)			
			Plum (2)			
			Pomegranate (1)			
			Pineapple (3)			



Institute	Location	Agro-ecological zone	Crop species
	Rahangala	Up country Intermediate zone	Citrus spp. (10)
			Mango (11)
			Guava (30)
			Avocado (34)
			Pears (3)
			Grapes (35)
			Anona (1)
			Apple (5)
			Plum (7)
			Peachs (9)
			Carambola (1)
			Macadamia (6)
			Strawberry (4)
	Matale	Mid country Intermediate zone	Citrus spp. (1)
			Banana (1)
	Makandura	Low country Intermediate zone	Citrus spp. (1)
			Mango (1)
			Guava (1)
			Jak (1)
			Rambutan (1)
			Anona (1)
			Banana (1)
			Durian (1)
	Pasyala	Low country Wet zone	Rambutan (4)
			Citrus spp. (1)
			Mango (6)
			Guava (2)
			Jak (1)
			Avocado (1)



Institute	Location	Agro-ecological zone	Crop species
FCRDI	Maha Illuppallama	low country Dry zone	Mango(53)
			Citrus spp. (1)
			Banana (12)
			Grapes (30)
	Girandurukotte	low country Dry zone	Mango (32)
			Guava (3)
	Aralagamwila	low country Dry zone	Citrus spp. (7)
			Mango (17)
			Grapes (11)
	Ulpatha-gama	low country Dry zone	Mango (8)
	Angunakolapelessa	low country Dry zone-South	Citrus spp. (22)
			Guava (5)
Banana (41)			
Plantain (13)			
RARDC	Bambuwela	low country Wet zone	Mango (23)
			Guava (3)
			Avocado (9)
			Banana (31)
Bandaragama	low country Wet zone	Citrus spp. (1)	
		Mango (20)	
		Guava(10)	
		Jak (1)	
		Mangosteen (1)	
		Rambutan (8)	
		Durian (2)	
		Pineapple (1)	
Soursop (1)			



Institute	Location	Agro-ecological zone	Crop species
Government Farm	Bibile	Up country Intermediate zone	Mango (33)
			Citrus spp.(4)
			Pineapple (3)
			Banana (5)
Maneragala	low country Dry zone		Citrus spp. (36)
			Mango (24)
			Guava (4)
			Jak (1)
			Avocado (1)
			Grapes(16)
			Banana (3)
			Rambutan(1)
			Durian (1)
			Papaya (1)
			Pomegranate (2)
			Carambola (2)
			Wood apple (2)
			Veralu (Elaeocarpus) (1)
			Loguats (1)
			Nelli (Phyllanthus spp.) (1)
			Aegele Marmelos (1)
PGRC	Gannoruwa	Mid country Wet zone	Citrus spp. (23)
			Mango (3)
			Jak
			Banana (10)
			Guava (2)





summarized in Table 9. The number of accessions available are given in paranthesis for each crop.

### 3.3.10 Botanical Gardens

The Botanical Gardens in Sri Lanka were really the precursor to the present Department of Agriculture. In the early era the gardens served the mission of introduction and acclimatisation of economic species. The introduction, for example of coffee, tea and rubber into Sri Lanka was so successful that even

**Table 10 Botanical Gardens in Sri Lanka**

Location	Year estbl.	Ecological zone	Extent (ha)	Plant species	
				Category	Number
Peradeniya (Royal Botanical Gardens)	1821	Mid country Wet zone	60	Trees & shrubs (local & exotic) Herbs Medicinal	5,000 3,000 75
Hakgala	1867	Up country Wet zone	20	Trees, herbs & shrubs	1,000
Gampaha	1876	Low country Wet zone	13	Trees, herbs & shrubs	500
Ganewatte	1951	Dry & Intermediate zone	23	Medicinal	150
Pallekele	1990	Up country Intermediate zone	0.4	Medicinal	100

today its beneficial effect to the local agricultural economy continues. Presently Botanical Garden comes under the purview of the Department of Agriculture. There are four Botanical gardens as listed below in Table 10.

Of the 202 ha in the Hakgala gardens, only 30 ha are landscaped and the balance is maintained as a natural reserve. Together, the four Botanical Gardens maintain over 10,000 plant species both indigenous and exotic. Many specialist collections are also being maintained. Ten species of Cacti and ten species of orchids are maintained as *in vitro* cultures. Twenty species of turf grass are maintained as vegetative collections.

The botanical gardens are also responsible for the development and maintenance of National Herbarium and conservation of endangered plant



species. In addition to their role in plant resources conservation, the botanical gardens offer unique opportunities in creating public awareness of the need for and method of conservation of plant resources.

### 3.3.11 Field genebanks for plantation crops, aromatics and medicinal plants

**Tea.** The Assam species of tea *Camellia assamica* were introduced to Sri Lanka in 1839 and commercial cultivation was started in 1867. Conservation and improvement of tea is carried out by the Tea Research Institute. The germplasm is maintained as vegetatively propagated clones.

**Rubber.** Rubber was introduced to Sri Lanka in 1876 from the Kew gardens by Wickam. Almost all the clones have been bred from the original seedling brought by Wickam. Subsequently in the recent times direct introductions have been made from Latin America and also Malaysia. A total of 9,046 clones are maintained as live collection by the Rubber Research Institute of Sri Lanka in 3 wet zone locations.

**Coconut.** Conservation of coconut germplasm is carried out by the Coconut Research Institute at 3 locations in the intermediate zone. These field genebanks are nearly 8 years old. Local germplasm as well as introductions are being maintained. Thirty nine germplasm accessions are presently available in the field genebanks.

**Table 11 Field genebanks for spices and beverage crops**

Location	Ecological zone	Crop species	No. of accessions
Matara	Low country Wet zone	<i>Cinnamomum spp.</i>	200
		<i>Citronella spp.</i>	25
Kurunegala	Low country Intermediate zone	<i>Piper betel</i>	15
Matale	Mid country Intermediate zone	<i>Elettaria cardamomum</i>	10
		<i>Piper nigrum</i>	167
		<i>Theobroma cacao</i>	65
		<i>Coffea spp.</i>	18
		<i>Areca catechu</i>	65



### 3.3.12 Spices and beverage crops

Conservation of genetic resources of aromatic crops is carried out by the Export Agriculture Research Centre of the Department of Export Agriculture. Three field genebanks are established for this purpose (Table 11). Additionally 20 accessions of Nutmeg (*Myristica fragrans*) and 10 accessions of clove (*Eugenia carophyllata*) are maintained *in situ* at two locations in Kandy and Matale.

### 3.3.13 Medicinal plants

Conservation of medicinal plant resources have been initiated in the recent years by the Bandaranaike Memorial Ayurvedic Research Institute (BMARI) which conducts research on indigenous medical systems. Four field genebanks are being established to suit the specific ecologic requirements of the target plant species. The location and extent planned is given in Table 12.

**Table 12 Field Genebanks for medicinal plants**

Location	Ecological zone	Extent (ha)
Haldumulla	Up country wet zone	7
Pattipola	Up country wet zone	7
Nawinna	Low country wet zone	20
Girandurukotte	Low country dry zone	45

Additionally, medicinal plants are also maintained by the Botanical Gardens in 3 locations (Table 10).

## 3.4 DOCUMENTATION OF CROP GENETIC RESOURCES

Plant genetic resources database management system for inventory purposes and to carryout various operations as well as to cover utilization aspects is now operational at PGRC. The database consists of data relating to crop species and their wild relatives. Personal computers are used and database system was designed using Informix SQL and 4GL Software. A local area network has been installed to increase the efficiency of database operations. Major categories of information and their current status are given in Table 13.



**Table 13 Status of PGRC genetic resources data**

Category	No. of Accessions	No. of Records
Passport	8,300	116,200
Characterization	3,000	90,000
Storage	4,100	77,900

The data incorporation has now been accelerated and the computerized database duplicated for safety through backup floppy diskettes, tape backup as well as by the manual record system. Considerable care and safeguards are being taken to maintain the integrity of the database system.

A genetic resources catalogue is now under publication to help the users. Data is also provided to the users through floppy diskettes. Users are also encouraged to interact with database management staff to obtain computer print outs of their requests.

Descriptor lists for 38 crop species were prepared with the active participation of the respective crop leaders and plant breeders. Work is being continued for other crop species. Check lists for taxonomic verification of assembled species have been completed. Rice evaluation data obtained from IRRI, Philippines was imported to the central database and is now available for users. A local area network has been recently installed to increase the efficiency of data management operations.

### 3.4.1 Documentation of forest species

The forest department has initiated a computerised Environment Information Management System. This database includes data relating to both plants and animals. Currently the database holds about 23,000 records in the plant database. The work is continuing.



