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Development of Forestry Research in the Forest Department

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Introduction

Forestry research is one of the important biological research areas in the country. Forests distributed in diverse ecosystems warrant the necessity of extensive research programmes for the scientific development and management of these resources. With the new developments in the forestry sector, it is important to identify new research areas to suit the requirements of the country. The research division of the Forest Department takes a lead role in conducting research, particularly to cater to the requirements of this Department which is the major agency responsible for the scientific development and management of the forest resources in the country. In addition to the Research Division of the Forest Department, universities and other organizations are also actively involved in conducting forestry research. The latter supplements and helps to fill the gaps in forestry research requirements.

History of Forestry Research Development in the Forest Department

Forestry research has been conducted for more than 70 years in the Forest Department of Sri Lanka. Forestry research was formalized in Sri Lanka in 1937 when a small Research Unit was established in the Department. The main research efforts in those days were regeneration of natural forests in the different climatic regions of the country. They included research on seeds, seedlings, planting methods and other silvicultural topics. Other studies involved tree phenology, enrichment planting and plantation establishment under different soil and climatic conditions as well as other silvicultural treatments of natural forests to improve their composition and yield. During the 1930's and 1940's, research efforts were concentrated on natural forest management, while plantation forestry was still in its formative years. Initial results proved that native species are not suitable for reforestation in dry and wet patana grasslands. The Department research into teak silviculture was given priority in the dry zone and was proving successful during those periods. Research from the late 1930's to the early 1950's produced successful results and paved the way for establishing commercial plantations (Neil, 1991).

To provide information on the utilization of wood, a Timber Utilization Research Branch was created in the Forest Department in 1949. In 1985, the unit was transferred to the State Timber Corporation. Forest protection and planting dominated the work of the Forest Department from the late 1950's to the 1970's. Research received lower priority at this time and silvicultural research was restricted due to limited staff and funding. However, observation plots of a large number of exotics were established in the "up-country" during this time. During the 1970's, tree improvement work began particularly of pines, eucalypts and teak. During this period *Pinus caribaea* was selected as a major plantation species in the up country (Vivekanandan, 1975).

In the early 1980's with the assistance of a USAID project a large number of trials were established. The first field Research station was established at Kurunegala under this project. In the mid 1980's a Community Forestry Project (CFP) funded by the Asian Development Bank was started and promoted research into fuelwood and agroforestry. The second field Research station was established at Badulla with financial assistance from this project. A new series of species/provenance trials was initiated in the 1980's. *Acacia auriculiformis* and *Acacia mangium* were introduced for large scale planting in this period. Various seedlots received from the Australian Tree Seed Centre (CSIRO) were tested for planting in degraded lands for reforestation purposes. The Forestry Resources Development Project (FRDP)

assisted by the World Bank also had an active research component which conducted research in both the dry zone and the up country. Trials established by this project that were completed were written up during the project period and results were built into recommendations for field practice.

The Forestry Master Plan for Sri Lanka prepared in 1986 identified the importance of research and recommended the strengthening of the Research Branch. The British ODA funded Forestry Research and Information (FORRI) project has actively supported the research branch since 1991.

Present Status of the Research Division

Two research stations are maintained within the Research Division in addition to Forestry information unit at the Head Office. The division is headed by the Conservator of Forests (Research and Education) while two Research Stations are under the supervision of the Chief Research Officer. The Research Centre at Kurunegala is mainly focuses on dry and western intermediate zone areas in the low country while Badulla station focuses on up country and eastern intermediate and dry zone areas.

A seed centre was established in 2003 at the Forest Research center, Kurunegala with cold storage facilities to distribute high quality seeds of commercial forest species to forest managers mainly within the Forest Department. Seed orchard development and maintenance work were carried out in connection with the seed centre work. A new approach is being developed from 2008 to collect seeds of medium scale commercial species and non-commercial species *viz.*, neem, halmilla, casuarinas, nedun, cypress, rattan, lunumidella, kumbuk and threatened species and distribute them for the requirement of the Department as well as for the private sector.

