People and Trees: The Role of Social Forestry in Sustainable Development

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EDI SEMINAR SERIES

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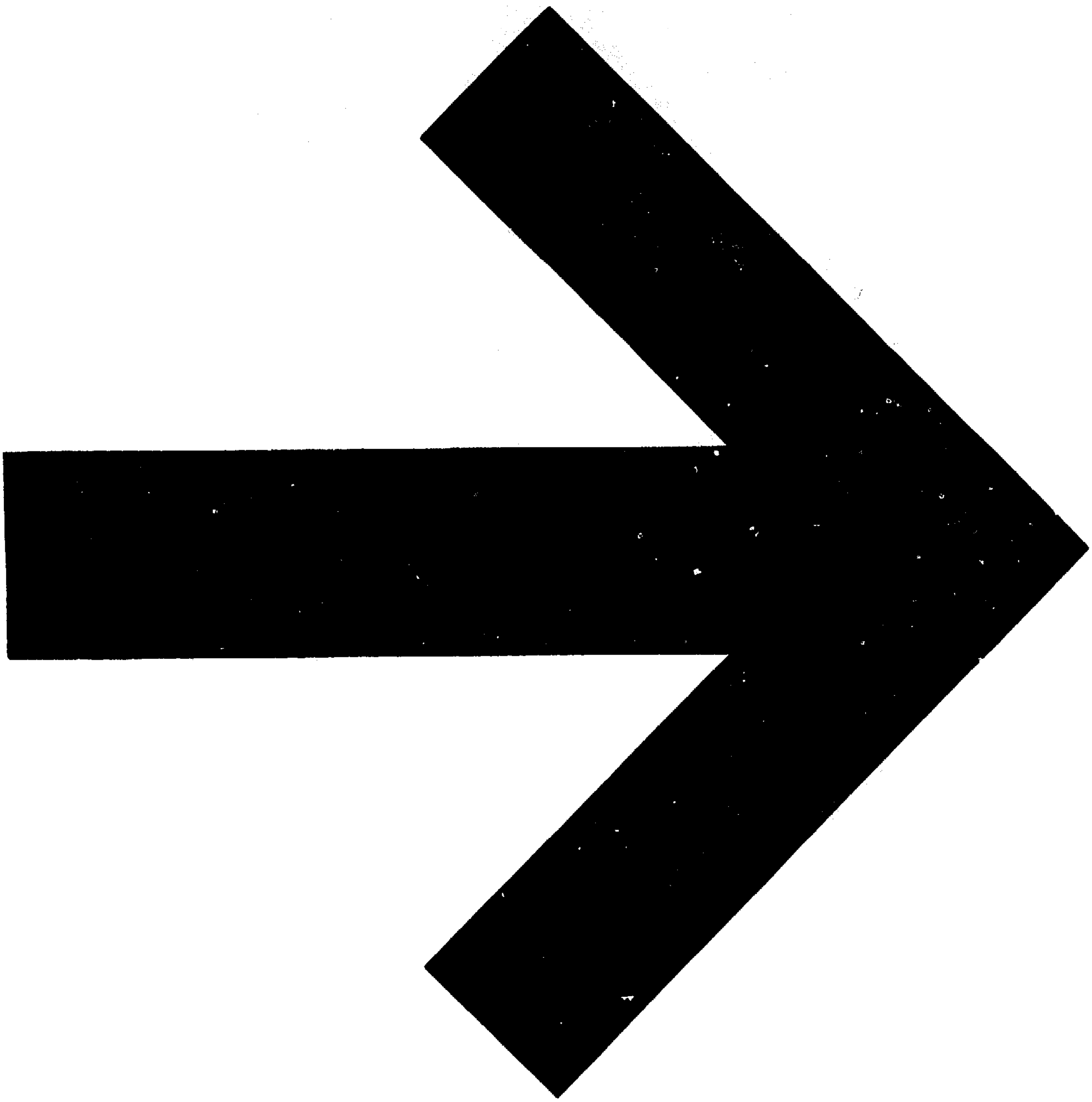

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ABBREVIATIONS

CARE	–	Cooperative for American Relief Everywhere
CATIE	–	Centro Agronómico Tropical de Investigación y Enseñanza
EDI	–	Economic Development Institute of the World Bank
FAO	–	Food and Agriculture Organization of the United Nations
ICRAF	–	International Council for Research in Agroforestry
IDRC	–	International Development Research Center
IITA	–	International Institute of Tropical Agriculture
NGO	–	nongovernmental organization
OECD	–	Organisation for Economic Co-operation and Development
U.N.	–	United Nations
UNDP	–	United Nations Development Programme
UNESCO	–	United Nations Educational, Scientific, and Cultural Organization
UNEP	–	United Nations Environment Programme
USAID	–	United States Agency for International Development
WRI	–	World Resources Institute

FOREWORD

This book was written for two main reasons. First, EDI's preparatory work for two courses on forestry projects revealed the need for a publication that brings together developing countries' recent experiences with social forestry programs and projects and that presents the material in a manner that would be useful for people working in this field. The second reason is somewhat more startling. Data produced for the courses indicated that investments in forestry and tree growing will have to be enormous in the medium-term future to achieve a reasonable balance between requirements for environmental stability and local demands for forest and tree products.

The authors have presented their experiences and relevant data in an informative manner, giving the background and rationale for actions taken. They have brought out the issues or problems encountered and have given examples of what to look for and how to go about solving problems. They hope that this book will help set in motion accelerated programs of social forestry and other developments that bring together trees and farming systems.

A review of the programs and projects discussed in this book will reveal that the two most important conditions for success are the stimulation of a high level of local participation and strong political commitment to long-term solutions to current problems. Very often, this is the most difficult part of setting in motion systematic remedies to a tree-deficit position. The appropriate technology may be available, and the required quantities of inputs and a network for their distribution may also be in place, but still successful programs are by no means assured. This is because of the complex nature of actions, often involving politically sensitive decisions, that have to be taken before local participation and commitment to the objectives can be confidently expected and be effective.

The book's main purpose is as a reference for training people who formulate policies and design or implement programs that recognize the vital importance of integrating trees into farming and ecological systems. It highlights fundamental issues and suggests ways to resolve them so that less time elapses between the planning stages and the successful implementation of sustainable programs for the development of communities, trees, and the environment in which people live.

J. A. N. Wallis
Chief, Agriculture and Rural Development Division
Economic Development Institute of the World Bank

PREFACE

Experts estimate that some 200 million hectares of new trees must be planted during the next ten years if developing countries are to meet their people's needs for tree products. If these plantings were done on a commercial basis, the investment needed would be at least US$100,000 million. Much of this investment is required in the countries least able to afford it. The governments of these countries, even with foreign or international support, cannot finance all, or even most, of the necessary work. Thus, much of the tree planting must be done by the beneficiaries, namely, the rural people themselves.

To build effective programs of local participation in forestry, new information and improved approaches are imperative, as is a fundamentally different form of education and training for foresters and others who will need to stimulate and guide tree growing by rural people through expanded social forestry programs.

The distinguishing feature of social forestry, as distinct from industrial and large-scale government forestry, is the involvement of local, generally rural, people in growing trees for their own use. Social forestry is often difficult to identify, since it seldom involves large blocks of trees or "forests." Instead, it involves a few trees here and a few trees there, a small village woodlot, trees along the road or interspersed in the fields. Yet the sum of these small-scale activities by millions of tree planters can be significant. Social forestry has existed for centuries and is a critical factor in the lives of most rural people today.

Much of the information necessary to improve education and training programs for social forestry has not been brought together in a systematic and consolidated form. This book represents an attempt to do this. The resulting review of the wide range of experiences gained during the past decade in social forestry programs and projects should be useful to people who work with social forestry policy and planning issues. This book is intended to be a reference for training that deals with the formulation of social forestry policies, the design of social forestry programs, and the implementation of projects.

The book is aimed primarily at people concerned with training for policy decisionmaking (senior government officials), project formulation (senior planners from ministries of economic development, planning, finance, agriculture, and forestry), and project implementation (senior staff in line agencies). Other readers will include staff of nongovernment organizations, international and bilateral lending/aid agencies, and students in colleges and universities.

The authors have attempted to present experiences and data in an informative manner, giving the background and rationale for actions taken, delineating problems, and offering examples of how to solve them. Many examples of actual projects and experiences are presented in boxes throughout the text for illustrative purposes. The issues presented are not necessarily new, only more pressing than in the past. For example, in 1973, the Indian Ministry of Agriculture explored many of the same topics in a commission report (Government of India 1973), and the U.N. formally recognized the seriousness of the situation almost a decade ago (FAO 1978). More recently, the FAO and the WRI, in conjunction with the World Bank and the UNDP, published reports detailing the problems and opportunities associated with farm and community forestry (Foley and Barnard 1985; FAO 1985d; WRI 1985). Together these publications provide a comprehensive treatment of different aspects of forests and tree resources in relation to rural populations in developing countries. This book is intended to complement the earlier work by focusing on policy, program, and project issues and on how training courses might address these issues most effectively.

The successful programs and projects discussed in this book have had high-level government support and committed local participation in activities that increase the productive use of land. In many situations, programs fail because of lack of such support, even though the required quantities of planting material and other inputs, as well as the appropriate technology, are available and the distribution networks for these inputs are in place. Issues of political and local participation must be resolved to make progress.

The discussion of successful interventions in this book may convey an oversimplified impression of the ease with which these successes were accomplished. For example, a very successful program in the Republic of Korea emerged from an earlier, decade-long reforestation program that suffered many disappointments. Similarly, efforts dragged and failures occurred for an extended period before programs in India, Kenya, and Rwanda reached or exceeded their goals. In all these instances, striking successes came about when programs were redesigned to focus on local participation. Instead of being viewed as government programs in which local people were expected to participate, they were seen as local programs supported by government.

The book has two main parts. Part I presents the rationale for increased support for social forestry. Part II discusses issues related to social forestry project planning and implementation. It is the result of an effort that involved many persons. The authors involved and the chapters to which they contributed are listed below.

Kenneth Brooks. College of Natural Resources, University of Minnesota (chapter 2).

William Burch. School of Forestry and Conservation, Yale University (chapter 7).