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### 3.5 REGENERATION OF GENE BANK ACCESSIONS

Regeneration of genebank accessions is carried out for:

1. multiplication of incoming genebank collections to achieve the required accession size in the base and active collections,
2. rejuvenation of stored accessions when viability decay of reaches rejuvenation threshold levels and also to meet the stock depletion in active collections.

The aim in both instances is to ensure the maintenance of genetic integrity and obtain adequate quantities of high quality germplasm. However there has still been no necessity to carry out rejuvenation of stored accessions.

Initial multiplication of PGRC collections are carried out at PGRC fields and also in the research fields of the Crop Research and Development Centres in the different agro-ecological regions of the country (Table 14). It is usual for initial multiplication of germplasm to be coupled with preliminary characterization. Nearly 60 percent of the assembled germplasm has undergone the initial multiplication programme.

For self pollinated crops harvest from about 60 plants are bulked. Plants of border rows are discarded. Depending on the crop the between row and within row spacing is adjusted to avoid contaminations.



**Table 14 Germplasm Regeneration Locations**

<b>Agro-ecological zone</b>	<b>Location</b>	<b>Crops</b>
Low country Dry zone	FCRDI, Maha Illuppallama	Rice, millets, vegetables, spices and condiments
Low country Intermediate zone	RRDI, Batalagoda	Rice
Mid country Wet zone	PGRC, and HORDI, Peradeniya	Rice, vegetables, spices and condiments
Low country Wet zone	RRDC, Bombuwela	Rice
Low country Dry zone	RRDC, Angunakolapelessa	Oil seeds, vegetables and rice

For cross pollinated crops controlled pollination is practiced during multiplication. However this practise impose difficulties when large number of accessions are being multiplied. Precautions are taken during multiplication to prevent genetic drift. Depending on the crop involved population size ranging from 80 - 200 plants are used. For introductions preliminary multiplication is carried out in isolation green houses.

Multiplication of wild populations present many difficulties. Difficulties are encountered with regards flowering behaviour, pollination, sterility etc. These plants are multiplied using pots in special green house. In general, 4 - 5 pots per accession are used and the seed harvest is very low.

### 3.6 CHARACTERIZATION AND EVALUATION

The characterization and preliminary evaluation of assembled germplasm is conducted at PGRC as well through the co-operation of the crop specific Research and Development Centres and the Regional Centres located in the different agro-ecological zones (Table 14). Wherever possible characterization is carried out during the initial seed multiplication programme. Standardised characterization descriptors based on IBPGR crop descriptors are used and plant characters which are expressed in all environments are recorded. Crops for which IBPGR descriptors are not available new descriptor states have been prepared by the PGRC Scientists. Morphological features such as plant, leaf, floral, fruiting and seed characteristics are recorded at predetermined growth stages. Limited agronomic characters e.g. tillering maturity, time of heading



etc. are also recorded. Most of the characterization is carried out in PGRC fields and the balance is carried in the regions.

Apart from morpho-agronomic traits, biochemical methods are also being used to characterize germplasm. Electrophoretic analysis using both isozymes and seed proteins are conducted.

Evaluation for economic traits such as pest and disease resistance are not directly carried out at PGRC. This programme is carried by the multi disciplinary specialists attached to the Crop Research and Development Institutes and the data feed back is obtained. During characterization these specialists co-operate and make visual observation which subsequently helps in the evaluation proper. Information on genetic evaluations carried out, using Sri Lankan germplasm, in the IARCs are obtained. These data, for example in rice, provide valuable clues in identifying useful gene sources in the PGRC collections. While farmers are not directly involved in germplasm evaluation, information obtained from them during collection expeditions helps to identify potential germplasm sources for the conduct of evaluations. Systematic evaluation of all the germplasm available with PGRC is difficult and not practicable. Currently material for evaluations are selected using :

1. Information assembled by collectors from farmers as well as their observations on biotic and abiotic factors recorded during collections.
2. Observations recorded during seed increase, and characterization.
3. Data obtained from systematic evaluations conducted on Sri Lankan germplasm in the different IARC.

Additionally the establishment of a "core collection" is under active consideration. Passport data of all the assembled collections are available. However characterization and preliminary evaluation data is not complete and is being accelerated. The core collection once designated is expected ease the present difficulties experienced in promoting systematic evaluations.

During the last five years of operation nearly 2,000 accessions have been distributed for evaluation to different Research Institutes and Universities in Sri Lanka. The users of this materials have undertaken to send back their research findings for incorporation into the PGRC database. Todate nearly 20 percent of the users have supplied the necessary information.





## CHAPTER 4

# National Goals, Policies, Programmes and Legislation

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The organization of the "national programme" for genetic resources, and its policy/political and legal framework emerged as a result of several decades of historical evolution, adjustment and adaptation. Fairly stable and functional institutional framework and legislation pertaining to natural resources management is available.

It is noteworthy to mention that section 28 (f) of the constitution of Sri Lanka has embodied into it as a duty of every person to conserve and protect nature. It reads as follows 28. The exercise and enjoyment of rights and freedom is inseparable from the performance of duties and obligations and accordingly it is the duty of every person in Sri Lanka (f) to protect nature and conserve its richness. Legislation pertaining to natural resources managements date back to the 19th century. In fact village traditions in most situations continued on sustainable resource use.

The Fauna and Flora Protection Ordinance of 1938 and its subsequent amendments protects the flora and fauna in National Reserves (Strict Natural Reserves, National Parks, Nature Reserves, Jungle Corridors, Refuges, Marine Reserves, and Buffer Zones) and Sanctuaries. The provisions of the ordinance, particularly with the far reaching amendments brought in by Fauna and Flora Protection (Amendment) Act of 1993, is fairly adequate to give legal protection to flora and fauna within the different categories of protected areas referred to above.

Well formulated resource management and environmental conservation policies were undertaken during the 1980s. To give greater emphasis to the constitutional pledge to protect the environment the National Environmental Act (No 47 of 1980) was introduced. To implement this, the Central



Environmental Authority (CEA) was set up in 1981 as the state agency to look after the "formulation and implementation of policies and strategies for the protection and management of the environment in Sri Lanka".

Sri Lanka has recognised the objectives of the World Conservation Strategy (WCS) of 1980, and prepared a National Conservation Strategy (NCS) which was initiated in 1982 by a task force appointed by the President. This programme was co-ordinated by the CEA. The NCS recommended that "natural forests should be identified and made inviolate by statute" and "land for economic exploitation be demarcated and systematically managed.

To safeguard the environment and nationally manage the natural resources a National Environmental Action Plan (NEAP) was developed in 1991, which emerged basically from the recommendations formulated in the NCS. In the NEAP the practical approaches and required management strategies for their implementation for a five year period (1992 to 1996).

The National Plant Genetic Resources activities are organised in various co-operating departments and institutions in different ministries. The major institutions are the departments in the Ministry of Agriculture, Lands and Forestry, Natural Resources, Energy and Science Authority (NARESA), the Central Environmental Authority, Department of Ayurveda, Coconut Research Institute, Rubber Research Institute, Tea Research Institute, Sugarcane Research Institute.

A new Cabinet Ministry of Environment and Parliamentary Affairs (MEPA) was initiated in March 1990 to formulate and co-ordinate all policy matters on environmental issues. In August 1994 the environmental issues are assigned to the Ministry of Environment, Highways, Transport and Women's Affairs.

The National Environmental Act which was passed in 1980 led to the establishment of District Environmental Agencies (DEAs) in the administrative districts. Devolution of power to the Provinces was effected by the Thirteenth Amendment to the constitution in 1987 which enhanced the management of the environment and natural resources at the provincial level. A long period of Participation of Non-governmental organizations (NGOs) has further enhanced effective public participation in decision making and activities that affect the environment and natural resources. Surveys of 1980s indicated that there were 800 community based NGOs who were principally concerned with environmental conservation. These NGOs generate public awareness on environmental issues, and advocate environmentally sound public policy.



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## 4.1 NATIONAL LEGISLATION

Quarantine laws allow the international transfer of seeds and *in vitro* materials, and no loss of materials through quarantine are experienced. National laws restricts unregulated collection and export of flora, as well as planting out of certain imported genetic resources to comply to quarantine regulations.

Sri Lanka's protected area network is considered to be large and lies in the dry and arid areas where both biodiversity and endemism are low. Many of the ecosystems in the wet areas, where most of the country's biodiversity and endemism occur, are not included in the protected area network. Hence it is vitally important that adequate measures be adopted to ensure the protection of the country's indigenous fauna and flora outside the protected area network.