Current staff position consists of 7 Research Officers including 2 PhD holders. Lack of qualified supporting staff continues to be a longstanding problem.

Priority Research Programmes Identified and Implemented in the Past Decade

Priority research areas may vary from time to time depending on the requirement of the Department and new developments in the forestry sector. Selection of research programmes and their implementation in each year also depend on the staff position of the Research Division of a particular year. Following research programmes under 4 main research areas were implemented during last few years.

Major Research Areas

1. Silvicultural improvement of forest species
2. Genetic improvement of forest plantation species
3. Natural forest management
4. Forest protection

1. Silvicultural improvement of forest species

- 1.1 Development of propagation techniques of forest species.
- 1.2 Growth evaluation studies of plantation species
- 1.3 Evaluation of local species for planting in 'difficult' sites (degraded sites, fire prone sites, moisture stress conditions, etc.)
- 1.4 Evaluation of underutilized species
- 1.5 Domestication of wild species
- 1.6 Fertilizer and soil improvement studies
- 1.7 Forest seed studies
- 1.8 Socio-economic studies
- 1.9 Non timber forest species improvement

2. Genetic improvement of forest plantation species

- 2.1 Genetic conservation of endangered species
- 2.2 Genetic improvement of plantation species
- 2.3 Seed orchard and Seed Production Area development

3. Natural forest management

- 3.1 Biodiversity surveys in selected natural forests
- 3.2 Invasive species in natural forests
- 3.3 Restoration of degraded natural forests
 - 3.3.1 Enrichment of degraded natural forests by planting suitable species
 - 3.3.2 Assisted natural regeneration
- 3.4 Mangrove forest related studies

4. Forest protection

- 4.1 Entomological studies of forest species
- 4.2 Pathological studies

Silviculture Research Programme

Various silviculture research programmes have been implemented over a long period of time. Species selection has been considered as a priority area. Species selection by field trials, particularly exotic species, has paved the way for establishment of large scale commercial plantations. Subsequent provenance testing further improves the performance of these species. Establishment of new plantations has been discontinued the case of exotic species, for example pinus, due to pressure from politicians and environmentalists. Other exotic species have also received some resistance from various environmental groups.

Khaya senegalensis (African mahogany) is becoming popular in reforestation programmes as a fast growing timber species. In general, Khaya is propagated by seeds, but there are several difficulties in seed propagation including unavailability of seeds, short viability, and damage by rodents, etc. *Khaya* seeds are almost entirely imported from African countries and cost a large sum of money. Vegetative propagation therefore is a good alternative to overcome this problem. Stem cutting from coppice shoots of mature trees and seedling cutting have been successfully rooted. Seedling cuttings have greater rooting ability than stem cutting from the shoot of mature trees. Further studies are being continued to investigate on multiplication rate and the most suitable age of seedling for maximum performance in multiplication programmes. Neem, acacia, and venivel are also being studied for vegetative propagation.

Forest plantations are mostly established in degraded sites and consequently plantation productivity is low in such sites. When second rotation plantations are established they also face the same problem showing even lower productivity. Therefore, productivity improvement measures such as fertilizer application and land preparation methods are also being tested. Soil analysis is being carried out in plantation sites to compare soil fertility of different sites and also to identify deficient nutrients.

Teak second rotation establishment methods have been studied in the eastern dry zone areas. This included establishment aspects of land preparation methods, weed control methods, different planting materials, effects of organic and inorganic fertilizer and moisture conservation methods. The objective was to develop a technical package for teak establishment in the dry zone.

Pine conversion trials have been conducted for a considerable period in the past. Results revealed that pine conversion was possible in the wet zone areas while in the dry areas of up country (up country

intermediate zone) the establishment was difficult due to moisture deficient conditions in the dry period, low soil fertility and fire problems in the dry periods. Resin tapping methods including tapping depth, rill inter space, acid treatment, tapping frequency etc were studied.