Jeffrey Burley. Oxford Forestry Institute, University of Oxford (chapter 14).

Tom Catterson. Associates in Rural Development (chapter 2).

Michael Cernea. World Bank (chapter 8).

Frederick Conway. University of Maine Agroforestry Research Project (chapter 11).

Robert Dixon. School of Forestry, Auburn University (chapter 14).

Sydney Draper. World Bank (chapters 1, 2, 3, 4, 6, 15).

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Hans Gregersen. College of Natural Resources, University of Minnesota (chapters 1, 2, 5, 6, 7, 9, 10, 11, 13, 15).

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Robert Winterbottom. Center for International Development and Environment, World Resources Institute (chapters 2, 3).

The editors extend special thanks to the authors for their contributions and for their patience during the editing process. With the authors' consent, the editors integrated the chapters to eliminate duplication and to make the chapters consistent. Thus, while the authors can take credit for the insights provided, the blame for shortcomings rests with the editors.

The editors also wish to thank John Spears of the World Bank, who provided his views on major social forestry issues that need to be dealt with; Chris Elliot of the World Wildlife Fund, whose insights helped to shape chapters 1 and 4 in particular; Alice Dowsett, Sam Brungardt, and Mimi Conway, who edited the manuscript; Clara Schreiber, who with great patience typed many versions of the manuscript and helped to edit it and to assemble the bibliography; Sonia Hoehlein and Carmen Palomino, who typed early drafts of the manuscript; and Carmen Peri, who typed the final manuscript.

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Hans M. Gregersen
Sydney Draper
Dieter Elz

PART I

SOCIAL FORESTRY AND DEVELOPMENT

Through the ages, trees have been essential to mankind's well-being. They have provided goods and services that were fundamental to development. At the same time, forests harbored wild animals that attacked people, and they stood in the way of agricultural expansion. Thus, people have looked at forests and trees with mixed feelings. The relative weights of these positive and negative feelings have varied as development has taken place. However, regardless of the strength of these feelings, trees continue to be part of most people's everyday lives, whether it is when they sit on wooden chairs in their wooden houses, collect tree fodder for their livestock, or cook their meals over a wood fire.

Part I deals with the contributions that social forestry makes to solving some major development problems. Chapter 1 provides an overview of the contributions of social forestry and provides some background. Chapter 2 focuses on how social forestry relates to environmental protection and sustainable development. Chapter 3 highlights ways in which trees can be incorporated into farming systems to increase agricultural productivity and contribute to food security. In chapter 4, the discussion turns to the contributions of social forestry to programs for overcoming the rural fuelwood crises that affect so many nations. Finally, chapter 5 focuses on the ways in which social forestry and related, traditional, small-scale processing activities can help to reduce unemployment and provide opportunities for generating income and investment returns for rural people.

1

SOCIAL FORESTRY: AN OVERVIEW

A village group in the Republic of Korea plants a small community fuelwood plantation. A Costa Rican landowner plants trees along her field as a living fence and a source of fuelwood. Philippine farmers plant trees that they will later sell to the Paper Industries Corporation of the Philippines for pulpwood. Rural, landless people in West Bengal, India, plant, tend, and benefit from trees they grow on government lands. Villagers in the Majjia Valley of Niger plant trees along fields for windbreaks and fuelwood. A women's group in Kenya tends its small tree nursery. A farmer in Nepal plants trees for fodder and other uses, while his landless neighbors tend a village woodlot. A Guatemalan farmer plants trees among his coffee bushes for shade and for fuel. Villagers in Thailand and Nigeria intercrop trees with food crops. All of these are examples of social forestry.

The term social forestry is used here interchangeably with "farm and community forestry," and "forestry for local community development" (FAO 1978). The terms refer to a broad range of tree- or forest-related activities that rural landowners and community groups undertake to provide products for their own use and to generate local income. They include farmers growing wood to sell or use for firewood. They also include communities or individuals earning income from the gathering, processing, and sale of minor forest products such as fruits, nuts, mushrooms, herbs, basketry materials, honey, and vines. Finally, they may also include governments or other groups planting trees on public lands to meet local village needs.

In the context of sector development, social forestry overlaps with the conventional production forestry sector, the agricultural sector, and in many countries, with the energy sector because of the importance of fuelwood in the overall energy supply picture. In conventional production forestry, trees are also used to meet people's needs, however, the distinction is that in social forestry, the primary focus is on people, on community involvement, and on the trees that offer direct and indirect benefits. In conventional production forestry, the focus is on the wood the trees produce. How people are involved in growing trees and using the trees while they grow are secondary considerations. The distinction is subtle. However, based on the lack of success to date in trying to achieve social forestry objectives with conventional production forestry approaches, the distinction is important.

Why Is Social Forestry Important?

At first glance, social forestry may seem far removed from the key issues facing most developing countries, such as food security, energy shortages, and unemployment. However, it is a critical element in the resolution of food scarcity because it can help to halt declining agricultural productivity associated with poor land use, deforestation, erosion, and declining water supplies. Social forestry is also critical in resolving energy crises in rural areas, which in most cases are caused by declining fuelwood availability. Finally, social forestry can give rise to significant opportunities for employment and income, both in forestry activities and in related processing activities.

The environmental protection connection

Deforestation and improper land use by farmers in the Himalayas, in the Andes, in Africa, and in the Far East result in hundreds of millions of dollars worth of damage in the form of agricultural productivity declines and flood losses, sometimes in areas that may be at considerable distances downstream, including estuaries (box 1.1). Because of poor land-use practices and deforestation, the productivity of cultivated land declines. Downstream, river banks are washed away, with the subsequent flooding of farmlands and the loss of crops. Reservoirs quickly fill with silt, resulting in a significant cost in terms of agricultural, hydropower, and other benefits foregone. In the Sahel and many other areas, improper land use has resulted in rapid desertification. Reduced deforestation, better management of existing forests and woodlands, and increased tree planting, skillfully integrated into programs that seek to create sustainable land-use systems, are needed to reduce these problems. These are also what social forestry is all about.

Box 1.1 Soil Conservation

The lives of approximately 500 million people in 30 countries are adversely affected by soil erosion. Increased sedimentation shortens the life of dams and reservoirs. For example, the life of the Tarbela dam in Pakistan, which was originally planned for 50 years, has been reduced to less than 20 years as a result of excessive sedimentation brought about by upstream deforestation, overgrazing, and cultivation of steep slopes. Colombia, Ethiopia, Haiti, India, Indonesia, Madagascar, and Nepal are experiencing similar problems. Soil erosion on deforested slopes affects half of Ethiopia's land area. Some 2,000 tons of topsoil per square kilometer are lost each year. Flood damage in India below the deforested areas of the Himalayan range has required emergency investment averaging US$210 million a year during the last decade. On a global basis, some 150 million hectares of watersheds need rehabilitation.

From Spears (1985).

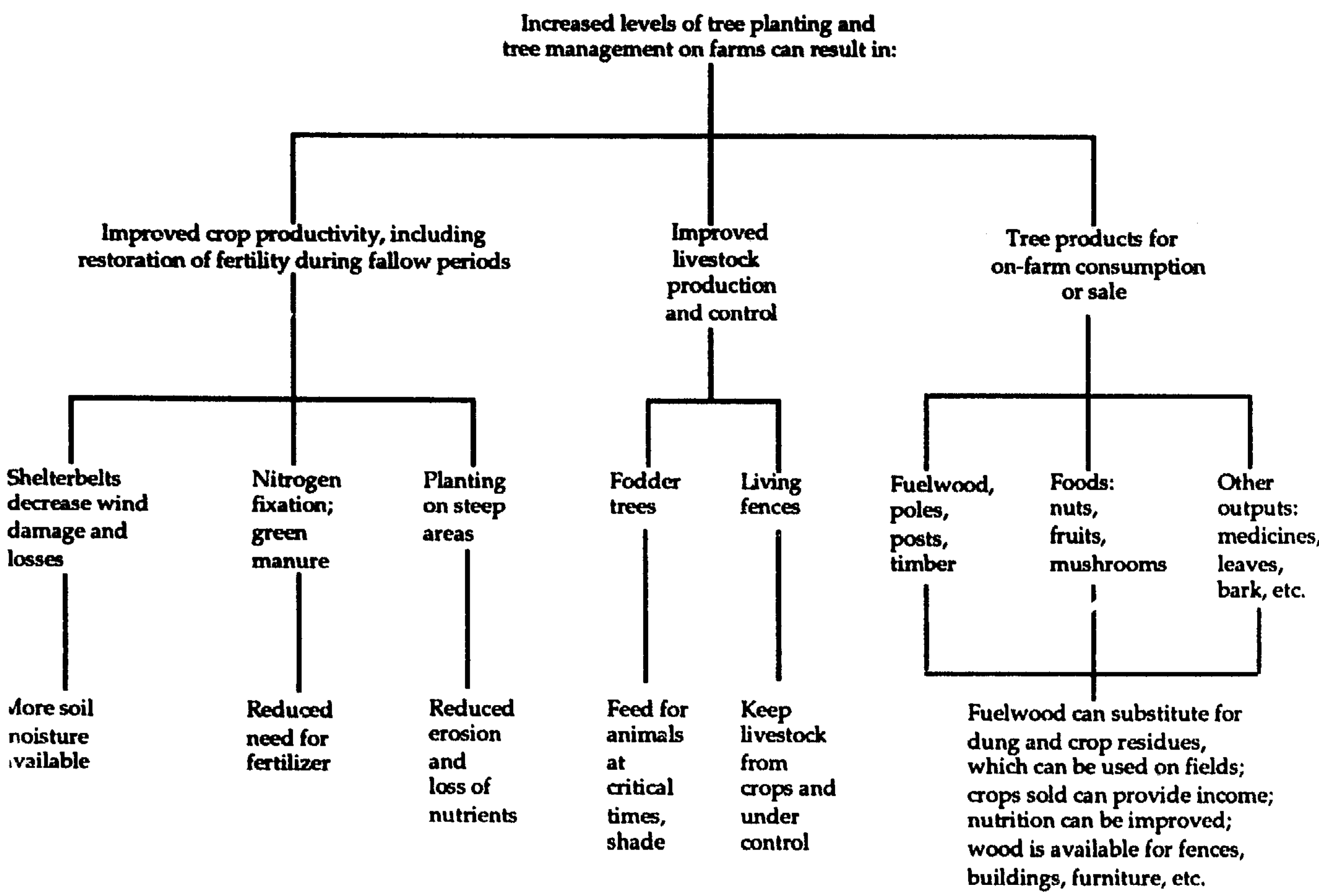
The agricultural productivity connection

Social forestry can contribute significantly to the livelihood of poor rural people by improving the soil and providing food supplements; wood for home construction, farm building, fencing, fuel, and fiber; and shade and fodder for livestock. Social forestry can provide income for farmers and rural communities and can help to raise people from the frightening and fragile condition of mere subsistence to a better level of living (figure 1.1). Of course, judgment has to be used in integrating trees into farming systems, since trees may also compete with agricultural crops and thereby reduce food production.