The protection of flora outside National Reserves and Sanctuaries is covered by Section 42 of the Fauna and Flora Protection Ordinance. The number of protected species of plants has been increased from nine to over 450 through the Fauna and Flora protection (Amendment Act of 1993).

Incentives are not provided to farmers for the on-farm conservation of traditional varieties. The sale and distribution of seeds are predominantly restricted to the Certified and Registered Seeds which comes under the Seed Certification scheme. However imported exotic vegetable seeds from Registered Companies are used for local cultivation. Farmers' varieties are not traded as seed legally, but can be used for seed by any other consenting private individual.

Intellectual Property Rights (IPR) legislation are yet to be formulated. However this does not affect the current genetic resources programme, and no external assistance are needed on legal matters concerning plant genetic resources.

Policy on exchange of plant genetic resources are to be based on additions to the Fauna and Flora Protection ordinance, which are given in the next chapter. A National Experts Committee on Biodiversity has been setup by the Ministry of Environment to guide and advice it on actions that are necessary to fulfill Sri Lanka's obligations and to promote the conservation and sustainable use of biodiversity as set out in the Biodiversity Convention.



## 4.2 OTHER POLICIES

Production and marketing of improved varieties as certified seed are mainly handled by the Department of Agriculture. Certain amount of certified seed is produced by Registered seed grovers with provision of some incentives. Depending on availability credits, subsidies or other incentives are available for the provision of fertilizer, seed etc. This scheme restricts the use of recommended variety for cultivation for increased production.

The national PGR programme staff and other PGR experts are involved in the planning of (a) major agricultural development projects, (b) Recommendation committee for the protection of fauna and flora in National Reserves, (c) Preparation of the Biodiversity Action Plan (d) National Experts Committee on Biological Diversity and (e) Biotechnology Steering Committee.



## CHAPTER 5

# International Collaboration - UNCED

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Sri Lanka adopted Agenda 21 with emphasis on conservation and sustainable utilization of plant genetic resources for food and sustainable agriculture, and the conservation of Biological Diversity.

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### 5.1 FAO AND CGIAR

Through the FAO system exchange of plant genetic resources was made possible, and the introduced materials were made use of in crop improvement programmes. With the formation of the International Board for Plant Genetic Resources (IBPGR), Sri Lanka participated at the inaugural meeting of South and South East Asian Plant Genetic Resources Group in May 1978. First Sri Lankan proposal for the collection and conservation of plant genetic resources in an organised manner was presented in 1978, and a National Plant Genetic Resources Team was setup at national level for the collection and conservation of agrobiodiversity.

The Genetic Evaluation and Utilization programme of the CGIAR commodity centres, and the Regional Research Centres have greatly enhanced the development and adaptability of high yielding cultivars of crops for the improvement of national yield levels. The support from CGIAR and Regional Research Centres came both directly from the institutes and also through the centre staff based in Sri Lanka. The national programme staff were greatly benefitted from short, medium and long term post-graduate training received from CGIAR centres.

The International Rice Research Institute (IRRI) Philippines has assisted Sri Lanka in maintaining 2,500 local rice varieties in the IRRI genebank, until 1988 as genebank facilities were not available in Sri Lanka at that time. Collaboratory CGIAR research and development programmes were undertaken locally with the participation of national scientists.



Recognising the urgent need to establish infrastructure facilities for Plant Genetic Resources Conservation in Sri Lanka, a firm request was made at the International Technical Conference on Crop Genetic Resources held at FAO Rome in April 1981, which resulted in IBPGR dispatching an Expert team, headed by Prof. Y. Izuka, in 1982 to evaluate the need, and selection of the Department/Institute, and the location for the setting-up of the facility. With the provision of Grant Aid funds from the Japan International Corporation Agency, the development of the Plant Genetic Resources Centre was initiated in 1987. Sri Lanka has no bilateral intergovernmental initiatives with the other governments.



## CHAPTER 6

# National Needs and Opportunities

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- Develop computerized database system, by collecting all the relevant data and maintain upto date information on the biodiversity of Sri Lanka, as available information are scattered and isolated among several institutions, agencies and individuals.
- Useful information from international sources also should be maintained and frequently updated.
- The Section 42 of the Fauna and Flora Protection ordinance not only prohibits the collection of indigenous and endemic plant species listed in Schedule V, but also the sale or export for sale of these plants. Such activities are now carried out openly and suitable action must be taken through the ordinance to curb this illegal practice. The provisions of Section 42 of the ordinance taken together with Schedule V should be vigorously implemented. Adequate training to be provided to train staff and other officers responsible for implementing. Section 42 of the ordinance to help them identify some of the species which are commonly subjected to removal and sale.
- Study should be undertaken to identify other species of plants that are threatened and which should be included in Schedule V so that these should be added to the schedule.
- Adequate safeguards have to be taken to prevent unregulated exports of endemic plant species. With increasing biotechnological research in developed countries, export of endemic and rare species should be made after effecting necessary regulatory measures to derive benefits to Sri Lanka from such research undertakings.
- The export of flora is covered under Section 45 of the ordinance which states that regulations may be made prohibiting or regulating the export from Sri Lanka of "any specified plants, whether or not such plant is included for the time being in Schedule V".

Thus the provision in the ordinance is quite inadequate to regulate the export of plant genetic resources from the country. Scientists and conservationists are of the view that with the exception of a few species that are artificially





propagated and exported for commercial purposes there should be careful control of the export of naturally occurring indigenous plant genetic resources from the country. Export of species will be allowed only when:

- a. the export of the species will not endanger the survival of the species in Sri Lanka,
  - b. the export will not pose a threat to the natural habitats of the species in Sri Lanka,
  - c. the relevant Articles of the convention on Biological Diversity, in as far as they are applicable to Sri Lanka and the importing country are complied with,
  - d. the export is in conformity with convention on Trade in Endangered Species of Fauna and Flora.
- Ongoing research programmes on biodiversity carried out under various Ministries and Institutions to be collated and reviewed periodically, and research needs to be focusing on the conservation and sustainable use of biodiversity identified.
  - Review of existing literature and indigenous knowledge on the biodiversity of Sri Lanka should be conducted and action taken to establish a central database.
  - Develop a system to ensure that local communities affected by conservation measures are benefitted by it.
  - Many protected areas in Sri Lanka are isolated and small, and surrounded by villages, making protection difficult. There is urgent need for a review of the current protected areas and establishment of a national and properly representative protected area system for the country and for more effective conservation of the protected areas. It is also essential to assess the prospects for *in situ* conservation outside the protected areas.
  - Develop a strategy to optimally sensitise the public on biodiversity conservation.



# Appendix 1

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## ***Threatened Species of Vascular Plants in Sri Lanka***

### **PTERIDOPHYTES**

#### ***Equisetaceae:***

*Equisetum debile* Roxb.

#### ***Isoetaceae:***

*Isoetes Coromandelina* L.f.

#### ***Lycopodiaceae:***

*Lycopodium carolinianum* L.

*L. ceylanicum* Spring

*L. clavatum* L.

*L. hamiltonii* Spreng.

*L. phlegmaria* L.

*L. phyllanthum* Hook. & Arn.

*L. pinifolium* Bl.

*L. pulcherrimum* Wall. ex Hook. & Grev.

*L. serratum* Thunb.

*L. squarrosum* Forst.

*L. wightianum* Wall

#### ***Psilotaceae:***

*Psilotum nudum* (L.) Beauv.

#### ***Cyatheaceae:***

*Cyathea hookeri* Thw.

*C. sinuata* Hook. & Grev.

**Dennstaedtiaceae:**

*Microlepia majuscula* (Lowe) T.Moore

*Lindsaea repens* var. *pectinata* (Bl.) Mett. ex Kuhn

**Selaginellaceae:**

*Selaginella calostachya* (Hook. & Grev.) Alston

*S. cochleata* (Hook. & Grev.) Spring

*S. praetermissa* Alston

*S. wightii* Hieron.

**Adiantaceae:**

*Actiniopteris radiata* (Sw.) Link

*Cheilanthes thwaitesii* Mett. ex Kuhn

*Idiopteris hookeriana* (Ag.) T.G. Walker

*Pellaea boivini* Hook

*P. falcata* (R.Br.) Fee

*Pteris argyrea* T. Moore

*P. confusa* T.G. Walker

*P. gongalensis* T.G. Walker

*P. praetermissa* T.G. Walker

*P. reptans* T.G. Walker

**Aspleniaceae:**

*Asplenium disjunctum* Sledge

*A. longipes* Fee

*A. nitidum*

*A. obscurum* Bl.Sw.

*A. pellucidum* Lam.

**Hymenophyllaceae:**

*Trichomanes exiguum* (Bedd.) Baker

*T. intramarginale* Hook. & Grev.

