

STATUS OF FOREST INVASIVE SPECIES IN SRILANKA

N.D.R. Weerawardane

Forest Department, Sri Lanka

Country Background

Introduction

Sri Lanka is a tropical island with a land area of About 6.5 million hectares. This country lies between 5° 52' North and 79° 41' and 81° 54' east. The country has a tropical climate with monsoon dominated rainfall. Total land area is about 65,610 sq km. The island consists of a mountainous area in the south-central parts and a vast coastal plain, which surrounds it.

Despite the relatively small size of the country, there is considerable variation in climate. There are three major ecological zones depending on the rainfall in the country viz: wet Zone, Intermediate Zone, Dry Zone and Arid Zone. The altitude varies from sea level to more than 2000 m. Both rainfall and altitude differences bring about a variety of climates in the country as shown in the following table.

Climatic and altitudinal zones of the country

Climatic Zone	Rainfall (mm)	Altitudinal Zone	Altitude (m)
Wet zone	>2500	Low country	0-300 m
Intermediate zone	>1750- 2500	Mid country	300-900 m
Dry zone	1000-1750	Up country	> 900 m
Arid zone	< 1000	Montane zone	> 1500 m

The Sri Lanka's population was around 18.1 million by mid-1998. Population growth has declined from 1.5% in during eighties to 1.2% in 2001. The population is projected to reach 23.1 million by the year 2031. The population is unevenly distributed across the country and nearly 60% is concentrated in the wet zone. Sri Lanka is one of the most densely populated countries in Asia with a density of 300 persons per square kilometer in year 2000 (Anon, 2000).

Until the 1960s the Sri Lankan economy depended heavily on the export-oriented plantation crops of tea, rubber and coconut. With the adoption of open economic policies in 1970s and the liberalization programme started in late 1980s increased the market orientation of the economy emphasizing export led growth and the development of the private sector. Despite the several civil strife, these economic reforms have resulted in an annual growth rate around 5.0% since 1990s. By 1994 the major sector of the growing economy was the service sector contributing 50.4% to the Gross Domestic product (GDP) This was followed by the agricultural, fisheries and the forestry sector with 20.5% and the manufacturing sector with 19.7% in the same year (Anon, 2000)

Forest Land ownership and management authority

Currently about 55 percent of the total area under natural forest is reserved and administered by the Forest Department. The rest belongs to the Department of Wild life conservation. The extents of Designated Areas under the two departments constitute respectively 17% and 13 % of the total land area. Designated areas under the Forest Department in 1995 comprised Forest Reserves, Proposed Forest Reserves and National Heritage and Wilderness Areas. The Sinharaja and Knuckles forests and a further 31 wet zone forests have subsequently been classified as Conservation Forests, thereby introducing a new category of Protected Area under the Forest Department. In addition, 20 mangrove sites selected for conservation and all of 42,000 ha of forests at elevations above 1500 m were proposed to bring under this category. The Protected Area network under the Forest Department thus includes all Conservation Forests and National Heritage and Wilderness Areas. The Forest Department has also demarcated 29 Man and Biosphere (MAB) Reserves within its forests to ensure that representative forest ecosystems are conserved, in addition to four MAB reserves in the wild life areas under the Department of Wildlife Conservation. The categories of Protected Areas within the jurisdiction of the Department of Wildlife Conservation comprise Strict Natural Reserves, National Parks, Nature Reserves, Jungle corridors and Sanctuaries.

Role of forests and forestry

It is a small but biologically diverse country that is recognized as a biodiversity hotspot of global importance for plants. It's varied topography and tropical conditions has given rise to this high level of biodiversity. There are many plant and animal species endemic to the country. Much of the diversity is found in the wet zone located in the south-west parts of the country. The Human threats to biodiversity are also greatest in this part of the country due to dense human population. It has been noted in the past

that bio-invasions can have serious negative impacts on the function of these ecosystems. The direct economic consequences are more prominent in the agricultural sector whilst the indirect economic consequences will be the loss of biodiversity. Agricultural sector has suffered a lot in the past from intentional or unintentional introduction of alien pest and diseases including weed species. However, more concern on introduction of invasive species and their impact on biodiversity in the country have been given from recent times comparatively.