In many parts of the world, agroforestry, or the integration of tree growing into farming systems, is a main tool in social forestry programs involving farmers. Agroforestry is a collective name for all land-use systems and practices in which woody perennials are deliberately grown on the same land management unit as crops and/or animals. This can be either in some form of spatial arrangement or in a time sequence. To qualify as agroforestry, a given land-use system or practice must permit significant economic and ecological interactions between the woody and nonwoody components (Lundgren 1987).

Agroforestry is a proven approach to creating sustainable land-use systems in many environments. While farmers have practiced it for centuries in most parts of the world, it has been subjected to major scientific investigation only recently. Recognizing the potential importance of such work, a number of countries joined together to create the International Council for Research in Agroforestry (ICRAF), which from its headquarters in Nairobi, Kenya, produces useful documentation on agroforestry systems (see ICRAF 1988). While some reference is made to this subject in chapter 3 and in other chapters, no attempt is made to duplicate the thorough treatment of the subject given elsewhere (Buck 1987; Steppler and Nair 1987; works cited in ICRAF 1986b; Raintree 1986).

Figure 1.1 On-Farm Benefits from Trees in the Farming System



The fuelwood connection

Fuelwood is the primary source of energy for poorer urban households and for the vast majority of rural households in developing countries. Total annual consumption of fuelwood in developing countries increased from 1,100 to 1,400 million cubic meters between 1973 and 1983, and fuelwood currently accounts for 82 percent of all the wood harvested in developing countries. According to an FAO survey, 1,100 million of the more than 2,000 million people who are dependent on fuelwood face hardship because they have over time been harvesting wood faster than it has been replenished by natural regeneration and planting (FAO 1985f).

According to various studies (for example, WRI 1985), approximately 100 million people in developing countries suffer from acute fuelwood shortages. Millions are forced to reduce their calorie and nutrient intake because they can no longer find free fuels to cook available foods, nor can they afford to buy other fuels. Millions are also cold because they cannot find wood to heat their homes. Many rural poor already spend a disproportionately high (30 percent or more) part of their incomes on fuelwood, and the situation is rapidly worsening in many countries.

Social forestry involving millions of people planting trees in and around their farms and villages is one economically feasible solution to the rural energy crisis in many countries (box

1.2). While fuel substitutes may be available, they are too expensive for most of the rural poor. They cannot afford them now or in the foreseeable future.

Box 1.2 Community Fuelwood Programs: The Republic of Korea

A group of people near the village of Changbaek, Republic of Korea, have installed a sign below a hillside covered with rows of newly planted seedlings. The sign announces the completion of a village fuelwood plantation and gives information on man-days of labor used, area planted, types and numbers of seedlings planted, and the amount of fertilizer used. The Village Forestry Association organized and completed the work. The villagers are proud of their accomplishment. Community residents undertook the project to provide for their future fuelwood needs, with technical and material support from the government.

Throughout Korea, one can see similar situations: villagers who have organized themselves with the help of the government to provide for their own needs and to develop income-producing forestry activities.

As one passes through the countryside, one can see the remarkable "greening of Korea," achieved mainly by the nationwide community forestry program started in 1973. Not so many years ago one could pass along the same route and see severe devastation of the land: eroded hillsides producing nothing, muddy rivers carrying away the land's wealth, and people walking for days to get whatever wood they could find to meet their cooking and heating needs.

Korea provides one example of a successful community fuelwood program. The equivalent of over 1 million hectares were reforested with multipurpose trees during a five-year period by about 20,000 village forestry cooperatives.

From Gregersen (1982).

The employment connection

Unemployment plagues many countries, both in the cities and in rural areas. Growing populations worsen the problem. While social forestry cannot solve the problem, it can contribute significantly to the creation of jobs and to larger incomes for the rural poor. In many countries, forestry-based activities are a major source of off-farm employment in rural areas. For example, in Sierra Leone and Jamaica, forest-based, small-scale enterprises account for more than one-fifth and one-third, respectively, of total employment in the small-scale enterprise sector (FAO 1985c). These jobs are diverse and depend not only on wood, but on fruits, mushrooms, nuts, leaves, fibers, and forest game. The multiple use aspects of trees means that investment in tree growing can be quite profitable for farmers, if they can find some way to tide themselves over until income starts flowing from the trees they have planted.

The connection between employment and social forestry may be indirect also. Many rural, nonwood-based industries—tobacco, pottery, sugar refining, bakeries, to name a few—often depend on wood for fuel. Local residents obtain income from growing, harvesting, and selling wood to these industries. In some cases, the survival of industries—and jobs—depends on the availability of woodfuels from local community forestry activity.

Concern for Social Forestry Issues Mounts

In many regions, population growth has led to increasing needs for agricultural land and fuelwood. Increasing efforts to meet these needs have accelerated deforestation and dependence on nonsustainable land-use practices. The affected societies have noticed too late the large-scale effects of such destruction: flooding, rapid silting of hydropower and irrigation reservoirs with consequent reduction in agricultural productivity, and scarcity of fuelwood and tree products for other uses. In some cases, the dimensions of the problem are staggering. Many governments and most international donor organizations now recognize the depletion of forest resources as a major issue (Conable 1987).

At least 7.5 million hectares of closed forests (in which the canopy allows little light to fall on the ground) and 3.8 million hectares of open forests (in which the canopy has openings that permit the ground to receive some light) and woodlands are being destroyed each year in tropical developing countries (FAO 1982b). More than 100,000 hectares are deforested annually in each of some 18 countries. In addition to the outright loss of forests, large areas of savanna woodlands and open forests in semi-arid regions are being degraded. This change is not reflected in the official statistics on deforestation, although the combined effects of soil exhaustion and erosion from rainfed farming, fuelwood harvesting, and grazing have resulted in severe desertification of many millions of hectares of productive land.

Deforestation and degradation of woodlands are primarily the consequence of human population growth and expanding needs for crop and grazing lands. However, harvesting of wood, particularly for fuel, contributes significantly to the process. The continued overcutting of wood for use as a household fuel and source of energy for small industries is an important cause of deforestation and degradation of the forest cover in at least 37 countries in Africa, 14 in Latin America, and 12 in Asia. An increasing number of countries is recognizing the severity of the issue and the need for action.

Massive deforestation and the fuelwood crisis are the main factors that have drawn worldwide, high-level, political and scientific attention to forests and social forestry. The political will, financial resources, and technology to address these problems exist. What is needed is to plan and implement action on a broad scale and in a concrete fashion.

Prior to the mid-1970s, most organizations that dealt with forestry did not clearly recognize the issues, much less the opportunities that exist to resolve them. They tended to emphasize the management of traditional plantations and natural forests for commercial output, that is, to produce wood products that would earn income and foreign exchange. They considered commercial-industrial forest plantations and natural forest management to be distinct and isolated from agriculture. Most agriculturists gave little consideration to the role that forests and trees play in agricultural systems. They treated forests mainly as a nuisance to be eliminated in order to expand croplands. Program and project planners showed little recognition of the symbiotic relationship between trees and agriculture that has existed in most countries for centuries. Agriculturists and foresters alike failed to recognize and capitalize on the fact that farmers had traditionally incorporated trees in their overall agricultural activity.

Initiatives for Action

During the mid-1970s, the perception of forestry and its role in rural development changed rapidly. Responding to changes in its member countries, the FAO initiated its work on forestry for local community development (FAO 1978) and the World Bank issued its forestry sector policy paper (World Bank 1978). These institutions and other donor agencies began to recognize the critical need to reorient countries' philosophy, policies, and programs toward supporting forestry for local people and to encourage rural populations to participate in local forestry and conservation efforts.

The widespread acceptance of this reorientation came about in part because of the rapid spread of deforestation in the tropics (Myers 1980) and the publication of accounts of the worldwide fuelwood crisis (Eckholm 1975). The change also occurred because decisionmakers became increasingly sensitive to criticism that rural development and conventional forestry projects were failing to consider local interests, needs, and participation. Evidence mounted about the significant role that trees could play in agricultural systems, in environmental protection, and in the livelihood of many rural people. Finally, foresters, agriculturists, and social scientists began to communicate and learn from each other. As mentioned earlier, the establishment of ICRAF in 1977 was one concrete manifestation of this new interaction.

From the late 1970s until the early 1980s, new programs were launched at an accelerated rate, accompanied by a tremendous growth in economic development activity related to farm and community forestry, including agroforestry and wood-energy forestry. Courses were developed, institutions were established or modified to deal with agroforestry research, significant programs were initiated and funded by multilateral and bilateral development organizations, and large sums of money were invested in community forestry projects in many countries. For example, during the decade 1977 to 1986, some 60 percent of World Bank lending in forestry (US$1,300 million) was for social forestry and related fuelwood and watershed protection projects. This compares to a mere 5 percent in the previous decade.

Social forestry activity has reached a point at which undertaking an assessment and evaluation of methods and results is possible. Several comprehensive reviews of experiences to date have been completed (FAO 1985d; Foley and Barnard 1985; WRI 1985; Harrison 1987; Blair and Olpadwala 1988). While sufficient evidence is not yet available to pass judgment on many aspects of the social forestry thrusts worldwide, much material is available that experts can analyze and evaluate to provide a basis for discussing key issues and the initiatives that have been taken to resolve them.