A programme on identification and control of invasive species has been started recently and a list has been prepared on important invasive species. Their control methods are being studied. Control of *Prosopis juliflora* by chemical control methods is being studied. Spread and control of kattakumanjal in mahogany forests have been studied in the past.

Underutilized species such as kapok, wetake, rush and sedges were studied for their commercial use and propagation.

Research on bamboo and rattan has been conducted for a long period and most of the basic research has been completed such as identification of species, propagation techniques, establishment methods etc. Present research includes yield and harvesting studies, processing technique development, physical and mechanical properties etc. An initial field survey was carried out in an 8 years old trial plantation on harvestable canes. A detailed yield study will be continued in the due course.

Small tanks in Sri Lanka provide a large number of benefits to rural livelihoods. At the present time, eco systems of many tanks in the dry zone have been adversely affected due to various human activities. Identification of species composition and distribution in different components of tank eco-systems is essential for rehabilitation of such tanks in a sustainable manner. Trees associated with small tank ecosystems of Sri Lanka, their ecological role and social values were listed and some indigenous knowledge recorded.

Seed germination and viability studies on gini sapu, kithul, sudu handun, teak and mahogany at present are being carried out as short term studies. A seed storage experiment was conducted to study the storage conditions and pretreatment methods of *Calamus rotang*.

A tissue culture lab was set up at the Kurunegala research centre and work is in progress. Micropropagation studies have been initiated and some encouraging results have been obtained so far on bamboo and teak.

A survey on tree seed use and forest plant production by the private sector is being studied to assess the future private sector involvement in forest seed use. A survey was carried out in three sites of the Natural Resource Management project in the Kurunegala District to study the success/failure of home garden programmes.

Tree Improvement Programme

Broad genetic variation of the base population is the fundamental requirement of a tree improvement programme. Forest genetic resource conservation also plays a major role in tree improvement programmes. Teak, Eucalypts and Mahogany are the main commercial tree species being focus in genetic improvement programmes. The following essential activities were included in the tree breeding programmes.

1. Broadening the genetic bases
2. Genetic test to estimate the genetic parameters
3. Selection of superior individuals from breeding populations and development of superior populations to be adopted to local conditions
4. Mass propagation i.e. seed orchard establishment, cloning

Teak Improvement Programme

Clonal seed orchard development was initiated in the 1970's. The Barigoda seed orchard in Kurunegala was established in 1976, with grafts from 39 clones. Up to 10 ramets per clone were planted in each of 5 blocks. These clonal materials were interplanted with teak seedlings. The normal teak seedlings were found to be phenotypically inferior to ramets indicating that the original selection was successful. This also indicates that significant genetic variation exists in teak populations in Sri Lanka. The Horakele seed orchard was established in 1977. Two other seed orchards at Wanniyagama (Puttalam) and Middeniya (Hambantota) were damaged by elephants. Present seed production from seed orchards and seed production areas ranges from 2000-5000 kg/year.

Teak progeny trials from established seed orchards, further establishment of clonal seed orchards and clonal hedge garden establishment are underway in the present programmes. A progeny trial with local 'plus' trees will act as the base population for future teak breeding programmes.

Eucalyptus Improvement Programme

The *Eucalyptus grandis* breeding programme was started in 1995 by establishing the first generation progeny trial at Welimada. Provenance trials have been conducted in the up country starting from early 1980's. *E. grandis* seedling seed orchards were established after progeny trials. The second generation progeny trial was established in 2007. Establishment of a clonal seed orchard has been planned. *E. grandis* Seed Production Areas (SPA) have been established in different locations in the Badulla district. *E. microcorys* SPA's have also been established. Genetic resource stands have been established with proven provenances viz., 10 ha of *E. grandis* and 3 ha of *E. microcorys*.