*T. motleyi* van den Bosch

*T. nitidulum* van den Bosch

*T. pallidum* Bl.

*T. saxifragoides* C. Presl

*T. wallii* Thw. ex Trim.

**Lomariopsidaceae:**

*Bolbitis appendiculata* var. *asplenifolia* (Bory) Sledge  
*Teratophyllum aculeatum* (Bl.) Mett.

**Dryopteridaceae:**

*Deparia polyrhizon* (Baker) Sledge  
*Diplazium cognatum* (Hieron.) Sledge  
*D. paradoxum* Fee  
*D. zeylanicum* (Hook.) T. Moore  
*Polystichum anomalum* (Hook. & Arn.) J. Sm.  
*Pteridrys syrmatia* (Willd.) C. Chr. & Ching  
*P. zeylanica* Ching  
*Tectaria thwaitesii* (Bedd.) Ching

**Grammitidaceae:**

*Ctenopteris glandulosa* J. Sm.  
*C. repandula* (Mett.)  
*Ctenopteris*. Chr. & Tard.  
*C. thwaitesii* (Bedd.) Sledge  
*Grammitis wallii* (Bedd.) Copel  
*Scleroglossum sulcatum* (Khun) V.A.V.R.  
*Xiphopteris cornigera* (Baker) Copel.

**Polypodiaceae:**

*Belvisia mucronata* (Fee) Copel.  
*Leptochilus wallii* (Baker) C. Chr.  
*Microsorium dilatatum* (Bedd.) Sledge  
*Pleopeltis macrocarpa* (Bory ex Willd.) Kaulf

**Schizaeaceae:**

*Schizaea digitata* (L.) Sw.

**Marattiaceae:**

*Marattia fraxinea* Sm.

**Ophioglossaceae:**

- Botrychium daucifolium* Wall. ex Hook & Grev.  
*B. lanuginosum* Wall. ex Hook. & Grev.  
*Helminthostachys zeylanica* (L.) Hook.  
*Ophioglossum costatum* R. Br.  
*O. gramineum* Willd.  
*O. nudicaule* L.f.  
*O. pendulum* L.  
*O. petiolatum* Hook.  
*O. reticulatum* L.

**Osmundaceae:**

- Osmunda collina* Sledge

**Thelypteridaceae:**

- Amauropelta hakgalensis* Holttum  
*Ampelopteris prolifera* (Retz.) Copel.  
*Christella meeboldii* (Rosenst.) Holttum  
*C. subpubescens* (Bl.) Holttum  
*C. zeylanica* (Fee) Holttum  
*Pronephrium gardneri* Holttum  
*Sphaerostephanos subtruncatus* (Bory) Holttum  
*Thelypteris confluens* (Thunb.) Morton  
*Trigonospora angustifrons* Sledge  
*T. calcarata* (Bl.) Holttum  
*T. ciliata* (Benth.) Holttum  
*T. glandulosa* Sledge  
*T. obtusiloba* Sledge  
*T. zeylanica* (Ching) Sledge

**GYMNOSPERMS****Cycadaceae:**

- Cycas circinalis* L.



## ANGIOSPERMS

### **Acanthaceae:**

- Andrographis macrobotrys* Nees
- Barleria nitida* Nees
- Gymnostachyum thwaitesii* T. Anders.
- Strobilanthes caudata* T. Anders.
- S. gardnerana* (Nees) T. Anders.
- S. nigrescens* T. Anders.
- S. nockii* Trim.
- S. punctata* Nees
- S. rhytisperma* C.B. Clarke
- S. stenodon* C.B. Clarke
- S. thwaitesii* T. Anders.
- S. zeylanica* T. Anders.
- Synnema uliginosum* (L.F.) Kuntze

### **Amaranthaceae:**

- Achyranthes bidentata* Bl.
- A. diandra* Roxb.
- Centrostachys aquatica* (R.Br.) Wall.ex Moq.
- Cyathula ceylanica* Hook.f.

### **Anacardiaceae:**

- Semecarpus moonii* Thw.
- S. obovata* Thw.
- S. parvifolia* Thw.

### **Annonaceae:**

- Alphonsea hortensis* H. Huber
- A. zeylanica* Hook.f. & Thomas.
- Anaxagorea luzonensis* A. Gray
- Artabotrys hexapetalus* (L.f.) Bhandhari
- Goniothalamus thomsonii* Thw.
- Milium zeylanica* Gardn. ex Hook.f. & Thoms
- Orophea polycarpa* A. DC.
- Phoenicanthus coriacea* (Thw.) H. Huber
- Polyalthia moonii* Thw.
- P. Persicaefolia* (Hook.f. & Thoms) Thw.
- Uvaria cordata* (Dunal) Alston
- U. semecarpifolia* Hook.f. & Thoms.
- Xylopia nigricans* Hook.f. & Thoms.

**Apocynaceae:**

- Anodendron rhinosporum* Thw.  
*Hunteria zeylanica* (Retz.) Gardn. ex Thw.  
*Rauvolfia serpentina* (L.) Benth. ex Kurz.  
*Vallaris solanacea* (Roth) Kuntze  
*Willughbeia cirrhifera* Abeywick.  
*Wrightia flavido-rosea* Trim.

**Apostasiaceae:**

- Apostasia wallichii* R. Br.

**Araceae:**

- Arisaema constrictum* Barned  
*Cryptocoryne spiralis* (Retz.) Fischer  
*C. thwaitesii* schott.  
*Rhaphidophora decursive* (Roxb.) Schott.  
*R. pertusa* (Roxb.) Schott.  
*Typhonium flagelliforme* (Lodd.)Bl.

**Araliaceae:**

- Polyscias acuminata* (Wight) seem

**Asclepiadaceae:**

- Bidaria cuspidata* (Thunb.) Huber  
*Brachystelma lankana* Dassanayake & Jayasuriya  
*Caralluma adscendens* (Roxb.) Haworth  
*C. umbellata* Haworth  
*Ceropegia candelabrum* L.  
*C. elegans* Wall. var. *gardneri* (thw.) Huber  
*C. parviflora* Trim  
*C. thwaitesii* Hook.  
*Cosmostigma racemosum* (Roxb.) Wight  
*Cynanchum alatum* Wight & Arn.  
*Dischidia nummularia* R. Br.  
*Gymnema rotundatum* Thw.  
*Heterostemma tanjorensis* Wight & Arn.  
*Hoya ovalifolia* Wight & Arn. ex Wight  
*H. pauciflora* Wight  
*Marsdenia tenacissima* (Roxb.) Moon  
*Oxystelma esculentum* (L.f.) R. Br. ex Schult.



**Asclepiadaceae:**

- Taxocarpus kleinii* Wight & Arn.
- Tylophora fasciculata* Buch. Ham. ex Wight & Arn.
- T. multiflora* (Wight & Arn.) Alston
- T. pauciflora* Wight & Arn.
- T. zeylanica* Decne

**Balanophoraceae:**

- Balanophora fungosa* J.R. & G. Forst

**Balsaminaceae:**

- Impatiens janthina* Thw.
- I. leucantha* Thw.
- I. repens* Moon
- I. subcordata* Arn.
- I. taprobanica* Hiern.
- I. walkeri* Hook.

**Begoniaceae:**

- Begonia dipetala* R. Grah.
- B. subpeltata* Wight
- B. tenera* Dry

**Bombacaceae:**

- (*Adansonia digitata*.
- L. Introduction to Sri Lanka, but needs protection for historical reasons)

**Boraginaceae:**

- Cordia subcordata* Lam.
- Heliotropium supinum* L.
- Rotula aquatica* Lour.

**Burmanniaceae:**

- Burmannia championii* Thw.
- Thismia gardnerana* Hook.f.

**Campanulaceae:**

*Campanula canescens* Wall. ex DC.  
*C. fulgens* Wall.

**Capparidaceae:**

*Cadaba fruticosa* (L.) Druce  
*Capparis divaricata* Lam.  
*C. floribunda* Wight  
*C. tenera* Dalz.  
*Cleome chelidonii* L.f.

**Caryophyllaceae:**

*Stellaria pauciflora* Zoll. & Mor.

**Celastraceae:**

*Celastrus paniculatus* Willd.  
*Euonymus thwaitesii* Laws.  
*Glyptopetalum zeylanicum* Thw.  
*Kokoona zeylanica* Thw.  
*Maytenus fruticosa* (Thw.) Loes.

**Combretaceae:**

*Lumnitzera littorea* (Jack.) J.O. Voigt

**Commelinaceae:**

*Cyanotis obtusa* (Trim.) Trim.