A Framework for Planning

Some common elements are involved in social forestry whether one is dealing with programs related to agricultural productivity increases, to land protection, to the rural fuelwood crisis, or to the production of products from trees and forests. The first element is local participation. This involves local knowledge and understanding and local resources, including physical resources as well as institutions to organize the means of production and to distribute any increased production fairly.

The second common element is technological innovation to generate and sustain increases in land productivity. This includes the technology related to an appropriate combination of suitable species; to planting, tending, and protection systems; to yields; to output uses; to agroforestry systems; to the planting of multiple-use species; and to the development of complementary forest products.

These two elements link the policy issues associated with social forestry's role in resolving the problems of insufficient food, the fuelwood crisis, and widespread land deterioration leading to unemployment.

Local participation

The basic issue in social forestry is how to change land use in such a way that people get what they need on a sustainable basis from a relatively fixed, or even shrinking, land base. Only the land users themselves can do this. As Lester Brown, president of Worldwatch Institute, observed:

> What needs to be done in Africa are very basic things, like planting trees and planning families. *There has to be a grassroots response.* Africa's isn't the kind of situation where the World Bank can invest $60 million here and $200 million there and expect instant cures. What is needed is a Peace Corps-style approach. Neither the international aid agencies nor the ministries of African governments can plant trees on a scale needed to reverse the environmental deterioration that's become so widespread in Africa. *The only labor forces that can plant trees on the magnitude needed are the rural populations of Africa* (Brown 1986, italics added).

On the social and economic fronts, the issue is how to promote local participation in activities involving a combination of technologies that can stabilize the environment and increase productivity simultaneously. Conservation without economic benefit is difficult to promote. If planners have a good understanding of the local situation, they can select improvement activities that are both technically sound and likely to be well supported by people because they involve an economic benefit. Program planners can gain local support and involvement by clearly showing local people that a program will meet the people's objectives, will be feasible, and will provide enough benefits to make it worthwhile. Local participation will take place only if people have the ability to participate, the knowledge of what to do and how, the appropriate mix of incentives to stimulate them, and the institutions to support and sustain their activities.

A major factor determining local response to technological innovation in social forestry is government commitment and response through legislation, technical support, and financial support, both direct and through incentive programs. Such commitment and response can have a direct effect on local ability, knowledge, interest, and institutions, and thus on local participation. The importance of strong support up to the highest levels of government cannot be overemphasized. Government commitment and support depend on the extent to which governments accept that social forestry will help to alleviate critical problems, such as hunger, energy crises, unemployment, and environmental degradation.

Sustainable increases in productivity

The second element common to all social forestry programs is the need for sustainable increases in production from the relatively fixed land base. A fundamental concept is of concern here, namely, the relationship between stocks of trees and the sustainable flow of goods and services from them. A community's forest and soil capital is being depleted when the available stock of tree and land resources cannot sustain the flow of products taken from them. The concept of stocks and flows is at the heart of all sound forest and tree management. Stands of trees represent the capital stocks that appreciate through growth. Because trees are a living resource, the capital stock will regenerate and maintain itself as long as wood harvesting and other removals (or flows) do not exceed the level of regeneration and renewal. Rural people deplete their forest and soil capital, often unaware that they are destroying their future source of fuel, fodder, and soil protection (box 1.3).

The people do not realize the danger until the local forest is nearly gone and they must go farther into the countryside to find fuelwood. When the stock is eventually used up, as has been the case in a growing number of countries, the extent of the crisis becomes evident. Fuel and food prices rise rapidly, and people go hungry. There is no "fast fix" when this happens. Rebuilding the forest and soil capital stock requires substantial time and effort and technological innovation.

Integrating trees with agriculture where land is scarce is one of the major challenges for those who deal with social forestry policy and practice. One of the important tools is agroforestry. Increases in productivity can result from growing trees that have multiple purposes, for example, trees can be planted to contain livestock, act as a windbreak, and add nutrients to the soil and protect it at the same time. They also can provide fuelwood, food, and fodder.

The key in all of this is to introduce tree-related technologies for sustainable development before depletion and degradation have taken place. Technologies to maintain or increase productivity in a healthy environment are easier and cheaper to put in place than are technologies to rehabilitate land after it has been exhausted. Unfortunately, the benefits of productivity maintenance and the losses avoided are much less visible and more difficult to identify than dramatic increases in productivity or the sight of restored environments. Thus, technologies to sustain development and maintain productivity—such as many of those associated with social forestry—have tended to get less support than those technologies associated with programs involving dramatic, but nonsustainable, increases in production of goods and services. Times are changing, however, as governments become increasingly aware of the longer-term problems associated with nonsustainable development and environmental degradation. The dramatic increase in social forestry activity is one indication of this shift in awareness and interest.

Box 1.3 Interrelations Between Forests, Agriculture, and Rural Society in the Himalayas

The following conclusions are from a study of rural development in a 14,000-hectare area in the northwestern part of the central Himalayas.

Two major conclusions are immediately obvious: first, the agroecosystems are centers of massive energy consumption and their viability depends on the supply of energy from the forest; and, second, adequate livelihoods are not possible from farming alone. Compared to requirements of 18 hectares of forest land per hectare of cultivated land at the present level of exploitation, the ratio of agricultural land to forest is only 1:1.33, and the ratio of agricultural land to good forest is only 1:0.84. Thus, the capacity of the forest has already been far exceeded.

The oak forest has been a mainstay of agriculture in the area. It supplies leaf fodder for cattle, wood for fuel, "fixed" nitrogen, and is often used as a source of supplemental manure. Farmland has frequently extended into the forest, and with increasing demands for fodder and firewood, its trees are repeatedly cut. Thus, seed output is reduced, pressures from seed predators such as the flying squirrel and langur increase on an already diminished seed crop, and livestock graze on the scanty, young regrowth. As a result, this forest is disappearing fast.

Because the landholdings are small (they average 0.5 hectares each), expecting farmers to grow forage in their fields is futile. Before long, farmers will burn increasing amounts of dung as fuel, and the productivity of the land will decline further from a lack of manure. The final consequences are a highly degraded environment and a population unable to earn a living.

Not only does forest destruction jeopardize the life support system of the mountain people, its effect cascades through the heavily populated Indo-Gangetic Plains to the Bay of Bengal, where an island was formed from accumulated silt in 1974. The life span of the reservoirs formed by damming Himalayan rivers has been reduced by more than half because of heavy sedimentation (Soil Conservation Digest 1974). The rate of erosion in the catchment area of the Himalayan rivers (100 centimeters in 1,000 years) is five times higher than the rate that prevailed in the past 40 million years (Menard 1963).

From Singh, Pandey, and Tiwari (1984).

Summing Up

The challenge for social forestry and agriculture alike is to find the most appropriate sustainable uses for land, given a relatively fixed or shrinking productive land base and an expanding population. The key tasks of those involved in planning and implementing social forestry programs are:

- to understand the relationships involved, including the social and economic ones associated with local participation and the technological ones necessary for sustainable productivity;
- to translate these relationships into feasible projects and programs that local people can accept and implement;
- to show high-level decisionmakers that such activities and programs can contribute directly and indirectly to achieving major national objectives, such as those related to food and energy security, employment, and environmental improvement.

2

SOCIAL FORESTRY AND THE ENVIRONMENT

Forests are being overexploited and are disappearing in many countries. The soils in deforested areas are being degraded through improper land use. The impacts of these problems are cumulative and can affect entire regions and nations.

Usually, such environmental problems are discussed in macro or global terms, and indeed, comprehensive policies are needed to deal with them at that level. However, solutions to these problems also rest with each land user and his or her land-use practices. This is the connection with social forestry, since, as emphasized in chapter 1, the development and adoption of sustainable land-use practices is a major concern of social forestry. Thus, appropriate social forestry activities—agroforestry and other tree management techniques—can help to protect the environment.

Deforestation and its consequent environmental damage affect the lives of people directly. Many of them will have to change their land-use habits to prevent further environmental damage. Thus, social forestry programs and activities should be of direct concern to those involved with environmental protection and improvement. Social forestry cannot be isolated from broader social concerns with the environment.

The most obvious and direct relationship is at the farm level. Improved land-use practices that involve planting and managing trees in farming systems can improve the welfare of individual farmers as well as the environment. This subject is explored at length in this chapter. It briefly discusses deforestation, and then deals with three broader environmental policy issues that planners of social forestry programs must consider; namely:

- how to manage natural forests and woodlands to produce output for local people while also protecting these areas;
- how social forestry relates to watershed management and protection;
- how social forestry relates to strategies to reduce or slow the process of desertification.

Deforestation: Its Causes and Consequences

A striking reduction in the per capita forest area has occurred in many developing countries during the last 30 years. This reduction has taken place almost entirely in some 40 countries (table 2.1).

As mentioned in chapter 1, at least 7.5 million hectares of closed forests and 3.8 million hectares of open forests and woodlands are cut down annually in tropical developing countries. In at least 11 countries, much of the remaining forests will be cleared in less than 50 years if the trend continues. In another 18 countries, deforestation affects more than 100,000 hectares annually (table 2.1). Statistics indicate that the average rate of transformation of tropical forest lands to nonforest uses is less than 1 percent per year. Stated in this way, the data mask the fact that deforestation is proceeding at a rate many times greater than that in dozens of countries that can ill afford the consequences. In addition, large areas of forest, particularly savanna woodlands and open forests in semi-arid regions, are being steadily degraded, but this deterioration is not reflected in the statistics on deforestation.

The main causes of deforestation

The main causes of deforestation are agricultural and livestock expansion and increased demand for commercial and noncommercial forest products.