Provenance Trials in the Dry Zone

Eucalyptus was introduced from Australia in the 1970's to the dry zone while Acacias were introduced in 1980s. A large number of species and provenance trials were established in the dry zone during that time. Eucalyptus species tested were *E. tereticornis*, *E. camaldulensis*, *E. alba*, *E. citriodora* etc.

E. tereticornis was found to be superior in these trials and plantations were established with this species (Bandaratillake, 1997). Eucalyptus provenances selected were Helenvale (Queensland), Mt garnet (Queensland), Laura (Queensland). North Queensland provenances were generally better.

Various Acacia species were also introduced from Australia and tested in field trials. Major Acacia species were *A. auriculiformis*, *A. mangium*, *A. crassicarpa* and *A. aulacocarpa*. By 1992, 20,000 ha of Eucalyptus and 3,700 ha of *A. auriculiformis* had been planted in the dry zone of Sri Lanka.

Gene Pool Conservation of Important Indigenous Tree Species

Genetic conservation is a priority aspect in the conservation of forest resources in Sri Lanka. Declining natural forest cover due to impact of growing human population is becoming a threat to biodiversity of forests and hence for genetic conservation (Weerawardane, 2000). Many important indigenous tree species have faced genetic degeneration over the years due to continuous removal of phenotypically better trees for various end uses. Some tree species are found only in home gardens while others are confined to a few natural habitats. Their natural regeneration is threatened due to various factors. Thus it is very important to protect the genetic resource of these species by the establishment of *ex-situ* gene conservation stands. These stands will be used as base populations for future tree improvement programmes. A strategy has been developed for the conservation of genetic resources of several threatened species such as nedun (*Pericopsis mooniana*) and gammalu (*Pterocarpus marsupium*).

Germplasm collection has been done from a natural range of distribution and planted as gene banks in several locations.

Exchange of germplasm of important commercial species particularly to improve genetic base of existing species, importation of promising plantation species which are not presently grown in the country and development of a network of relevant scientists to share information are suggested for regional collaboration with in other Asian countries.

Natural Forest Management

Restoration of degraded natural forests is one of the main research areas. Restoration methods are carried out by means of enrichment planting and assisted natural regeneration. Assisted natural regeneration studies have shown promising results but the success depends on availability of mother trees in the nearby areas and the level of degradation of both the forest and soil of the sites. Natural forest degradation methods and restoration pathways are being studied.

Forest Protection

Control of Ambrosia beetle/Black twig borer (*Xylosandrus compactus*) in forest nurseries was studied. The beetle attacks a broad range of tree species including *Khaya*. Control methods have been developed. Estimation of yield loss by teak fruit borers was studied. This insect attacks teak fruits and contribute to low fruit yield as well as low germination in teak seed.

Red stem borer (*Zeuzera coffeae*) has been identified as an emerging threat to forest plantations in the country (Mannakkara, 2006). This insect attacks teak, mahogany and khaya. Its life cycle has been studied and control measures have been recommended. Mahogany shoot borer (*Hypsipyla robusta*) has also been studied (Mahroof and Edirisinghe, 1999) and control measures have been developed. Other important forest pests recorded and studied are cockchafer grub (*Holotrichia serrata*), teak defoliator (*Hyblaea puera*), teak skeletonizer (*Eutectona machaeralis*) and effects of subterranean termites on exotic plantations (Midgley and Weerawardane, 1986).

A survey on timber pests has commenced. A check list of Sri Lankan long horned beetles has been prepared to support identification and investigation.

Canker disease in nedun saplings was studied and control measures were developed.

Dissemination of Research Findings

Research results are published in the official journal of the forest Department viz., "The Sri Lanka Forester", which is an international journal. A newsletter named "Forest Research Newsletter" is also published by the Research Division of the Forest Department. In addition, posters, leaflets and booklets are also published from time to time to cater to the requirements of the Forest Department and other stakeholders. An annual research seminar is conducted to facilitate two way communication between researchers and forest managers where field problems are brought to the notice of researchers to develop appropriate research programmes while managers are made aware of new research findings and recommendations.

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