**Compositae:**

*Adenostemma angustifolium* Arn.  
*Anaphalis fruticosa* Hook.f.  
*A. pelliculata* Trim.  
*A. thwaitesii* C.B. Clarke  
*Blepharispermum petiolare* DC.  
*Blumea angustifolia* Thw.  
*B. aurita* (L.f.) DC.  
*B. barbata* DC.  
*B. crinita* Arn.  
*B. lanceolaria* (Roxb.) Druce  
*Glossogyne bidens* (Retz.) Alston  
*Gynura hispida* Thw.

**Compositae:**

*G. zeylanica* Trim.  
*Notonia grandiflora* DC.  
*N. walkeri* (Wight) C.B. Clarke  
*Senecio gardneri* (Thw.) C.B. Clarke  
*Sphaeranthus amaranthoides* Burm. f.  
*Vernonia anceps* C.B. Clarke ex Hook.f.  
*V. pectiniformis* DC.  
*V. thwaitesii* C.B. Clarke  
*Xanthium indicum* Konig

**Connaraceae:**

*Ellipanthus unifolius* (Thw.) Thw.

**Convolvulaceae:**

*Argyreia choisyana* Wight ex C.B. Clarke  
*A. hancorniiifolia* Gardn. ex Thw.  
*A. pomacea* Choisy  
*A. splendens* (Roxb.) Sweet  
*Bonamia semidigyna* (Roxb.) Hallier f.  
*Ipomoea coptica* (L.) Rome. & Schultes  
*I. jucunda* Thw.  
*I. staphylina* Roem. & Schult.  
*I. wightii* (Wall.) Choisy

**Crassulaceae:**

*Kalanchoe laciniata* (L.) Pers.

**Cucurbitaceae:**

*Kedrostis rostrata* (Rottl.) Cogn.  
*Melothria leiosperma* (Wight & Arn.) Cogn.

**Cyperaceae:**

*Baeothryon subcapitatum* (Thw.) T. Koyama  
*Carex breviscapa* C.B. Clarke  
*C. taprobanensis* T. Koyama  
*Cyperus articulatus* L.  
*C. cephalotes* Vahl  
*Eleocharis confervoides* (Poir.) T. Koyama  
*E. lankana* T. Koyama

**Cyperaceae:**

- Fimbristylis zeylanica* T. Koyama  
*F. monticola* Hochst. ex Steud.  
*Hypolytrum longirostre* Thw.  
*Mapania immersa* (Thw.) Benth. ex C.B. Clarke  
*M. zeylanica* (Thw.) Benth. ex Clarke  
*Mariscus compactus* (Retz.) Boldingh  
*Pycreus stramineus* (Nees) Clarke  
*Rhynchospora gracillima* Thw.  
*Scirpodendron ghaeri* (Gaertn.) Merr.  
*Scleria pilosa* Boeck.  
*Tricostularia undulata* (Thw.) Kern.

**Dilleniaceae:**

- Acrotrema dissectum* Thw. ex Hook. f.  
*A. lyratum* Thw. ex Hook.f.  
*A. thwaitesii* Hook.f. & Thoms.

**Dioscoreaceae:**

- Dioscorea trimenii* Prain & Burkill

**Dipterocarpaceae:**

- Cotylelobium scabriusculum* (Thw.) Brandis  
*Hopea cordifolia* (Thw.) Trim.  
*Shorea disticha* (Thw.) Alston  
*S. ovalifolia* (Thw.) Ashton  
*Stemonoporus affinis* Thw.  
*S. bullatus* Kosterm.  
*S. lanceolatus* Thw.  
*S. moonii* Thw.  
*S. nitidus* Thw.  
*S. oblongifolius* Thw.  
*S. petiolaris* Thw.  
*S. reticulatus* Thw.  
*S. rigidus* Thw.  
*Vatica obscura* Trim.

**Ebenaceae:**

- Diospyros acuta* Thw.  
*D. albiflora* Alston



### **Ebenaceae:**

- D. atrata* (Thw.) Alston
- D. attenuata* Thw.
- D. chaetocarpa* Kosterm.
- D. koenigii* Kosterm.
- D. moonii* Thw.
- D. opaca* Clarke
- D. oppositifolia* Thw.
- D. quaesita* Thw.

### **Elaeocarpaceae:**

- Elaeocarpus ceylanicus* (Arn.) Mast.

### **Gesneriaceae:**

- E. montanus* Thw.

### **Eriocaulaceae:**

- Eriocaulon fluviatile* Trim.
- E. longicuspis* Hook. f.
- E. luzulifolium* Mart.
- E. philippo-coburgi* Szy.
- E. walkeri* Hook. f.

### **Euphorbiaceae:**

- Antidesma thwaitesianum* Muell. Arg. *Bridelia stipularis* (L.) Bl. (= *B. scandens* Willd.)
- Chaetocarpus pubescens* (Thw.) Hook. f.
- Chrozophora rottleri* (Geisel.) A. juss. ex Spreng.
- Cleidion javanicum* Bl.
- C. nitidum* (Muell. Arg.) Thw. ex Kurz
- Cleistanthus collinus* (Roxb.) Hook. f.
- Croton moonii* Thw.
- Dalechampia indica* Wight
- Drypetes lanceolata* (Thw.) Pax & Hoffm.
- Euphorbia cristata* Heyne ex Roth
- Glochidion nemorale* Thw.
- Mallotus distans* Muell. Arg.
- Phyllanthus affinis* Muell. Arg.
- P. anabaptizatus* Muell. Arg.
- P. hakgalensis* Thw. ex Trim.
- P. longiflorus* Heyne

**Euphorbiaceae:**

- P. rotundifolius* Klein ex Willd.  
*Putranjiva zeylanica* (Thw.) Muell. Arg.  
*Sauropus assimilis* Thw.  
*S. retroversus* Wight  
*Trigonostemon diplopetalus* Thw.

**Flacourtiaceae:**

- Hydnocarpus octandra* Thw.

**Gentianaceae:**

- Exacum sessile* L.  
*Crawfordia championii* (Gradn.) Trim.

**Geraniaceae:**

- Geranium nepalense* Sweet  
*Aeschynanthus ceylanica* Gardn.  
*Chirita moonii* Gardn.  
*C. walkeri* Gardn.  
*Didymocarpus floccosus* Thw.  
*D. zeylanicus* R. Br.  
*Epithems carnosum* (G. Don) Benth.

**Goodeniaceae:**

- Scaevola plumieri* (L.) Vahl

**Guttiferae (= Clusiaceae):**

- Calophyllum cordata-oblongum* Thw.  
*C. cuneifolium* Thw.  
*C. trapezifolium* Thw.  
*Mesua stylosa* (Thw.) Kosterm.

**Haloragidaceae:**

- Laurembergia indica* (Thw.) Schindl.  
*L. zeylanica* (Arn. ex C.B. Clarke) Schindl.

**Hippocrateaceae:**

*Hippocratea arnottiana* Wight  
*H. macrantha* Korth.

**Hydrocharitaceae:**

*Nechamandra alternifolia* (Roxb.) Thw.

**Utriculariaceae:**

*Pyrenacantha volubilis* Wight

**Labiatae (= Lamiaceae):**

*Anisochilus paniculatus* Benth.  
*Coleus elongatus* Trim.  
*Leucas longifolia* Benth.  
*Plectranthus capillipes* Benth.  
*P. glabratus* (Benth.) Alston  
*P. subincisus* Benth.  
*Scutellaria robusta* Benth

**Lauraceae:**

*Actinodaphne albifrons* Kosterm.  
*Cassytha capillaris* Meisn.  
*Cinnamomum capparucoronae* Bl.  
*C. citriodorum* Thw.  
*C. litseifolium* Thw.  
*Cryptocarya membranacea* Thw.  
*Litsea nemoralis* (Thw.) Hook. f.  
*L. undulata* Hook. f.

**Leguminosae (= Fabaceae):**

*Acacia ferruginea* DC.  
*Adenanthera bicolor* Moon  
*Albizia amara* (Roxb.) Boivin  
*Alysicarpus longifolius* (Rott. ex. Spreng.) Wight & Arn.  
*Bauhinia scandens* L.  
*Cassia italica* (Mill.) F.W. Andr.  
*C. senna* L.  
*Caesalpinia crista* L.  
*C. digyna* Rottl. ex Willd.