Table 2.1 Deforestation in Tropical Developing Countries, 1981-85

Country	*Closed forest area, 1980 (ha 1000s)*	*Annual rate of deforestation (percent)*	*Area deforested annually (ha 1000s)*
Group I[a]			
Colombia	47,351	1.7	820
Mexico	47,840	1.2	595
Ecuador	14,679	2.3	340
Paraguay	4,100	4.6	190
Nicaragua	4,508	2.7	121
Guatemala	4,596	2.0	90
Honduras	3,797	2.4	90
Costa Rica	1,664	3.9	65
Panama	4,204	0.9	36
Malaysia	21,256	1.2	255
Thailand	10,375	2.4	252
Lao People's Democratic Republic	8,520	1.2	100
Philippines	12,510	0.7	91
Nepal	2,128	3.9	84
Vietnam	10,810	0.6	65
Sri Lanka	2,782	2.1	58
Nigeria	7,583	4.0	300
Côte d'Ivoire	4,907	5.9	290
Madagascar	12,960	1.2	150
Liberia	2,063	2.2	46
Angola	4,471	1.0	44
Zambia	3,390	1.2	40
Guinea	2,072	1.7	36
Ghana	2,471	0.9	22
Total	241,037	1.7 (average)	4,180
Group II[b]			
Brazil	396,030	0.4	1,480
Peru	70,520	0.4	270
Venezuela	33,075	0.4	125
Bolivia	44,013	0.2	87
Indonesia	123,235	0.5	600
India	72,521	0.2	147
Burma	32,101	0.3	105
Democratic Kampuchea	7,616	0.3	25
Papua New Guinea	34,447	0.1	22
Zaire	105,975	0.2	182
Cameroon	18,105	0.4	80
People's Republic of the Congo	21,508	0.1	22
Gabon	20,690	0.1	15
Total	979,836	0.3 (average)	3,160

Table 2.1 (continued)

Country	Closed forest area, 1980 (ha 1000s)	Annual rate of deforestation (percent)	Area deforested annually (ha 1000s)
Group III[c]			
El Salvador	155	3.2	5
Jamaica	195	1.0	2
Haiti	58	3.4	2
Kenya	2,650	0.7	19
Guinea-Bissau	664	2.6	17
Mozambique	1,189	0.8	10
Uganda	879	1.1	10
Brunei	325	2.2	7
Rwanda	412	0.7	3
Benin	47	2.1	1
Total	6,529	1.2 (average)	76
Group IV[d]			
Belize	1,385	0.6	9
Dominican Republic	685	0.6	4
Cuba	3,025	0.1	2
Trinidad & Tobago	368	0.3	1
Bangladesh	2,207	0.4	8
Pakistan	3,785	0.2	7
Bhutan	2,170	0.1	2
Tanzania	2,658	0.4	10
Ethiopia	5,332	0.2	8
Sierra Leone	798	0.8	6
Central African Republic	3,595	0.1	5
Somalia	1,650	0.2	4
Sudan	2,532	0.2	4
Equatorial Guinea	1,295	0.2	3
Togo	304	0.7	2
Total	31,789	0.2 (average)	75

a. Higher than average rate of deforestation and large areas deforested.
b. Relatively low rates of deforestation, but large areas deforested.
c. High rates of deforestation and small areas of remaining forest.
d. Low or moderate rates of deforestation and small areas affected.

Source: International Institute for Environment and Development/WRI (1986).

AGRICULTURAL EXPANSION. Deforestation is primarily the consequence of human population growth, which leads to expanded needs for crop and grazing land. The area of crop and grazing land in developing countries increased by nearly 100 million hectares, or 11.5 percent, from 1954 to 1983. Much of this increase came from clearing forested land. For example, during the past three decades, the area of forests and woodlands declined from 140 to 70 million hectares in Central America and from 765 to 688 million hectares in Africa.

As clearing of forested lands commences in an area, the first settlers clear and work the best, most productive lands. Attracted by their relative success, new waves of settlers arrive. Each successive group takes increasingly marginal, fragile lands that are left. The greatest environmental damage is often done by the latter groups. Agricultural production cannot be sustained long on many of the marginal lands that farmers are clearing, and they must soon abandon the degraded, unproductive sites and clear other land. The need to continue this destructive cycle of clearing, farming, abandoning, shifting, and clearing again, combined with a lack of secure tenure and incentives to invest in erosion control and practices that improve soil fertility, is responsible for further deforestation.

INCREASED DEMAND FOR COMMERCIAL FOREST PRODUCTS. National economic development and international trade stimulate the demand for forest products. Timber harvesting to meet this demand can lead to increased deforestation. Although the use of industrial roundwood is still relatively limited in developing countries, more than 4.4 million hectares of tropical forests are logged each year to supply local forest industries and to produce sawlogs and veneer logs for export. Only a small portion of the 211 million hectares of closed tropical forest that have been logged during the past 40 years is now being managed to promote regeneration of the forest cover.

INCREASED DEMAND FOR NONCOMMERCIAL FOREST PRODUCTS. Forests are also being cleared or degraded by local people cutting wood to use for home construction, fuel (charcoal and firewood), and many other products. Total consumption of woodfuel in developing countries increased from 1,100 to 1,400 million cubic meters between 1973 and 1983, and currently amounts to 82 percent of all the wood harvested in developing countries (FAO 1983a).

INCREASED DEMAND FOR FODDER AND GRAZING. Forests and woodlands also supply browse and pasture for livestock, but as in the case of fuelwood collection, more intensive exploitation has led to overuse and depletion of the tree resource, particularly in regions of lower rainfall. The combined effects of soil exhaustion and erosion from nonsustainable agricultural practices, fuelwood harvesting, and grazing have resulted in the severe desertification of 1,350 million hectares, or 30 percent, of the world's arid and semi-arid lands (*International Tree Crops Journal* 1985). Clearing forest for commercial grazing is the major cause of deforestation in many Latin American countries. Poor grazing practices can inhibit regrowth of vegetation.

The consequences of deforestation

Deforestation has different impacts at the local level, at the national level, and at a wider, regional level that may span several countries. Often, the consequences of deforestation cannot be assessed precisely, but they can be real and costly nonetheless (Arnold 1987a).

LOCAL CONSEQUENCES. As deforestation progresses and trees and other forest products become scarce, rural people feel the effects first. Construction timber, fuelwood, and a whole range of other products for human use and consumption as well as for livestock become less available. The range and diversity of forest products that local people use are much greater than is generally recognized, as illustrated for a group of Pacific countries in table 2.2. The progressive decline in the flow of forest products brought about by deforestation sets in motion a process of impoverishment that is difficult to reverse. In some countries, the value to local people of forest grazing and fodder is equal to or higher than that of other forest products (World Bank 1985b; FAO 1986d).

Rural people react to the growing local scarcity in a variety of ways. They forage further afield, thereby spreading the problem while having to spend increasing amounts of their time gathering tree products instead of doing more productive work. They grub up roots and other combustible material, thereby adding to the soil's instability. They substitute crop residues and dung for firewood, thereby diverting soil enrichment materials that they should use to maintain food crop production levels.

Besides the foregoing, the most significant loss for rural families may be the declining production of annual crops. Researchers have shown that a gradual reduction in forest cover in tropical environments is associated with decreased rainfall infiltration, increased runoff, accelerated water erosion and soil loss, reduced nutrient uptake, reduced nitrogen fixation, reduced replenishment of soil organic matter, increased wind erosion, and other harmful influences that contribute to a decline in soil fertility and crop yields. Water tables may also be lowered, as increased runoff results in reduced rates of groundwater recharge. Shallow wells dry up sooner, and families must walk farther to get water.

NATIONAL CONSEQUENCES. Apart from the direct impoverishment of and increased hardship for rural households, deforestation has important consequences over larger areas, especially in the lower parts of deforested watersheds. Forest degradation and loss of tree cover in the higher elevations increases the intensity of flooding and erosion downstream. Uncontrolled flooding and higher rates of siltation reduce the useful lives of reservoirs, hydroelectric facilities, and investments in irrigation. The WRI (1985) estimates that in India, the downstream costs associated with deforestation in the Himalayan uplands is in excess of US$1,000 million annually. More research is needed to quantify these effects, but enough is known already to recognize that they can be substantial.

REGIONAL CONSEQUENCES. At the regional and global levels, deforestation contributes to a decline in biological diversity and accelerates the extinction of the world's flora and fauna. This is a serious concern even on immediate economic grounds for two reasons. First, continued advances in plant breeding depend on the availability of a broad genetic base and on the wild strains of plants related to the world's major food and industrial crops. Second, the economic contributions of most tropical species have barely been exploited. For a fuller discussion of genetic and ecological diversity and strategies for addressing these important concerns see International Union for Conservation of Nature and Natural Resources (1980).

This brief discussion of the consequences of deforestation clearly indicates the need for those countries that depend heavily on forests and trees to reassess the ways and means of managing these resources to reestablish a satisfactory balance between trees and land. One major means is through social forestry programs.

Managing and Protecting Natural Forests

The Tropical Forests Resources Assessment project executed by the FAO, UNEP, and UNESCO in collaboration with member governments (FAO 1981b, 1982b) attempted to assess the status of tropical forests. Estimates stemming from this work were alarming: only about 5 percent of the world's closed tropical forests were under intensive management. The estimates of the proportion of managed open or savanna-type woodlands were even lower. In Africa, only 1 percent of productive forest area has management plans (WRI 1986).

Many management plans for commercial forests do not reflect current noncommercial product flows. Often, the usage of noncommercial products is based on local people's user rights, which were established when forest output was more than adequate to meet demand. Governments did not view planning to achieve a sustainable flow of these noncommercial products as necessary and rarely did so. Rather, concessions or rights for wood collection, grazing, fodder collection, and so on were awarded or informally recognized on the basis of quantities per head or per family, without regard to the long-term productive potential of the resource base. A comparable situation involving cash income generation also exists in some countries, for example, the exploitation of natural rubber, collection of nuts, and use of the babassu palm by local people in Brazil.