According to the forest cover map prepared in 1992, Sri Lanka's closed natural forest cover was 23.9% of the total land area which amounts to about 1.5 million ha. Including sparse forests, total natural forest cover is 30.9% of the land cover which is around 2.0 million ha. The average rate of deforestation during the past few decades, both planned and unplanned, had been around 42,000 ha per year (Bandaratillake, 2001).

The natural forest play an important role in the conservation of soil and water resources. They contribute to the stability of watershed by protecting the soil surface from the direct impact of intensive tropical rain fall, by stabilizing ground water levels and stream flows, and by recycling sum rain fall as part of the hydrological cycle.

The major natural forest ecosystems and their extent is given in the following Table:

Natural forests in Sri Lanka, 1992

Forest type	Total area (ha)	Percentage of total land area	Bioclimatic zone
Closed canopy:			
Montane	3 108	0.05	Montane zone
Sub montane	68 616	1.04	Sub montane zone
Lowland rain	141 506	2.14	Low/mid country wet
Moist monsoon	243 886	3.69	Low/mid country intermediate
Dry monsoon	1 090 981	16.49	Low country dry
Riverine	22 435	0.34	Low country wet dry
Mangrove	8 688	0.13	Costal areas, lagoons
Sub-total	1 579 220	23.88	
Open canopy:			
Sparse	164 076	7.01	Low country dry and arid
Total	2 043 296	30.89	

Forest invasive species background

Introduction of alien invasive species intentionally or unintentionally can cause a tremendous negative impact on biodiversity in a country like Sri Lanka. A large number of species extinction can occur by the introduction of invasive species. In additions, sum invasive species can contribute to degradation of catchment areas irrigation systems incurring severe economic losses. Intentional introductions include deliberate introductions for use in agriculture, forestry, horticulture, fisheries, aquaculture, landscaping, zoos, pet trade etc. Unintentional introductions include accidental introductions of species through transport, trade, travel, tourism etc.

In Sri Lanka, alien invasive species are particularly important due to following factors as depicted by IUCN, Sri Lanka, 2000:

- i) Geographically separated small size and island nature of the country
- ii) Developing status
- iii) Greater diversity of habitats
- iv) High levels of species endemism in the south western parts of the country
- v) Increased degradation and fragmentation of natural habitats due to development activities
- vi) Current highly threatened status of many endemic species and their habitats

As some invasions have the potential to become irreversible, the prevention of new introductions is of prime importance followed by the management of already established species which can cause a conservation threat

Most significant forest invasive species in the country

Most significant invasive species and their mode and source of introduction, distribution and affected habitats/ecosystems are given in the annexure

Biology and life history have been studied in some species. Such information of the most significant invasive are given below.

a) Grasses

Imperata cylindrical, gramineae

A rapidly spreading noxious perennial weed in agricultural, forest and waste lands. Once the land is colonized by this weed its subsequent propagation takes place by stolons. It poses serious problems to many agricultural crops and forest seedlings in plantation establishment. It is found most parts of the country. It grows year round and up to 1 m height. Propagation is by wind dispersal of seeds and by underground stem parts. Manual control is very difficult and chemical control is successful.

Lantana camera, Verbanaceae

Lantana camera is a plant introduced to Sri Lanka in 1926 through the Royal Botanic garden of Sri Lanka. Currently a major weed found throughout the country and has invaded natural ecosystems particularly when open conditions are prevalent. This species is commonly found in dense stands along the roadsides and abandoned lands. It is a fast spreading; thicket forming perennial shrub and is somewhat shade tolerant. The weed has invaded the Udawalawe National Park, which is a leading elephant sanctuary of the island, significantly reducing the grazing lands available for the elephants. It has also spread in forest plantations and degraded natural forests interfering with natural regeneration. The spread is influenced by the birds eating fruits. Manual methods are somewhat successful in controlling this grass.

