Chapter (non-refereed)

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Preface

Domestication of 'Cinderella' species as the start of a woody-plant revolution

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We are all aware that the pressures on tropical ecosystems are increasing daily: that human and livestock populations are rising, and that the stock of productive land is finite and dwindling as a result of misuse. Deforestation is reducing species diversity and eroding the genetic base of many tropical tree species, including those used traditionally by local people for products that fulfil many of their domestic needs. Forest degradation is also having negative impacts on soil fertility, and is modifying climate by local/regional influences on the albedo and hydrological cycle, as well as by the emission of trace gases to the atmosphere.

Together, the above consequences of deforestation combine to reduce the area of productive land needed by growing human populations, and to increase poverty and the incidence and severity of famine. At present, the demand for farm land is met by opening up new areas of forest to agriculture. It is therefore important to increase the resource of trees in deforested areas, so as to meet the traditional needs of local people, including the urban populations. Somehow a way has to be found to make the land more productive and to rehabilitate degraded areas in a way which will diversify production, promote genetic conservation, enhance the development of sustainable land use and contribute to domestic, regional and international trade.

Great progress was made with food crops in the 1960–80s, as a result of the 'green revolution', but now there is a need to diversify into new crops, many of which could be tree crops. This diversification is desirable ecologically and economically, to reduce the dependence on commodity crops with falling product prices. In addition, without genetic engineering, further large increases in the yield of the current narrow range of crop species are unlikely.

Throughout the tropics there are numerous perennial woody species that have provided indigenous peoples with many of their needs for millennia. Many of these people have now left the land for the concrete jungles of urban life, but would still like supplies of traditional food, medicines and other natural products. These traditionally important woody plants are virtually undomesticated, ignored by the 'green revolution', yet probably have great genetic diversity. They also play a key role in the biological, chemical, physical and hydrological cycles of the soil and the atmosphere, protecting soils from damage and acting as a buffer against environmental change. These same plants are the ones that are cut down indiscriminately to relinquish a few valuable logs per hectare, to clear land for 'development' projects or to provide a subsistence living for a year or two. These overlooked and often highly desirable trees are the 'Cinderella' species of our forests.

'Cinderella' species are often ignored by agriculturalists of the developed world in favour of a handful of exotic species which have been domesticated and grown artificially on a large scale. The choice is often made without much thought for the environment, and, perhaps, with thought only for relatively short-term economic gains. The same scenario has occurred in forestry. While planting and domesticating a few exotic fast-growing trees for pulp and paper, the majority of the hardwood species forming the basis of the timber trade have not, for a variety of reasons, contributed significantly to reafforestation programmes. Surprisingly, therefore, the absence of even beautiful and commercially important timber trees such as mahogany from man-made forests allows them to be classed as 'Cinderella' species. The resources of these 'Cinderella' tree species can be tapped by the process of 'domestication', which has been applied so successfully to agricultural and horticultural crops.

One of the objectives of this Conference is to raise the profile of the 'Cinderella' species, and, particularly, to draw attention to a growing effort to domesticate a much wider array of tree species and introduce them into agricultural and forestry systems. The domestication of traditionally utilised 'Cinderella' species providing fuelwood, poles, timber, fruits, gums, nuts, resins,

fibre, pharmaceutical products, etc, can now be rapidly achieved by applying some of the techniques described in these Proceedings. This approach has the added environmental benefit of diversifying the species grown on farm land and in forest plantations. In addition, domesticating these species will go some way towards reducing economic dependence on a few 'commodity' species. In this way, a start is being made to initiate a 'woody-plant revolution', which could provide some cheer in the otherwise gloomy outlook for tropical forests. Opportunities are currently being lost because of a lack of awareness of the potential to domesticate forest tree species for the production of timber and non-timber products.

What are the issues that have to be resolved to trigger this new revolution? From the viewpoint of a farmer, there are:

- *the political and social issues,* such as how to acquire the right to own and protect a piece of land and the trees on it, and the need for incentives to plant trees;
- *the economic issues*, such as what is the value of these trees in terms of their wood, other products and environmental services;
- *the biological issues,* such as how to grow the trees wanted by farmers; how they can be made more desirable and productive, to the extent of satisfying the farmers' needs and even providing a surplus which could be sold to urban populations.

This Conference is about solving the biological issues concerned with the provision of timber, food and other domestic necessities. However, there are also direct economic and social benefits, such as improving community welfare through the market-place. To plant and grow trees on a scale necessary to have any impact on either the environmental or social consequences of deforestation, it is essential that farmers, communities and companies see financial and other incentives accruing from tree planting. The incentive of greater profitability is proposed as a powerful means of promoting the planting and growth of tree species. Genetic improvements in yield and quality should increase the value of the products of a tree crop, while increased growth rates in timber trees will allow a shortening of the rotation, and hence a more rapid return on invested capital. It should not be at the expense, however, of the environmental benefits of tree planting.

There has been a recent awakening to these biological issues, and significant progress has been made in the past 10–15 years. It has been realised that it is possible to capture the genetic variation inherent in tropical tree populations, and that this can be used to domesticate trees rapidly for timber as well as non-timber products for sale in local, regional and even international market-places. It has also been realised that there is a need to improve management systems if new cultivars are to be as productive as they could be, and if they are to be used to rehabilitate deforested land. Options include systems which rehabilitate the environment on a local scale, by improving soil structure and fertility. Other systems may have more wide-scale effects, such as beneficial impacts on the regional hydrology or global climate, by the creation of complex canopies which mimic natural forests.

There is also a growing realisation that the domestication of these 'Cinderella' trees involves protecting their genetic resources and growing them wisely and efficiently to protect the environment. Perhaps a 'woody-plant revolution' of this sort could contribute significantly to the rehabilitation of our planet and the feeding of its population. Hopefully, the Proceedings of this Conference will inspire fairy godmothers, particularly policy-makers and donors, to mobilise their glass carriages and get Cinderella to the ball.