Table 2.2 Tree Uses by Specific Island Types in the Pacific

Function	Highland: PNG	Continental islands: Namosi, Fiji	High volcanic: Rotuma	High volcanic: Rarotonga	Large limestone/volcanic: Tonga	Small coral limestone: Nauru	Urban: PNG	Urban: Fiji	Urban: Tonga
Shade	x	x	x	x	x	x	x	x	x
Wind protection[1]	x	x	x	x	x	x	x	x	x
Erosion control	x	x	x	x	x	x	x	x	x
Soil improvement	x	x	x	x	x	x	x	x	x
Animal/plant habitats	x	x	x	x	x	x	x	x	x
Frost protection	x	–	–	–	–	–	–	–	–
Flood/runoff control	x	x	x	x	x	–	–	–	–
Timber (commercial)	x	x	x	–	x	x	–	–	–
Timber (subsistence)	x	x	x	x	x	x	x	x	x
Fuelwood	x	x	x	x	x	x	x	x	x
Boatbuilding/canoes	–	x	x	x	x	x	–	–	x
Tools	x	x	x	x	x	x	x	x	x
Weapons/hunting[2]	x	x	x	x	x	x	x	–	–
Containers	x	x	x	x	x	x	x	x	x
Handcraft/carving	x	x	x	x	x	x	x	x	x
Fishing equipment	x	x	x	x	x	x	x	x	x
Floats	–	–	x	x	x	x	–	–	–
Toys	x	x	x	–	x	x	–	x	x
Switch for children/discipline	–	x	–	–	x	x	–	x	x
Brush/paint brush	x	x	x	x	x	x	–	–	x
Broom	x	x	x	x	x	x	x	x	x
Parcelization/wrapping	x	x	x	x	x	x	x	x	x
Abrasive	x	x	x	x	x	–	–	–	–
Illumination	x	x	x	x	x	x	–	–	x
Decoration/ornamentation	x	x	x	x	x	x	x	x	x
Cordage/ropes/lashing	x	x	x	x	x	x	x	x	x
Glues/adhesives/caulking	x	x	x	x	x	x	–	–	–
Fiber/fabric	x	x	x	x	x	x	–	–	x
Dyes	x	x	x	x	x	x	–	x	x
Plaited ware/mats, sails, etc.	x	x	x	x	x	x	x	x	x
Insulation	x	x	x	x	x	x	x	x	x
Commercial/export	x	x	x	x	x	–	x	x	x

Table 2.2 (continued)

Function	*Highland: PNG*	*Continental islands: Namosi, Fiji*	*High volcanic: Rotuma*	*High volcanic: Rarotonga*	*Large limestone/ volcanic: Tonga*	*Small coral limestone: Nauru*	*Urban PNG*	*Urban Fiji*	*Urban Tonga*
Propr or nurse plants	x	x	x	–	x	–	–	–	–
Major staple food	x	x	x	x	x	x	x	x	x
Supplementary food	x	x	x	x	x	x	x	x	x
Wild/snack/emergency food	x	x	x	x	x	x	–	x	x
Musical instruments	x	x	x	x	x	x	x	x	x
Spices/sauces	x	x	x	x	x	x	x	x	x
Beverages	–	x	x	x	x	x	x	x	x
Livestock feed	x	x	x	x	x	x	x	x	x
Cages/roosts	x	x	x	x	x	x	x	x	x
Preservatives	x	x	x	x	x	x	x	x	x
Meat tenderizer	–	x	x	–	x	x	–	x	x
Narcotics/stimulants[3]	x	x	–	–	–	–	x	x	–
Nasticants	x	x	x	x	x	x	–	–	x
Medicines	x	x	x	x	x	x	x	x	x
Aphrodisiacs	x	x	–	–	–	x	–	–	–
Fertility control	x	x	x	–	x	x	–	x	x
Abortifacients	x	x	–	–	x	x	x	x	x
Scents/perfumes	x	x	x	x	x	x	x	x	x
Poisons	x	x	x	x	x	x	–	–	–
Insect repellent	x	x	x	x	x	x	–	x	x
Magico-religious	x	x	x	x	x	x	x	x	x
Ritual exchange	x	x	x	x	x	x	x	x	x
Recreation	x	x	x	x	x	x	x	x	x
Oils	x	x	x	x	x	x	x	x	x

PNG = Papua New Guinea
x = observed function
– = no known function
— = not applicable

1. In urban areas tree fall may in fact constitute a danger to inhabitants.
2. Internecine warfare, although still practiced in highland PNG, has ceased in Fiji, Tonga, and other areas, but warclubs, spears, etc. were made in the past.
3. Betelnut, although not grown in the highlands, is widely used there and imported from coastal PNG.

Source: Thaman and Clarke (1983). Reprinted with permission from the German Foundation for International Development.

Competition between commercial and noncommercial users

When pressures on existing forest increase, policymakers must resolve some difficult questions. Noncommercial users jealously guard their concessions and informal rights. When they see these threatened by commercial activities, they will naturally resist to safeguard their own long-standing interests. The situation is made worse where the number of noncommercial users is increasing and each new noncommercial user expects to have the same rights as other noncommercial users. At the same time, the commercial users, operating under licenses or concessions, are concerned with maintaining their levels of commercial operations. Quite often, the latter will form part of government planning goals for the domestic supply of forest products and also for exports.

To resolve this conflict of interest, policymakers must decide on (a) the levels of future concessions for noncommercial users and how these are to be maintained and distributed; and (b) the volumes of timber for commercial exploitation and how to maintain these volumes through management.

Policymakers must maintain the goodwill and support of local people and forest dwellers who have user rights to forest products. When their goodwill is in evidence, they act as a first line of defense against forest destruction and in emergencies, such as forest fires. Because of their proximity to the forests, they can help significantly in controlling illegal extraction and other misuses of the forest. Therefore, making sure that any changes in current rights do not alienate local rights-holders is important.

Examples of social forestry-related management approaches that some countries have taken include:

- closing forest areas to free-range grazing in exchange for the controlled collection of fodder for stall-feeding;
- replacing uncontrolled grazing with a rotational grazing system that limits the number of animals to the carrying capacity of available fodder;
- establishing tree plantations on state land expressly for local wood gathering;
- apportioning control over the use of the forest for both commercial and noncommercial purposes to local forest agencies that receive government technical guidance and subsidies.

In a deficit situation, continuing to rely upon old laws and customs in the hope that they will somehow resolve the problem is pointless. New initiatives are needed that are based on technically feasible product flows, acceptance of the limitation of these flows, a clear understanding of the rights and obligations covering their future use, and an effective management system to see that these are carried out. This brief review merely demonstrates the enormity of the problem and shows that, in many instances, social forestry aspects are integral to a solution of the problems of restructuring commercial forest management.

Dealing with open and savanna-type woodlands

The FAO tropical forest resources assessment (FAO 1981b, 1982b) estimated that out of the total area of tropical forests of 2,968 million hectares, some 1,360 million hectares are composed of open woodlands, savanna, or shrub-type forest, most of which are not regarded or operated as commercial forests.[1] There are many possible approaches to improving the management and, thus, the contribution to society of these noncommercial forests.

Since local people harvest the bulk of the product flows from these woodlands for their own use or for sale locally, they can be considered part of the social forestry complex. The tragedy is that these open woodlands form part of the intricate balance of land use that determines the

1. In a number of countries, other types of land such as "rangeland" or "wastelands" are put in the same category as scrub woodlands and open woodlands. Forest agencies often administer these lands. The approaches for improving the management of rangeland and wasteland are very similar to those that can be used on scrub or open woodlands.

state of environmental stability for much larger areas, especially in fairly arid regions. They are the product of a natural selection process and are composed of species that are well adapted to the sites. The fact that they are open or scrub woodlands indicates that these sites generally have a relatively low production capability, either because of poor soils, inadequate rainfall, or a combination of both. This means that, although replacing some of these open woodlands with commercial, high-production plantations on the better sites may be possible, as has been done in Nigeria and Zambia, this option generally presents many technical difficulties and may not be financially sound because of the high costs involved relative to expected benefits.

To put in place satisfactory management systems for these forests, a substantial change in attitude toward them is needed. For many generations, national governments have regarded these forests as inconsequential lands. National and local decisionmakers, government officials, and even foresters have held this view. This is evident from the lack of a meaningful data base in some countries on the extent of the areas these forests cover and the composition and quantities of product flows that they sustain. A great deal of research and rethinking is needed to accord these forests their appropriate importance in maintaining stability and providing sustainable product flows for local communities and for sale. Where present usage patterns are unsustainable, officials should use this as a basis for working out with the local population a social forestry program to rectify the imbalance.

Among the work being done to improve the management of noncommercial forests are two recent initiatives taken in the Sahelian countries and in Malawi in Africa (see boxes 2.1 and 2.2). The Sahelian initiatives reveal some very encouraging results including:

Box 2.1 Increasing the Production of Natural Forests: The Sahel

A 1983 report on the management of the natural forests of Burkina Faso, Cape Verde, Chad, The Gambia, Mali, Mauritania, Niger, and Senegal highlights the potential for increasing the production of these forests. Earlier expectations that large-scale plantations of fast-growing, exotic species would meet future forest product requirements are proving to be overoptimistic because of relatively low growth rates (in some cases, only marginally better than natural "bush" species) because of unfavorable soils and climate, and the high costs of plantation establishment and maintenance. While much remains to be learned about the productivity of natural forest for both wood and nonwood products, introducing protection from indiscriminate exploitation, grazing, and fire and establishing optimum rotations for systematic exploitation can increase yields significantly at a fraction of the cost of establishing plantations.

Priorities for securing the increased production of the natural forests are:

- acknowledgement by governments of the importance of natural forests and allocation of more resources for their management;
- selection of pilot areas for implementing improved management, using these as training/ demonstration areas;
- inventory, assessment, and classification of remaining natural forest area;
- expansion of improved management into other natural forests as more trained manpower and appropriate socioeconomic approaches are developed;
- more involvement of local communities in managing natural forests;
- concurrent research into improving management methods.

From Jackson et al. (1983).

- low-cost mapping and inventory techniques;
- simple management systems that make wide use of coppicing on periodic rotation (a system in which the stump of a felled tree is protected so that regrowth can occur from the root system, thus obviating the need to replant);
- fire protection using controlled grazing to reduce the fire hazard;
- specific management guidelines for locally important species.

The Malawi example demonstrates better management of natural open woodlands while at the same time encouraging private tree planting. This is to be achieved by increasing the charges for natural forest products that are marketed commercially so that their cost is comparable to the cost of growing wood by private farmers and commercial estates. Also, management systems for the natural forests will be introduced to maintain their capital stock and to continue to provide local users with free forest products.