**Leguminosae (= Fabaceae):**

- C. hymenocarpa* (Prain) Hattink  
*C. major* (Medic.) Dandy & Exell  
*Crotalaria berteriana* DC.  
*C. linifolia* L.f.  
*C. montana* Roth  
*C. mysorensis* Roth  
*C. triquetra* Dalzell  
*C. wightiana* Graham  
*C. willdenowiana* DC.  
*Crudia zeylanica* (Thw.) Benth.  
*Cynometra ripa* Kostel.  
*Desmodium gangeticum* (L.) DC.  
*D. jucundum* Thw.  
*D. zonatum* Miq.  
*Dioclea javanica* Benth.  
*Dunbaria ferruginea* Wight & Arn.  
*Eleiotis monophylla* (Burm. f.) DC.  
*Eriosema chinense* Vogel  
*Galactia striata* (Jacq.) Urban  
*Indigofera constricta* (Thw.) Trim.  
*I. glabra* L.  
*I. parviflora* Heyne  
*I. trifoliata* L.  
*I. wightii* Grah. ex Wight & Arn.  
*Mucuna gigantea* (Willd.) DC.  
*M. monosperma* (Roxb.) DC.  
*Pericopsis mooniana* (Thw.) Thw.  
*Rhynchosia acutissima* Thw.  
*R. densiflora* (Roth) DC.  
*R. nummularia* (L.) DC.  
*R. suaveolens* (L.f.) DC.  
*Sesbania sericea* (Willd.) Link  
*Smithia conferta* J.E. sm.  
*Sophora violacea* Thw.  
*S. zeylanica* Trim.  
*Strongylodon siderospermus* Cordemoy  
*Tephrosia hookerana* Wight & Arn.  
*T. senticosa* (L.) Pers.  
*T. spinosa* (L.) Pers.



**Lemnaceae:**

*Lemna gibba* L.

**Lentibulariaceae:**

*Utricularia scandens* Benj. (= *U. capillacea* Wall.)

**Liliaceae:**

*Chlorophytum heyneanum* Wall.

*Dipcadi montanum* (Dalz.) Bak.

*Urginea rupicola* (Trim.) Trim. ex Hook. f.

Loranthaceae: (See also Viscaceae)

*Barathranthus mabaeoides* (Trim.) Danser

*Dendrophthoe lonchiphyllus* (Thw.) Danser

*Helixanthera ensifolia* (Thw.) Danser

*Macrosolen barlowii* Wiens

*Tolypanthus gardneri* (Thw.) v. Tiegh.

**Malvaceae:**

*Abutilon pannosum* (Forest. f.) Schlecht. (= *A. muticum* G. Don.)

*Dicelostyles axillaris* (Thw.) Thw.

*Julostylis angustifolia* (Arn.) Thw.

*Pavonia patens* (Andr.) Chiov. (= *P. glechomifolia* Garcke)

*Thespesia lampas* (L.) Soland. ex. Correa

**Melastomaceae:**

*Medinilla cuneata* (Thw.) Bremer & Lundin

*M. maculata* Gardn.

*Memecylon ellipticum* Thw.

*M. gracillimum* Alston

*M. grande* Retz.

*M. leucanthum* Thw.

*M. macrocarpum* Thw.

*M. orbiculare* Thw.

*M. ovoideum* Thw.

*M. phyllanthifolium* Thw. ex. C.B. Clarke

*M. revolutum* Thw.

*M. rotundatum* (Thw.) Cogn. Bremer.

*Sonerila brunonis* Wight & Arn.

*S. cordifolia* Cogn.

*S. firma* (Thw.) Lundin

**Melastomaceae:**

- S. gardneri* Thw.
- S. lanceolata* Thw.
- S. pilosula* Thw.
- S. robusta* Arn.
- S. tomentella* Thw.
- S. wightiana* Arn.

**Menispermaceae:**

- Coscinium fenestratum* (Gaertn.) Colebr.

**Menyanthaceae:**

- Nymphoides aurantiaca* (Dals.) Kuntze
- Moraceae
- Broussonetia zeylanica* (Thw.) Corner
- Dorstenia indica* Wight
- Ficus costata* Ait.
- F. trimenii* King
- Maclura cochinchinensis* (Lour.) Corner

**Myrtaceae:**

- Eugenia amoena* Thw.
- E. cotinifolia* ssp. *phyllyraeoides* (Trim.) Ashton
- E. fulva* Thw.
- E. glabra* Alston
- E. mabaeoides* ssp. *pedunculata* Trim. Ashton
- E. rivulorum* Thw.
- E. rufifulva* Thw.
- E. terpnophylla* Thw.
- Syzygium lewisii* Alston

**Ochnaceae:**

- Ochna refuscens* Thw.

**Olacaceae:**

- Ximenia americana* L.



### Oleaceae:

*Jasminum bignoniaceum* Wall.

*Zeylanicum* P.S. Green subsp.

*Olea paniculata* R.Br.

### Orchidaceae:

*Agrostophyllum zeylanicum* Hook. f.

*Bulbophyllum crassifolium* Thw. ex. Trim.

*B. purpureum* Thw.

*B. tricarinatum* Petch

*Coelogyne zeylanica* Hook. f.

*Corymborchis veratrifolia* (Reinw.) Bl.

*Dendrobium maccarthiae* Thw.

*Diplocentrum recurvum* Lindl.

*Eria tricolor* Thw.

*Galeola javanica* (Bl.) Benth. & Hook. f.

*Gastrodia zeylanica* Schlecht.

*Goodyera fumata* Thw.

*Habenaria virens* (Lindl.) Abeywick.

*Liparis barbata* Lindl.

*L. brachyglottis* Reichb. f. ex Trim.

*Malaxis densiflora* (A. Rich.) Kuntze

*M. lancifolia* (Thw.) Kuntze

*M. purpurea* (Lindl.) Kuntze

*Oberonia claviloba* Jayaweera

*O. dolabrata* Jayaweera

*O. fornicata* Jayaweera

*O. quadrilatera* Jayaweera

*O. recurva* Lindl.

*O. scyllae* Lindl.

*O. wallie-silvae* Jayaweera

*O. weragamensis* Jayaweera

*Peristylus plantagineus* (Lindl.) Lindl.

*Phaius luridus* Thw.

*Phreatia elegans* Lindl.

*Pteroceras viridiflorum* (Thw.) Holttum

*Rhynchostylis retusa* Bl.

*Robiquetia gracilis* (Lindl.) Garay

*Sirhookera latifolia* (Wight) Kuntze

*Taeniophyllum gilimalense* Jayaweera

*Vanda thwaitesii* Hook.f.

**Orobanchaceae:**

*Aeginetia pendunculata* Wall.  
*Cambellia aurantiaca* Wight  
*Christisonia thwaitesii* Trim.

**Palmae:**

*Areca concinna* Thw.  
*Nypa fruticans* Wurmb.

**Piperaceae:**

*Peperomia wightiana* Miq.

**Podostemaceae:**

*Dicraea stylosa* Wight

**Polygalaceae:**

*Polygala leptalea* DC.

**Portulacaceae:**

*Portulaca wightiana* Wall. ex Wight & Arn.

**Proteaceae:**

*Helicia ceylanica* Gardn.

**Rhizophoraceae:**

*Ceriops decandra* (Griff.) Ding Hou

**Rosaceae:**

*Alchemilla indica* var. *sibthorpioides* Hook.f.  
*Rubus glomeratus* Blume  
*Sanguisorba indicum* (Gardn.)  
*Thirvengadam*

**Roxburghiaceae:**

*Stemona minor* (Thw.) Hook.f.

**Rubiaceae:**

*Byrsophyllum ellipticum* (Thw.) Bedd.  
*Canthium macrocarpum* Thw.  
*Dichilanthe zeylanica* Thw.  
*Gardenia turgida* Roxb.  
*Hedyotis cyanescens* Thw.  
*H. evenia* Thw.  
*H. gardneri* Thw.  
*H. inamoena* Thw.  
*H. quinquenervia* Thw.  
*H. rhinophylla* Thw. ex Trim.  
*Lasianthus rhinophyllus* (Thw.) Thw.  
*L. thwaitesii* Hook. f.  
*Nargedia macrocarpa* (Thw.) Bedd.  
*Neurocalyx gardneri* Thw.  
*Oldenlandia trinervia* Retz.  
*Ophiorrhiza pallida* Thw.  
*Psychotria glandulifera* Thw. ex Hook.f.  
*P. longipetiolata* Thw.  
*P. moonii* (Thw.) Hook.f.  
*P. plurivenia* Thw.  
*P. stenophylla* (Thw.) Hook.f.  
*Saprosma indicum* Dalz.  
*S. scabridum* (Thw.) Bedd.  
*Scyphiphora hydrophyllacea* Gaertn. f.  
*Scyphostachys pedunculatus* Thw.  
*Tricalysia erythrospora* (Thw.) Alston

**Rutaceae:**

*Atalantia racemosa* Wight  
*Glycosmis cyanocarpa* (Bl.) Spreng. var. *simplicifolia* Kurz  
*Naringi crenulata* (Roxb.) Nicolson  
*Zanthophyllum caudatum* Alston

**Sapindaceae:**

*Cardiospermum corindum* L.  
*Euphoria gardneri* (Thw.) Thw.  
*Thraulococcus simplicifolius* (Thw.) Radlk.

