
Chapter 3

Constraints and Opportunities

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Constraints and Opportunities

TECHNOLOGICAL CONSTRAINTS

Currently available technologies can be directly applied to reforestation of degraded lands. For almost any type of land, someone, somewhere, has grown trees. However, important technical constraints exist that must be overcome to expedite reforestation. Some of these constraints are:

- shortage of planting stock;
- inadequate attention to collecting, testing, and distributing high quality seeds and clones;
- lack of information and research; and
- lack of trained staff.

In addition, because it is economically infeasible to reforest the broad expanse of degraded tropical land using conventional technologies, the technologies need to be redesigned to require less organization, less infrastructure, and less capital investment. Only then can there be rapid and widespread reforestation.

One major technical constraint to reforestation is the shortage of planting stock. The seed supply is generally adequate for species commonly used in tropical industrial plantations (pines, eucalyptus, *Gmelina*, teak), although some valuable provenances are in short supply and their natural origins are threatened with genetic impoverishment or extinction. On the other hand, seeds for most of the multipurpose and nitrogen-fixing tree species are available only in small quantities and are often of poor quality. The seed supply problem can be alleviated through the use of vegetative propagation such as rooted cuttings or tissue culture. These techniques have great potential to accelerate the process of matching provenances to specific site conditions and to reproduce those provenances on a massive scale. Caution is advised because these techniques greatly reduce the genetic base and thus can increase the forest's susceptibility to outbreaks of pests and disease.

Even though more seeds are needed, care should be taken in their collection. No mechanism exists today to control the quality of tree seeds traded. Most tree seed dealers do not supply adequate information on the origin of the seed and this results in the use of genetic types that are poorly matched to site conditions. Planting the wrong seeds may cause a reforestation project to fail. Similarly, it may be difficult to trace the origin of those seeds that do produce well to get more planting material. Seed certification procedures have been established for agricultural seeds and to a much lesser extent for tree seeds in Europe (89), Canada, and the United States. These are valuable aids for controlling genetic history and seed quality, but they are extremely difficult to negotiate and control, particularly internationally.

Another constraint on reforestation is the lack of relevant and timely information and research. Without accurate data, it is impossible to understand how and why land became degraded or to plan the proper scale and action needed. Although the data base is improving because of the Global Environment Monitoring System (GEMS) sponsored by FAO and UNEP, it will require continuous refining and updating. Information is unavailable on silviculture of various tropical tree species (especially species with many uses), on species and provenances suited for specific sites, on management of mixed-species plantations, and on the best follow-on maintenance and protection.

Even when information on appropriate species and technologies is available, it often is not disseminated effectively to scientists, technicians, and decisionmakers. This is partly because of a dearth of published material and insufficient information transfer within countries. Another constraint on information flow

is the lack of an institution with a mandate to coordinate reforestation research, development, and implementation on degraded tropical lands. Thus, foresters are often unaware of what is being done elsewhere in their own country, in other projects or administrative districts, or by various research agencies. Furthermore, they are often unaware of previous work in their own region. Duplication, redundancy, and waste of precious time occur.

Finally, in most tropical countries there is a lack of sufficient numbers of trained staff at professional and technical levels for direct operational forestry research or for extension work. The reasons are many:

- forestry ranks low in public recognition;
- financial rewards are poor in comparison with other professions, since most tropical

forestry jobs are in the government sector, which is poorly rewarded in comparison with the private sector;

- competition among ministries, between ministries and industry, and among national and international agencies, and the emphasis on post-graduate qualifications for promotion have led to a “brain drain” from the local government agencies.

Yet even when staff numbers and training are adequate, their efficiency can be impaired by poor project management and poor logistical and technical support (126). Further:

- government officials generally are unwilling to serve in rural areas where the need is greatest; presumably this will continue until the market is saturated with trained personnel.

TECHNOLOGICAL OPPORTUNITIES

Opportunities exist to overcome these technological constraints, including:

- developing international systems for seed source identification, collection, production, and distribution;
- supporting programs on tree improvement, propagation of *Rhizobia* and mycorrhizae, mixed species plantations, and other related subjects;
- supporting efforts to disseminate research information globally, regionally, and in-country;
- including research and dissemination of information as components of reforestation programs; and
- creating incentives for developing country people to enter forestry, such as changing the reward systems in forestry institutions.

Lack of sufficient and appropriate planting materials can be alleviated by developing international systems to identify seed origin, certify quality, and collect seeds in commercial quantities; protect natural stands to conserve germ plasm; and establish seed orchards from which seeds can be made available interna-

tionally. Support for tree improvement activities will encourage self-sufficiency in seed production and allow genetic improvement to serve local needs,

Genetic improvement can give gains of 10 to 30 percent in yield in the first few generations (131), and generations can be as short as 2 to 3 years for some tropical trees. Clonal propagation has great potential, particularly where seed is in short supply and where certain site-specific genetic characteristics are desired. Techniques for mass production of cuttings can be developed locally by private nurseries, universities, or research institutions (including forest departments). Additional research may be required, particularly for fast growing tropical species with short rotations. Financial support for techniques such as tissue culture may prove beneficial in the long run because its greatest value may be in gene conservation. Given the potential to increase survivorship and yield with inoculation of seedlings with *Rhizobium* or mycorrhizae (as described in ch. 2), additional support could be given to collect, identify, culture, test, and mass propagate productive strains of those bacteria and fungi.