Panicum maximum (Guinea grass), Graminae

It is an ubiquitous perennial weed. It poses a major problem in agriculture and forestry plantation establishment. It has spread in most parts of the country including natural ecosystems, abandoned or degraded lands, forest plantations etc. when the growth is uncontrolled it can grow up to about 2 m in height shading out and out-competing natural or planted seedlings in forests and retarding their establishment and growth. Taller height can blocks the access of humans and vehicles. Its faster spread both by seeds and underground stem parts threatens natural ecosystems by replacing native plants. In addition, it creates a fire hazard in the dry periods which can also replace natural vegetation in the area. Its control is extremely difficult unless long term control measures are taken. Cattle grazing is somewhat effective in controlling this grass not to eradicate but to keep it under control.

b) Shrubs

Myroxylon balsamum, Fabaceae

First reported in 1920's have recently been identified colonizing natural and semi-natural habitats in some parts of the country. It has planted as a shade along roadsides, windbreak and in plantations. It has reported to damage the composition, structure and functions of natural ecosystems. In certain forests, it has developed in to a mono- specific stand, for example in Udawattakele Nature Reserve and in some mahogany mixed forests.

Impacts of FIS to forestry

These species can be categorized according to their anticipated impact to forest ecosystems.

1. Impact on plantation establishment and management
2. Impact on natural forest biodiversity

First category of species are a threat to plantations due to their highly competitiveness with forest seedlings and saplings. They suppress the growth of seedlings and saplings incurring a large cost for weeding. In most cases only the standard weeding practices are carried out in plantation establishment despite of the aggressiveness of FIS which leads to unsuccessful weeding in most case. Control methods of such aggressive weed species are available but high costs are incurred. Some simple but effective control methods are increasing the number of weeding per year, uprooting such weeds rather than slashing which encourage fast re-growth subsequently and controlling weed growth before flowering period. These practices are not usually done in plantations mainly due to lack of awareness among foresters of the impact and lack of sufficient funds. The threat to agriculture and other similar crops already exists in most of these species.

Second category does not pose any threat to plantation establishment but spread fast within natural forests and interfere with the biodiversity. Major characteristic of these species is the adaptation to shade and ability to grow well in the forest environment. Threat to other sectors is not so far observed probably due to lack of similar environments. The most effective method of control is the complete uprooting them regularly until eradication achieved.

The economic costs of control of FIS can be worked out depending on species, extent of spread and condition of the forest etc. However, this type of studies has not yet been done. The areas of study needed include economic loss incurred to ecosystems due to the spread of invasive species and economics of controlling such species.

Current methods being employed to attempt to prevent the introduction of FIS mainly include quarantine regulations. Monitoring and controlling techniques are not effectively applied to date. One of the important reasons is the lack of awareness of the impact of invasive species on biodiversity and other losses. The lack of scientific studies in certain cases also poses problems for management of those species. It has been emphasized that a proper criteria for identification of FIS is not available in the country which greatly limits the relevant studies.

IUCN country office is involved with Global Invasive Species Programme (GISP) and they are developing strategies for addressing FIS. Apart from that, no body is working happen particularly in agriculture sector and ultimately can affected forest areas also.

National priority in combating FIS nationally and regionally should include development of an action plan to combat FIS which may include gathering information on ecology and biology of important FIS, development of a mechanism to monitor spread of FIS in the country, awareness programmes etc.

Level of public awareness of existing and potential FIS minimal at present due to lack of organized mechanism for it and no information is available on economic and environmental costs.