Another interesting example of social forestry using naturally occurring trees concerns the babassu palm in Brazil. This species grows during fallow periods on burnt and cutover lands. Due to its distinctive ecological characteristics, it survives. "When forests are cut and burned in the palm zones, seedling and stemless palms survive due to babassu's mode of germination in which the growing point is placed beneath the surface of the ground. As a result, cutting and burning do not kill stemless palms, and high densities of the latter are consequently released and form monospecific stands during the subsequent fallow" (Anderson et al. 1987, p. 4).

Box 2.2 Increasing the Production of Natural Forests: Malawi

In Malawi, the depletion of forest resources is caused by both the lack of restrictions on exploiting indigenous forests on customary land and the low stumpage rate charged for fuelwood. The woodlands on customary land are considered common property. Therefore, access is not restricted. This discourages production or conservation of wood by individuals. At present, fuelwood obtained from forest resources designated as commercial fuelwood is only MK 1.80 (US$1.03) per cubic meter compared with an estimated, average, long-term, real cost of MK 10.20 (US$5.90) per cubic meter. This low stumpage rate does not give individuals the incentive to produce their own wood. It also implies that the government, as the major producer of wood, cannot recover its investment costs. In addition, the existing stumpage rate encourages excessive use of fuelwood and leads to low public revenues, which prevents the government from initiating and financing measures to control forest depletion.

The Malawi program is setting up 27 area control units (ACUs) in 12 priority districts that are experiencing severe forest depletion. The ACUs will determine and monitor cutting rates, take preventive measures against any form of damage to the forests, collaborate with the extension unit to educate wood users on sustainable use of these forests, and license and charge a stumpage fee to commercial users. Wood collected in headloads for subsistence would continue to be free. Also, 17 revenue collection posts are being set up along major roads to charge royalties on all commercial wood that by-passes the ACU system.

Successful implementation of the proposed forest protection and revenue collection system would depend on training the forest staff for their task and on the cooperation of the traditional and political leaders, for which the plan has made appropriate training, education, and public relations provisions. Twenty-five percent of the gross revenue collected on forest products from customary land will be given to traditional authorities to invest in local development, including an improved energy supply.

From Jackson et al. (1983); World Bank (1986c).

In addition to manual extraction of oil-rich kernels from the babassu, which are sold to local industry for production of vegetable oil, soap, and feedcake, a wide variety of subsistence products are also derived, including baskets, mats, fans, sieves, thatch, laths, rails, bridge foundations, palm heart, edible sap, mulch, salt, oil animal feed, charcoal, and flour. Kernel production is especially important as a source of employment for rural women in some areas. May et al. (1985) found that babassu products contributed an average of 64 percent to total cash and noncash income in three counties of Maranhao state during peak harvest periods.

Watershed Management and Protection

The concept of a watershed is one that recognizes that the forces of nature do not follow political boundaries. A watershed is an area of land with common drainage. In its broadest sense, a watershed that includes all the area that contributes water to a river that drains into an ocean is called a river basin.

Watershed management is the process of guiding and organizing the use of land and other resources on a watershed to provide needed goods and services without adversely affecting soil and water resources. Embedded in the concept of watershed management is the recognition of the interrelationships among land use, soil, and water, and the linkages between uplands and downstream areas. Watershed management can involve an array of vegetation management and other nonstructural and structural (engineering) actions. Watershed management relates directly to the concept of sustainable development and to the practices of soil conservation and land-use planning. As such, the concepts and objectives of watershed management are directly linked to those of social forestry. Watershed management is distinguished from social forestry because of its focus on the water-related linkages between upstream and downstream areas. Since these linkages are so critical in most countries, the concepts of watershed management must be incorporated into social forestry programs.

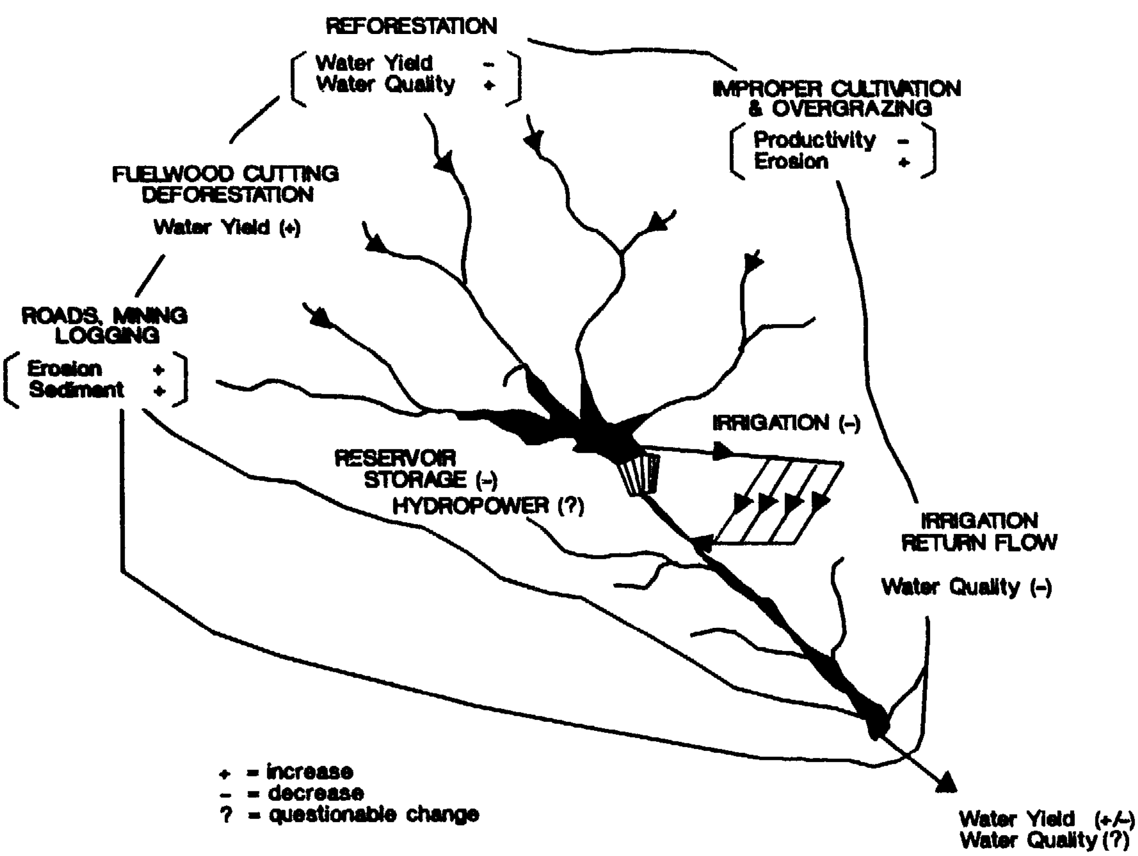
As with social forestry, local people and government must support watershed management for programs to be sustainable. Thus, watershed projects whose major objective is to reduce sedimentation of large, high-investment reservoirs must address the situation of local watershed inhabitants. For example, to encourage reforestation and protection of steep-sloped watersheds above such reservoirs, project planners may need to implement community forestry programs to provide wood products that previously came from those fragile lands. Conversely, community forestry programs should recognize the need to protect forests on fragile lands; planting trees close to villages may have little rehabilitation value other than to reduce the pressures to cut forests elsewhere.

We can better understand and examine the reality of watershed management and its relationship to society when we consider the physical-biological linkages (figure 2.1) and the institutional linkages (figure 2.2) of a watershed. Neither local communities nor governments can ignore the physical linkages. Water and sediment will flow downhill regardless of land ownership, governmental responsibilities, and political boundaries. Conversely, the practical means of achieving sustainable projects in watershed management cannot ignore land tenure, institutions, and the culture of watershed inhabitants. While the actions of one individual may appear insignificant, the cumulative effects of thousands of farmers or communities changing their land-use approaches can make a significant difference to downstream populations, and planners of social forestry and other land-use programs must consider such impacts.

Complexities of watershed management

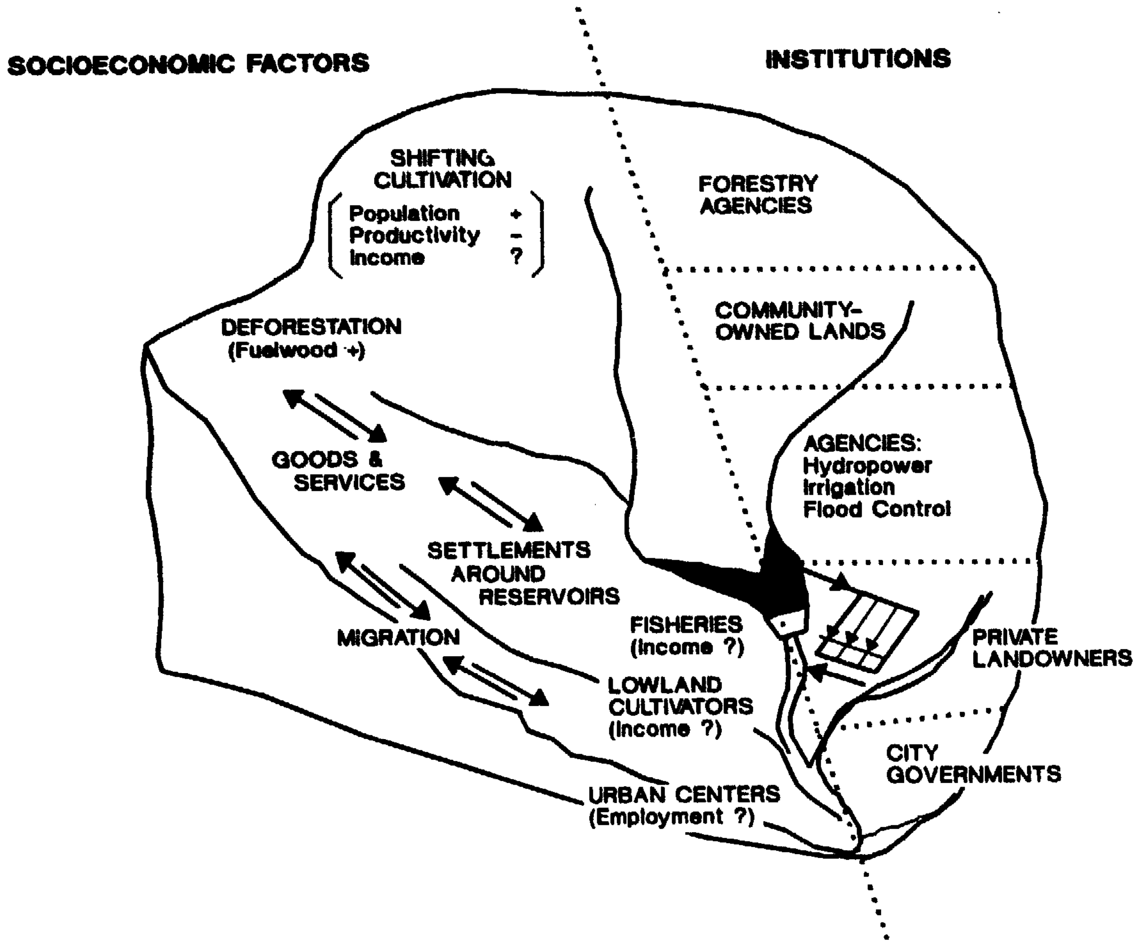
As indicated in figure 2.3, the activities involved in watershed management go far beyond those commonly considered in social forestry programs. They include many engineering activities, including building dams and terraces, holding tanks, roads, and so forth. However, tree management is also critical, given the relationship between forests and soil, water conservation, and watershed stabilization. Trees can use rainfall in the most manageable and least wasteful means for production purposes. First, the crowns of the trees and associated understory plants break the force of raindrops so that they do not shatter the soil surface on impact and cause erosion. Then, the organic litter of fallen leaves acts as a sponge, absorbing the rainfall into the soil mantle to a considerable depth with a minimum movement of soil on the surface. Forests, therefore, promote rapid movement of water into the soil surface (infiltration). The water percolates into the subsurface aquifers instead of becoming surface runoff that could cause flash floods and erosion. Surplus water flows into the stream channels and subsurface waterways in a more stable manner, forming water regimes that are more manageable.