Research on interactions between agricultural crops and trees has begun in many parts of the world. However, very little research is being conducted on mixing species of trees. It is a practice that is seldom used and poorly understood. Support could be given to initiate more research in this area. The research should aim at both the biological interactions of tree mixtures and at management systems to follow when one species begins to dominate another.

Inadequate information gathering and dissemination lead to inefficient expenditure of funds. The publication of information on local reforestation and research in internationally available journals could help to prevent constantly "reinventing the wheel." Providing published literature to operational and research personnel, especially at the field level, could enhance the likelihood of the most appropriate, up-to-date, and low-cost reforestation technologies being applied to the degraded land. Results of local research and management experience can be published locally at low cost in the form of departmental technical notes and bulletins. Efforts should be made to ensure that staff members receive relevant materials, read them, and, where appropriate, use them. Distributing information internationally is more complicated and expensive. The Commonwealth Forestry Bureau (CFB) maintains all of its forestry research information in Lockheed Dialog, a computer-based information retrieval system in California, but too few institutions in tropical countries have access to necessary computer terminals or money to use this service. Mail service and reprints are also expensive. Donor institutions might help by financing an international information service to provide microfiches containing each month's CFB abstracts to developing countries. Thus, field staff could be kept up to date on current literature and the latest advances in reforestation,

Improvements in information dissemination can be linked to a well-coordinated research effort based on some systematic, scientific approach eliminating unnecessary duplication and waste. In some cases assistance may be needed from established research institutions to design research programs and to help train research staff to interpret and implement results. Donor institutions can help, for example, by providing appropriate equipment. Twinning of research institutions in developed and developing nations is one vehicle to provide this kind of support. (See ref. 132 for more information.) However, other methods to coordinate funding for research need to be formulated.

Providing additional staff, like reforesting additional hectares, requires increased government expenditures, and, where necessary, financial or technical support from donor institutions. Staff recruitment and maintenance depend on a rewarding career structure with sufficient financial inducement. In many countries provision of additional staff could be provided at little extra cost by restructuring forest agencies to reduce unnecessary duplication and complex hierarchies (131).

Forestry extension is becoming increasingly important as planners recognize that project success depends largely on active participation of local people. Incentives must be developed to entice more foresters to live and work in the field to provide necessary support to local people. Unfortunately, most existing forest services are not structured to provide forestry extension services, nor is staff trained in extension and communication skills (6). Therefore, major changes are in order for forestry administration, staffing, and training—changes also designed to acknowledge that forestry extension needs to work with local women who, in many countries, perform the tasks of planting and caring for crops including trees (53).

OTHER CONSIDERATIONS

Forestry is low in priority in many tropical countries. Forest plantations have not competed well against other land uses because the

economic returns are often spread over a long time and short-term profits are low compared to those of alternative investments. This is

often in conflict with government priorities for projects with quick returns (for which leaders receive more political credit) and with bankers who use conventional discounting methods and have little interest in moderate returns in 30 years. In addition, the lack of comprehensive forestry or land use policies has prevented forestry investment and development. But firm policy guidelines from the governments can produce significant results. For example, fiscal tax incentives for private reforestation established by the Brazilian Government have led to an increase in the rate of reforestation in Brazil (103). By giving tax breaks to landowners who reforest their lands, the Brazilian Government has given recognition to the importance of reforestation.

Reforestation projects may not receive adequate funding and support because benefit/cost analysis can show unfavorable results when it fails to include both direct and indirect costs and benefits. Adequate analysis also requires comprehensive data on costs, benefits, and man- or machine-times and productivities, yet much of this information is unknown at the project planning stage. Price estimates often are unreliable and do not account for inflation. Information on labor requirements is usually missing as well. Moreover, in forestry, yields are difficult to predict because of the long-term nature of the enterprise, climate and management uncertainty, and, more importantly, a lack of accurate information on site/species interactions. New technologies, such as tissue culture to accelerate vegetative propagation and bacterial inoculation to increase seedling survival, are reducing the costs of reforesting

degraded lands. Yet methods are not developed to measure the important but indirect benefits to justify investment in reforestation.

Many nonmarket costs and benefits must be included in economic analysis, especially for reforestation projects where the indirect benefits may be more significant than direct benefits. But benefits such as improved environmental quality are often the most difficult variables to quantify. Economists are grappling with this problem. International development banks tend to treat many nonmarket considerations in a qualitative fashion rather than trying to develop artificial values for them (45). However, unless treated carefully, simply listing nonquantified variables may serve to remove them from consideration. Therefore, given the large uncertainties in selecting the best method for reforestation of a degraded site, it may be advisable to try out in practice several approaches until the uncertainties have been sufficiently reduced (51).

Most experts find that major constraints to reforestation of degraded tropical lands are economic, institutional, and social rather than technical. A technical package, once accepted by funding institutions and the host-country government, may solve certain problems, but many obstacles to its acceptance remain. Experts must remember that "forestry is not, in essence, about trees. It is about people. It is only about trees so far as they serve the needs of the people" (46). Successful reforestation requires sufficient funds, strong political will, massive popular support, and cooperation among all involved parties.