**Sapotaceae:**

*Madhuca clavata* Jayasuriya  
*M. moonii* (Thw.) H.J. Lam  
*Palaquium canaliculatum* (Thw.) Engl.  
*P. thwaitesii* Trim.

**Scrophulariaceae:**

*Adenosma subrepens* (Thw.) Benth ex Hook. f.  
*Lindernia viscosa* (Hornem.) Boldingh  
*Verbascum chinense* (L.) Santapau

**Simaroubaceae:**

*Suriana maritima* L.

**Sonneratiaceae:**

*Sonneratia apetala* Buch. - Ham.

**Sterculiaceae:**

*Pentapetes phoenicea* L.  
*Pterygota thwaitesii* (Mast.) Alston  
*Sterculia guttata* Roxb.

**Stylidiaceae:**

*Stylidium uliginosum* Sw.

**Symplocaceae:**

*Symplocos diversifolia* Brand.  
*S. elegans* Thw.  
*S. kurgensis* Clarke

**Symphoremaceae:**

*Symphorema involucreatum* Roxb.

**Taccaceae:**

*Tacca leontopetaloides* (L.) Kuntze

**Theaceae:**

*Gordonia speciosa* (Gardn.) Choisy



**Thymelaeaceae:**

*Phaleria capitata* Jack.

**Tiliaceae:**

*Corchorus tridens* L.

*Grewia asiantica* L.

*G. hirsuta* Vahl

*Triumfetta glabra* Rottl. ex Spreng.

**Triuridaceae:**

*Hyalisma janthina* Champ.

*Sciaphila erubescens* (Champ.) Miers

*S. inornata* Petch ex Alston

*S. secundiflora* Trim. ex Benth.

**Umbelliferae:**

*Peucedanum ceylanicum* Gardn.

*Sanicula elata* Buch. - Ham. ex D. Don

**Urticaceae:**

*Elatostema acuminatum* (Poir.) Brongn.

*E. walkerae* Hook.f.

*Lecanthus peduncularis* (Royle) Wedd.

**Vahliaceae:**

*Vahlia dichotoma* (Murr.) Kuntze

**Verbenaceae:**

*Premna divaricata* Wall.

*P. purpurascens* Thw.

*P. thwaitesii* C.B. Clarke

*Priva cordifolia* (L.f.) Druce

*Svensonia hyderabadensis* (Walp.) Moldenks

**Violaceae:**

*Hybanthus ramosissimus* (Thw.) Melch.

**Viscaceae:**

*Ginalloa spathulifolia* (Thw.) Oliv. ex Hook.f.

*Korthalsella japonica* (Thunb.) Engl.

*Notothixos floccosus* (Thw.) Oliver

*Viscum ramosissimum* Roxb. ex DC.

**Zingiberaceae:**

*Alpinia fax* Burt & Smith

*A. rufescens* (Thw.) Schum.

*Amomum acuminatum* Thw.

*A. benthamianum* Trim.

*A. graminifolium* Thw.

*A. hypoleucum* Thw.

*A. trichostachyum* Alston

*Curcuma albiflora* Thw.



## Appendix 2

### List of widely used Medicinal Species from the Forests in Sri Lanka

Local Name	Scientific Name
Ahu-kola	<i>Morinda citrifolia</i>
Ammukkara	<i>Withania somnifera</i>
Andun-wenna	<i>Ilex zeylanica</i>
Ankenda	<i>Acronychia pedunculata</i>
Aralu	<i>Terminalia chebula</i>
Araththa	<i>Ophiorrhiza mungos</i>
Eth-demata	<i>Gmelina arborea</i>
Athi-udayan	<i>Cryptocoryne spiralis</i>
Atimeeriya	<i>Erycibe paniculata</i>
Attikka	<i>Ficus racemosa</i>
Bebila	<i>Sida</i> spp.
Bandunra	<i>Nepenthes distillatoria</i>
Benduru	<i>Drynaria</i> spp.
Bemathiriya	<i>Bacopa monniera</i>
Bolvila	<i>Anisochilus velutinus</i>
Bomi	<i>Litsea glutinosa</i>
Bovitiya	<i>Osbeckia aspera</i>
Bulu	<i>Terminalia bellirica</i>
Burulla	<i>Leea indica</i>
Daluk	<i>Euphorbia antiquorum</i>
Damba	<i>Sezygium</i> spp.
Dath-ketiya	<i>Xylopiya championii</i>
Demata	<i>Gmelina asiatica</i>
Divi-kaduru	<i>Pagiantha dicotoma</i>
Diya-inguru	<i>Zingiber</i> sp.
Diya-kirala	<i>Hydrolea zeylanica</i>
Diya-mitta	<i>Cissampelos pareira</i>
Domba	<i>Calophyllum inophyllum</i>
Duhundu	<i>Celastrus paniculatus</i>
Dummala	<i>Doona</i> spp.
Dummella	<i>Trichosanthes cucumerina</i>
Dutu-sathuta	<i>Centranthera indica</i>
Ehala	<i>Cassia fistula</i>
Elabatu	<i>Solanum surattense</i>
Eraminiya	<i>Zizyphus</i> spp.

**Local Name****Scientific Name**

Eta-muru	<i>Cansjera rheedii</i>
Gedumba	<i>Trema orientale</i>
Galkuru	<i>Melochia corchorifolia</i>
Galpara	<i>Dillenia sp.</i>
Gerandi-dul	<i>Ichnocarpus frutescens</i>
Ginihota	<i>Cyathea sp.</i>
Gonika	<i>Psychotria sarmentosa</i>
Goraka	<i>Garcinia cambogia</i>
Hal	<i>Vateria copallifera</i>
Hampila	<i>Desmodium pulchellum</i>
Harankaha	<i>Curcuma zedoaria</i>
Hata-wariya	<i>Asparagus falcatus</i>
Heen-bovitiya	<i>Osbeckia octandra</i>
Heen-hadaya	<i>Lycopodium squarrosum</i>
Himbutu	<i>Salacia reticulata</i>
Hinguru	<i>Acacia caesia</i>
Hik	<i>Lanea coromandelica</i>
Hondala	<i>Adenia palmata</i>
Hulanthala	<i>Ageratum conyzoides</i>
Hubas-kola	
Hunukirilla	<i>Glochidion zeylanicum</i>
Illuk	<i>Imperata cylindrica</i>
Imbul	<i>Ceiba pentandra</i>
Indi	<i>Phoenix zeylanica</i>
Iramusu	<i>Hemidesmus indicus</i>
Iriya	<i>Horsfieldia irya</i>
Iriweriya	<i>Pletranthus zeylanicus</i>
Iru-raja	<i>Zeuxine regia</i>
Itta-kola	<i>Schefflera stellata</i>
Jata-makuta	<i>Dendrobium macraei</i>
Jata-mansa	<i>Balanophora indica</i>
Kaba-rossa	<i>Smilax zeylanica</i>
Kadu-pahara	<i>Emilia sonchifolia</i>
Kaduru	<i>Strychnos nuxvomica</i>
Kaha-kiridiya	<i>Coix sp.</i>
Kahambiliya	<i>Fleurya interrupta</i>
Kahata	<i>Careya coccinea</i>
Kaladuru	<i>Cyperus rotundus</i>
Kalu-kidaran	<i>Amorphophallus campanulatus</i>
Kamaranga	<i>Averrhoa carambola</i>
Kankubal	<i>Turpinia malabarica</i>
Kapparawalliya	<i>Coleus amboinicus</i>