Management and institutional framework

Existing policies, laws and regulations on identifying, preventing control of FIS

In Sri Lanka, the legal basis for plant protection and plant quarantine (Plant Protection Ordinance) dates as far back as 1924. Plant Quarantine ordinance is enacted by the Department of Agriculture in Sri Lanka. It provides provisions against the introduction of weeds, pests and diseases and for the sanitation of plants in the country. The same ordinance has been amended in 1956 and 1981. However, several devastating pests have established themselves in the country during the last decade. Therefore the ordinance has been totally revised in 1999 to make adequate provisions to cope up with the current

trends on the movement of flora and fauna with increased international trade and traffic. Plant protection ordinance of Sri Lanka aims at preventing introduction of exotic pests including insects, diseases and weeds but makes less emphasis on plant species that can have serious negative effects on biodiversity of natural habitats.

Fauna and flora act in the country was amended in 1964 and 1970 which provides provisions for establishment and maintenance of national reserves, national parks and jungle corridors.

Other relevant legal framework include National environment Action Plan, Flora and Fauna Ordinance, Forest Ordinance, Forestry Sector Master Plan, National Forestry Policy, Unesco Man Biosphere Programme, National Policy for Wild life Conservation, National Heritage Wilderness Act, National Biosafety guidelines etc. (Anon, 1997).

At present identification and prioritization of species is done on an ad hoc basis \. There is a lack of proper institutional and legal framework to deal with invasive species. Furthermore, there is no coordination among various government institutions that are directly or indirectly involved in dealing with alien invasive species. Currently there is no connected efforts to manage the invasive species in Sri Lanka, except several isolated attempts to control such species.

To deal with this situation, Biodiversity Secretariat of the Ministry of Environment and Natural Resources organized a national workshop on Alien Invasive Species (AIS) of Sri Lanka in October, 1999. Some of the important recommendations in this workshop are given below as depicted in the workshop proceedings (Marambe, 1999).

1. Develop a National strategy/ Action plan and a comprehensive set of clear guidelines to prevent introduction, eradicate and mitigate the impacts of AIS.
2. To carry out a comprehensive capacity building and awareness program
3. To establish a National Database and prepare a National Action Plan on AIS and to prepare a National weed Strategy.
4. To review the existing national legislations and regulations and practice in quarantine, plant protection and other relevant acts and ordinances to avoid introduction of potential invasive species.

5. To make more funds available for research, awareness and control measures on AIS.
6. To develop technologies to use weed for useful purposes
7. To appoint two separate task forces for alien invasive flora fauna

A follow up workshop was held in September, 2000 to make an in –depth analysis of the problem. There it was emphasized to develop a National Invasive Species Action Plan (NISAP) to overcome the problems of AIS (Marambe, 2000). Strategies to be included in the NISAP were identified in this workshop.

Certain invasive species have the potential to be utilized in ways. For example, water plants such as *Eichornia*, *Salvinia*, *Hydrilla*, species and grasses such as *Imperata* and *Panicum* have the potential to be used as compost manure and mulch. Some are useful in making bio-gas. Species such as *Colocasia* and *Tithonia* can be used as organic manure in agriculture fields. *Dillenia* and *Clusia* species can be used as a Mahogany and *Alstonia* are good timber species and used widely in the local markets.

In case of forestry, no assessment has been done with regard to the cost of damage caused by the alien invasive species. In general, no special pest or disease invasions have been recorded in the past except some common pests found in teak, mahogany etc.

National and local agencies with FIS management responsibilities

In Sri Lanka, there are several institutions involved with alien invasive species management which are mainly those involved with biodiversity conservation. They are listed below:

1. Ministry of environment and Natural resources
2. Forest Department
3. Department of Wild Life conservation
4. Agriculture Department
5. University of Peradeniya
6. University of Sri Jayawardanapura
7. IUCN, Sri Lanka
8. National Science Foundation
9. Royal Botanic Gardens, Peradeniya
10. National Science Foundation
11. Tea, Rubber and Coconut Research Institutes
12. NGOs

Forest Department and wild Life Department are mainly responsible for the management all state forests in Sri Lanka. Privately owned forests are of very small scale. Therefore, these two organizations are mainly responsible for managing invasive species within the forests in the country. However, investigations on FIS and development of management guidelines based on research finding can be done by any agency in the country. However, consensus of any of above two organizations is generally required for the research or any similar activity to be done within the forests. A major limitation within those two agencies for the relevant activities is lack of sufficient research personnel to undertake long term research studies. Therefore research support from other agencies would be required.