Dedication

These Proceedings are dedicated to Douglas G B Leakey, who as a forester in Kenya all his career tried to encourage the planting of trees for environmental protection. It was this awareness of the importance of trees that led him to write a paper in 1948 for a conference in the Belgian Congo, which subsequently inspired Professor Anthony Young of the International Centre for Research in Agroforestry to commend him as one of the early advocates of agroforestry. (See *ICRAF Newsletter* (October 1986), **18**, 5.)

Domestication: a definition

The concept of a domesticated species is familiar to most people in terms of farm animals and household pets, but is not so common in plants. However, it is well known that modern grain cultivars have been bred over generations from wild grasses, and that our gardens and orchards are stocked with woody plants that have similarly been subjected to selection and breeding. Foresters have been slow to see the need to domesticate their crops. Until relatively recently, foresters have collected seeds from the wild and used them without selection. The use of provenance selection, an early stage in the domestication process, gained international importance in the 1960s, although techniques such as clonal selection have been used for centuries in a limited number of species – *Salix, Populus, Cryptomeria japonica,* etc.

The following are definitions which help to explain the processes which are involved in the domestication of a plant species.

- To domesticate is to naturalise; make fond of home; bring under human control, tame; civilise (*Concise Oxford Dictionary*)
- Domestication is closely linked to the idea of selection, of fitness for purpose, of pushing nature into a higher gear and in a particular direction (Palmer, pp16–24)
- Domestication is a two-stage process in plants: the bringing into cultivation of wild plants or exposing them to some form of management, and subjecting these to differential production or selection (Janick *et al.* 1982)
- Domestication is human-induced change in the genetics of a plant to conform to human desires and agroecosystems, culminating in the plant's loss of its ability to survive in natural ecosystems (Harlan 1975)
- The four elements of the domestication process in forest trees (Libby 1973):
  - the original genetic variability
  - selection of the desired trees or genes
  - a packaging of those genes in the plants to be used
  - converting those gene packages into the growing trees which are harvested as a renewable resource.
- There are several stages to the domestication of crops (described by Clement & Villachica, pp230–238):
  - managed species
  - semi-domesticates
  - full domesticates

At the Conference, the full 'domestication' of a tree species was taken to encompass the identification and characterisation of its germplasm resources; the capture, selection and management of genetic resources; and the regeneration and sustainable cultivation of the species in managed ecosystems (Figure 1). In the papers presented, it is clear that the starting point can vary considerably depending on the approach taken, which in turn seems to depend on whether the domesticator is a peasant farmer or a research scientist. Many of the species described can, thus, at best be described as semi-domesticates.

In forestry, the term 'domestication' has mostly been applied to the genetic improvement of trees for industrial plantations, but one message from the Conference is that the domestication process in trees also has a strong social involvement, seen clearly from the examples of non-timber species. The need to develop this social aspect has recently been recognised in the strategic plan for the new Centre for International Forestry Research (CIFOR) prepared by the Australian Centre for International Agricultural Research. CIFOR is the newest institute of the Consultative Group for International Agricultural Research.

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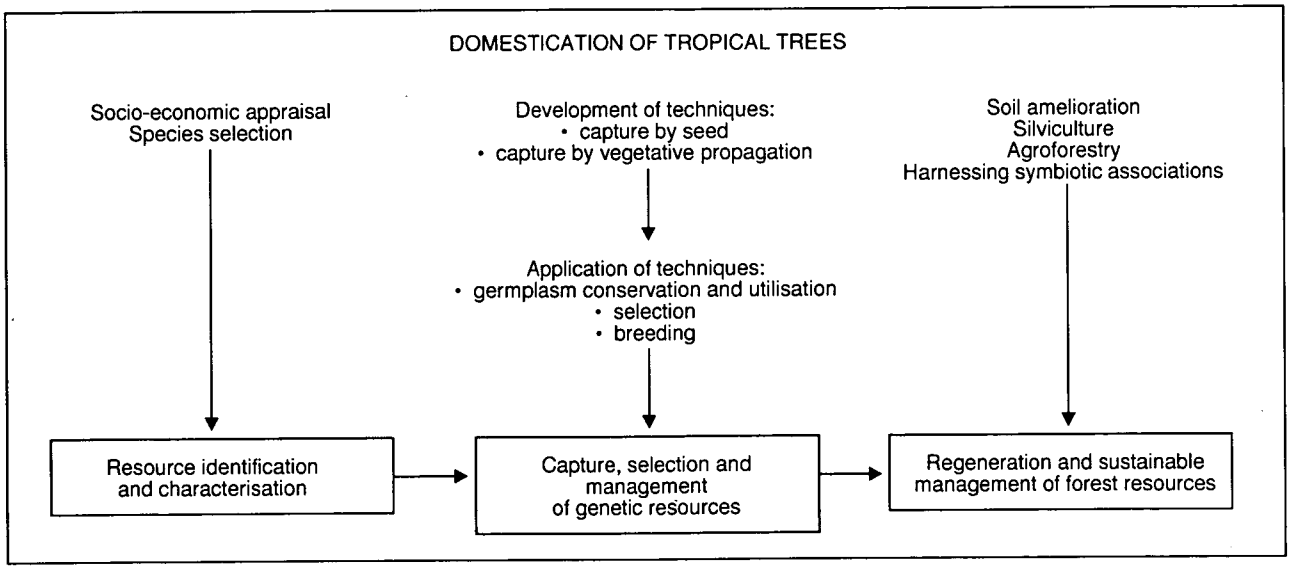

Figure 1. Stages involved in the domestication of tropical trees

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