**Local Name****Scientific Name**

Kapunkeeriya	<i>Hedyotis hirta</i>
Karal-heba	<i>Achyranthes aspera</i>
Karanda	<i>Pongamia pinnata</i>
Katakarau	<i>Phyllanthus indicus</i>
Katu-ala	<i>Dioscorea pentaphylla</i>
Katukirindi	<i>Coix sp.</i>
Katu-thiyambara	
Katukela	<i>Erythrina fusca</i>
Kebella	<i>Aporosa lindleyana</i>
Kidaran	<i>Amorphophallus campanulatus</i>
Keekirindiya	<i>Eclipta prostata</i>
Keena	<i>Calophyllum walkeri</i>
Kekiriwara	<i>Shumacheria castaneifolia</i>
Kekuna	<i>Canarium zeylanicum</i>
Kelaniya	<i>Languas chinensis</i>
Kella	<i>Delbergia lanceolaria</i>
Keppitiya	<i>Croton laccifer</i>
Kiri-aguna	<i>Dregea volubilis</i>
Kiri Koon	<i>Walsura piscidia</i>
Kirimediya	<i>Cayratia sp.</i>
Kiriwel	<i>Ichnocarpus frutescens</i>
Kobba	<i>Allophylus cobbe</i>
Kokmota	<i>Eriocaulon sexangulare</i>
Kokun	<i>Kokoona zeylanica</i>
Kollan-kola	<i>Pogostemon parviflorus</i>
Korasa	<i>Tetracera sarmentosa</i>
Kota-Dimbula	<i>Ficus hispida</i>
Kuda-hedaya	<i>Lycopodium squarrosus</i>
Kudu-miris	<i>Toddalia asiatica</i>
Kumburu-eta	<i>Caesalpinia bunduc</i>
Kuppameniya	<i>Acalypha indica</i>
Lada-Liya/Rada-liya	<i>Connarus monocarpus</i>
Lunu-wila	<i>Bacopa monniera</i>
Lunu-ankenda	<i>Euodia lunu-ankenda</i>
Madan	<i>Zyzygium cumini</i>
Madithiya	<i>Adenanthera pavonina</i>
Madol	<i>Garcinia echinocarpa</i>
Magul-karanda	<i>Pongamia pinnata</i>
Maha-hedaya	<i>Lycopodium plegmaria</i>
Maha-rathmal	<i>Rhododendron zeylanicum</i>
Mala-goraka	<i>Garcinia sp.</i>
Madu	<i>Cycas circinalis</i>

**Local Name****Scientific Name**

Maran	<i>Syzygium zeylanicum</i>
Masmoru	<i>Adenantha bicollor</i>
Mee	<i>Madhuca</i> spp.
Mihiriya	<i>Palaquim grande</i>
Milla	<i>Vitex altissima</i>
Monarakudumbiya	<i>Vernonia cinerea</i>
Munamal	<i>Himusops elengi</i>
Mudu-kenda	<i>Debregeasia ceylanica</i>
Mugatiraja	
Murunga	<i>Moringa oleifera</i>
Muruwadul	<i>Marsdeniya tenacissima</i>
Mussenda	<i>Mussanda frondosa</i>
Na Mesua ferrea	
Napiritta	<i>Hibiscus furcatus</i>
Nai-hanassa	
Nawahandi	<i>Euphorbia tirucalli</i>
Nelli	<i>Phyllanthus emblica</i>
Nidikumba	<i>Mimosa pudica</i>
Niyagala	<i>Gloriosa superba</i>
Nuga	<i>Ficus</i> spp.
Nuga-deliya	
Olinda	<i>Abrus precatorius</i>
Palol	<i>Stereospermum suaveolens</i>
Panam-pethi	<i>Drymoglossum heterophyllum</i>
Panitora	<i>Cassia occidentalis</i>
Parawal	
Path-kela	<i>Bridelia moonii</i>
Pathmaraja	
Patiya-dhathu	<i>Ophioglossum pendulum</i>
Penela	<i>Sapindus emarginatus</i>
Pila	<i>Desmodium pulchellum</i>
Pinna	<i>Clerodendrum infortunatum</i>
Pitawakka	<i>Phyllanthus debilis</i>
Pota-wel	<i>Pothos scandens</i>
Pupula	<i>Vernonia zeylanica</i>
Pus-eta	<i>Entada phaseoloides</i>
Ran-bokatu	
Ranawara	<i>Cassia auriculata</i>
Rasakinda	<i>Tinospora cordifolia</i>
Rat-kela	<i>Litsea longifolia</i>
Ratu-thampala	<i>Amaranthus</i> sp.
Samadara	<i>Samadera indica</i>

**Local Name****Scientific Name**

Sandaraja	<i>Hypericum japonicum</i>
Sewendara	<i>Vetiveria zizanioides</i>
Siviya kola	<i>Piper chaba</i>
Sup-sanda	<i>Aristolochia bracteolata</i>
Sulunayi	<i>Rungia repens</i>
Tebu	<i>Costus speciosus</i>
Thapssara bulath	<i>Apama siliquosa</i>
Thilaberiya	
Thippili	<i>Piper longum</i>
Thirastavalu	<i>Operculina turpethum</i>
Tholabo	<i>Crinum asiaticum</i>
Thotila	<i>Oroxylum indicum</i>
Tiththa	<i>Trichadenia zeylanica</i>
Ululu	<i>Machilus macrantha</i>
Undupiyali	<i>Desmodium spp.</i>
Ununu	<i>Pygeum wightianum</i>
Vishnu-kranthi	<i>Evolvulus alsinoides</i>
Wal-dumkola	<i>Lobelia nictianifolia</i>
Wal-enasal	<i>Elettaria ensal</i>
Wal-inguru	<i>Zingiber zerumbet</i>
Wal-kahabiliya	<i>Fleurya interrupta</i>
Wal-karapincha	<i>Micromelum ceylanicum</i>
Wal-kidaran	<i>Arisaema leschenaultii</i>
Wal-kurundu	<i>Cinnamomum multiflorum</i>
Wal-lunu	<i>Pancratium zeylanicum</i>
Walla	<i>Gyneros walla</i>
Wallakada	
Wana-mee	<i>Madhuca fulva</i>
Wana-rajaja	<i>Anoectochilus setaceus</i>
Wara	<i>Calotropis gigantea</i>
Wasa-tella	
Wayupalu	
Webada	
Wellangiriya	<i>Capparis zeylanica</i>
Weniwel	<i>Cosciniium fenestratum</i>
Weralu	<i>Elaeocarpus spp.</i>
Weraniya	<i>Hedyotis fruticosa</i>
Wewal	<i>Calamus rotang</i>
Yak-wanassa	<i>Anisomeles indica</i>
Yakberiya	<i>Crotolaria labumifolia</i>

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## Abbreviations

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<b>AVRDC:</b>	Asian Vegetable Research and Development Centre, Taiwan.
<b>BAP:</b>	Biodiversity Action Plan.
<b>BG:</b>	Botanical Gardens, Peradeniya, Sri Lanka.
<b>BMAR:</b>	Bandaranyake Memorial Ayurvedic Research Institute, Sri Lanka.
<b>CIAT:</b>	International Centre for Tropical Agriculture, Colombia.
<b>CIMMYT:</b>	Centro Internacional de Mejoramiento de Maiz y Trigo, Mexico.
<b>CIP:</b>	International Potato Centre, Peru.
<b>CRI:</b>	Coconut Research Institute, Sri Lanka.
<b>DEA:</b>	District Environmental Agencies , Sri Lanka.
<b>DOA:</b>	Department of Agriculture , Sri Lanka.
<b>DWLC:</b>	Department of Wildlife Conservation, Sri Lanka.
<b>FCRDI:</b>	Field Crops Research and Development Institute, Sri Lanka.
<b>FD:</b>	Forest Department, Sri Lanka.
<b>GEF:</b>	Global Environment Facility.
<b>GOSL:</b>	Government of Sri Lanka.
<b>HORDI:</b>	Horticulture Research and Development Institute, Sri Lanka.
<b>IARC:</b>	International Agricultural Research Centres.
<b>ICRISAT:</b>	International Crops Research Institute for Semi Arid Tropics, India.
<b>IFS:</b>	Institute of Fundamental Studies, Sri Lanka.
<b>IRRI:</b>	International Rice Research Institute, Philippines.
<b>IUCN:</b>	World Conservation Union, Switzerland.
<b>JICA:</b>	Japan International Co-operation Agency.
<b>MALF:</b>	Ministry of Agriculture, Lands and Forestry, Sri Lanka.
<b>MOU:</b>	Memorandum of Understanding.
<b>NARESA:</b>	Natural Resources , Energy and Science Authority, Sri Lanka.
<b>NIAR:</b>	National Institute of Agrobiological Resources, Japan.
<b>NBPGR:</b>	National Bureau of Plant Genetic Resources, New Delhi.
<b>PGRC:</b>	Plant Genetic Resources Centre, Sri Lanka.
<b>RRI:</b>	Rubber Research Institute, Sri Lanka.
<b>RRDC:</b>	Regional Research and Development Centre, DOA, Sri Lanka.



- RRDI:** Rice Research and Development Institute, Sri Lanka.
- SPMC:** Seed and Planting Material Centre, DOA, Sri Lanka.
- SRI:** Sugar Research Institute, Sri Lanka.
- TRI:** Tea Research Institute, Sri Lanka.
- UNCED:** United Nations Conference on Environment and Development Programme.
- UNEP:** United Nations Environment Programme.
- USDA:** United States Department of Agriculture, USA.
- WRI:** World Resources Institute, USA.



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