In identification, monitoring or controlling of FIS, major requirements are training on identification of invasive species, awareness programmes etc and facilities for undertaking research including funds. There seems to be no conflicting authority for FIS activity but ultimate management authority lies with the Forest or Wild Life department depending on the site.

Strategies, mechanisms and measures to control FIS

No strong mechanism or strategy is available at present for controlling FIS in the country. In the past, a few workshops have been organized on Alien Invasive Species (AIS) which have covered all invasive species but one specifically on forest invasive species have never been organized. At present no proper mechanism is available for reporting and recording FIS information but researchers are paying attention by themselves because of some awareness created by past workshops and media publications relevant to AIS.

No effective measures are available for control of FIS within the country but quarantine measures to prevent new introductions into the country are in place for a long time as mentioned earlier.

No proper mechanism is available to inform government officials and the general public on issues related to FIS. However, this has been done with some aggressive agricultural weeds such as giant mimosa but not in FIS.

Some joint mechanisms have been implemented in controlling FIS may harm natural ecosystems such as uprooting of such species with the help of general public and NGOs.

Facilities and services available for national or regional cooperation

Some important information is available with IUCN, Sri Lanka since they have worked on invasive species for quite a long time compared to the other organizations in the country.

List of names of experts:

1. Prof. national Gunatilake, Professor of Botany, Faculty of Science, University of peradeniya, peradeniya
2. Dr. Siril Wijesundara, Director, Royal Botanic Garden, Department of Agriculture, Peradeniya
3. Dr. Buddhi Marambe, Dean, Faculty of Agriculture, University of Peradeniya, Peradeniya
4. Dr. Lakshman Amarasinghe, Plant Protection service, Department of Agriculture, Peradeniya
5. Dr. Channa Bambaradeniya, IUCN, Colombo
6. Dr. Nirmalee Pallewatta, Deputy Coordinator, Regional Biodiversity Programme, IUCN, Colombo
7. Prof. Sarath Kotagama, Professor of Environmental science, University of Colombo, Colombo
8. Dr. D.K.N.G.pushpakumara, Senior lecturer, Faculty of Agriculture, University of Peradeniya, Peradeniya
9. Dr. N.D.R. Weerawardane, Chief Research Officer, Forest Research Centre, Kumbalpola, Boyagane
10. Ms. Deepani Alawatugoda, Reserch Officer, Forest Reserch Center, Kumbalpola, Boyagane

Details of Institutions for undertaking research

1. Forest Department
2. Wild life Department
3. IUCN
4. University of Peradeniya
5. Univvrsity of Sri Jayaawardanepura
6. University of Colombo
7. Ministry of Forestry and Environmet
8. Royal Botanic Gardens

Some expertise is available in the universities and IUC office on invasive species management. Sites where successful control measures have been taken are not known to date. Venues for holding workshops are available in the institutes mentioned above.

There are several international approaches available in Sri Lanka as follows:

1. The order to protect biodiversity in the country, it became a signatory to the Convention on Biological Diversity in 1992 and ratified it on 1994, and the Ministry of forestry and Environment was identified as the focal point for activities related to the biological diversity. It has prepared a document on Biodiversity Conservation in Sri Lanka - A frame work for action. The CBD provides the best opportunity for developing global and regional programmes and plans for prevention of entry and establishment and management of FIS.

2. The guidelines set out by the United Nations International Maritime Organization (IMO) for prevention of alien invasive species through ship's ballast water (1993) is of special importance for Sri Lankan coast zones.

3. Global Invasive Species Programme (GISP)

The development of a global strategy for alien invasive species under this programme will be particularly important for a country like Sri Lanka and currently IUCN is involved with relevant activities.

4. IUCN regional Biodiversity Programme

This programme active in 14 countries in the region and biodiversity and invasive species are considered as one of their core themes. Workshops have been held in country with the objective of developing action plan on invasive species and their impact on biodiversity in Asia.

Reference

Anon. 2000. Initial National Communication under the United Nations Framework Convention on Climate Change, Ministry of Forestry and Environment.

Anon, 1997. Designing an optimum protected area system for Sri Lanka's Natural forests, Vol 1. A project report prepared by IUCN, FAO and World Conservation Monitoring Centre for the Ministry of Forestry and Environment

Bandaratillake H.M. 2001. Forests out of bounds. Impacts and effectiveness of logging bans in natural forests in Asia - Pacific. RAP publication 2001/08, FAO, Bangkok, Thailand.

Marambe B. 1999 (Ed). Proceedings of the National Workshop on Alien Invasive Species in Sri Lanka, Ministry of Forestry and Environment, Sri Lanka.

Marambe B. 2000 (Ed). Proceedings of the Symposium "Alien Invasive Species of Sri Lanka": Impacts on ecosystems and Management. Ministry of Forestry and Environment, Sri Lanka.

Seneviratne G.I. and Algama, A.L.M.N.S. (2001). Invasive species *Prosopis juliflora* in the coastal regions of Hambantota district. Sri Lankan Biodiversity review. Volume 1: 79-83.

Checklist of Forest Invasive Species Present in SRI LANKA

Scientific name	Common name	Origin	Introduction		Likely pathways of spread	Vectors
			Method	Year		
<i>Wedelia triloba</i> (runner)	Arunadevi Kaha karabu		Ornamental Plant, cover Crop for Erosion control			
<u><i>Mikania micrantha</i></u> <i>Miconia calvescens</i> <i>Miconia calvescens</i> (runner)	Watupalu	South America / Mexico	Negligence	1888	Wind, runners	
<u><i>Mimosa invisa</i></u> (runner)						
<i>Opuntia stricta</i> (shrub)	Pathok					
<i>Lantana camera</i> (shrub)	Grandapan a/ Lantana	South America	Ornamental Plant	c. 1930	Nursery Trade, Animal Excretion, Garden waste	Animals, Transport Networks, Commercial nurseries
<i>Ulex europaeus</i> (shrub)	Gorse	Europe	Ornamental Plant	1888		
<i>Eupatorium riparium</i> (shrub) <i>Eupatorium odoratum</i> (shrub)	Podisngho Maran		Negligence	1918		
<i>Clidemia hirta</i> (shrub)	Katalalu Bowitiya	Tropical America	Unknown	1884		
<i>Dillenia sufruticosa</i> (shrub)	Diyapara		Negligence Horticulturists	1882		
<i>Millingtonia hortens</i> (shrub)			Negligence Ornamental Plant			
<i>Prosopis juliflora</i>	Mesquite		Afforestation	1880		

(Small tree)						
<i>Annona glabra</i> (small tree/ shrub)	Wal anoda Wel atha		Unknown			
<i>Mimosa pigra</i> (small tree)	Yodha Nidikumba		Negligence			
<i>Clusia rosea</i> (small tree)	Gal goraka	West Indies		1866		
<i>Swietenia macrophylla</i> (large tree)	Mahogany		Forestry / timber			
<i>Leucaena leucocephala</i> (large tree)	Ipil Ipil		Fodder Plant, Soil rehabilitation			
<i>Myroxylon balsamum</i> (large tree)	Balsam Tree Kattakuma njai	Venezuela	Forestry	1870		
<i>Alstonia macrophylla</i> (large tree)	Hawarinuga	Malaysia	Forestry			
<i>Imperata cylindrical</i> (grass)	Illuk					
<i>Panicum cylindrical</i> (grass)	Gini grass		Fodder			
<i>Ochlandra stridula</i> (bamboo)	Bata		Native			
<i>Bambusa bambos</i> (bamboo)	Katu una					
<i>Acrostichum aureum</i> (fern)						