Figure 2.1 Land Use and Physical Linkages within a Watershed



Source: Gregersen et al. (1987). Reprinted with permission from FAO.

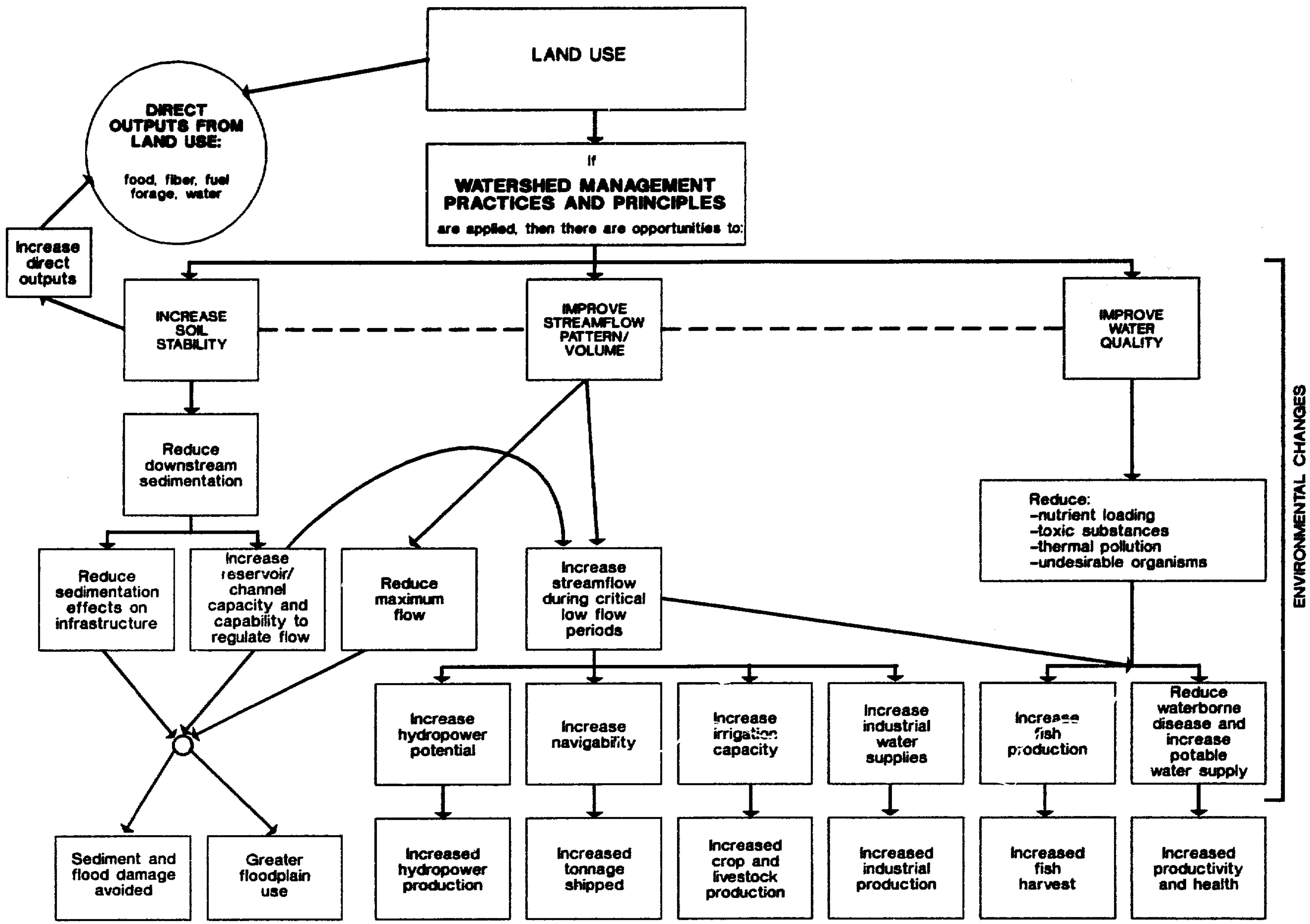
Figure 2.2 Social, Institutional, and Economic Linkages in a Watershed



Source: Gregersen et al. (1987). Reprinted with permission from FAO.

Technical expertise is available to rehabilitate or manage most watersheds. The form of management will depend on the measures used. Structural measures—that is, engineering works designed to stabilize soil, control the rate of surface flow, safely dispose of surface water, and promote the establishment of vegetative cover—can be taken if biological and changing land-use practices are inadequate for the job. Examples are gully-control dams, bench terraces, contour trenches, and water-spreading systems. Vegetative measures, including reforesting, reseeding grassland, stabilizing waterways by planting grasses, protecting terraces by planting the lip of the terrace wall, and introducing more perennial crops into the farming system, are another option. Management measures, such as actions to protect the soil, vegetative cover, and water resources and at the same time produce needed goods and services, can be taken also. Examples are protecting forests from fire, improving cultivation practices, controlling grazing and wood harvesting, delineating hazardous areas (such as flood plains and landslide zones), and protecting special areas (such as wildlife preserves).

Figure 2.3 Effects and Benefits of Watershed Management



Source: Gregersen et al. (1987). Reprinted with permission from FAO.

Benefits of water management

The benefits of watershed management vary from situation to situation, depending on the area's physical characteristics and the levels of activity downstream from where the watershed management activities take place. Figure 2.3 provides an overview of the potential benefits and how to generate them. The impacts can be substantial and can range from cost savings to production increases and health-related benefits.

Not all the benefits shown in figure 2.3 occur in every situation, and their relative importance varies. Where researchers have estimated the benefits, they have found the economic rates of return to investment in watershed management and soil conservation to be generally quite high, for example, in the 15 to 21 percent range for World Bank-financed projects (Brooks et al. 1982; World Bank 1984a). Integrating social forestry into broader agricultural and rural development programs is critical to achieve widespread watershed management and agricultural productivity increases.

Gaining local acceptance

The people living in the watersheds must be actively involved in initiating action to improve land use. This is where social forestry approaches can play a role. An understanding of upland inhabitant's existing land-use practices and resource needs must precede program planning. For example, controlled grazing to improve watershed conditions might require reducing the number of animals. Yet grazing control would meet serious opposition in societies in which the number of animals a family holds represents its status and wealth. An alternative, such as stall-feeding of animals, combined with social forestry programs for grass and tree fodder production, might be acceptable to local people and be a key factor in protecting critically steep slopes. An example of such an approach is the Phewa Tal watershed project in Nepal (box 2.3). In Nepal, some local communities have come to accept and support reforestation on steep slopes because they appreciate the role that trees play in reducing the frequency of landslides and mudflows that destroy homes, villages, and crops. Another alternative is careful rotation of small, fenced enclosures, sometimes with living fences that produce protein-rich fodder.

Upstream landowners and land users generally bear the cost of upstream activities that benefit downstream water and land users. The problem is how to distribute the costs and benefits fairly. Basically, the problem is one of incentives and transfer payments. Why should upstream land users incur all the costs if they will not reap all the benefits? Under such circumstances and from a public welfare point of view, payment to upstream land users by the government or by the downstream beneficiaries may be justified. To give farmers additional incentives, planners should, if possible, link conservation activities with the on-site production of goods and services that the farmers want.

Institutional mechanisms for watershed management

Because the downstream effects of upstream land use are cumulative from activities undertaken over a whole watershed, organizing and coordinating watershed management is vital. In most cases, needed actions cut across the boundaries of political and organizational units and appropriate transfers of resources will be needed to reflect the incidence of benefits and costs.

One of the more difficult problems involved in developing sound watershed management in association with social forestry programs is how to create and sustain institutions that will be effective in the local environments. Effectiveness depends on the resolution of two issues: first, how well agreement is reached on appropriate administrative responsibilities for the different field activities and on mechanisms to coordinate them; and, second, how appropriate the financing and cost-sharing mechanisms are for local social and economic conditions.

Box 2.3 Improving the Phewa Tal Watershed: Nepal

A watershed improvement project, supported by a UNDP/FAO team, began in 1975 to reform land use on the steep, eroding, 140-square-kilometer catchment area of the Phewa Tal. This small lake already supports modest developments of irrigation, hydropower, and fisheries. With an average annual rainfall of 4,500 millimeters (177 inches), the natural vegetation is dense montane forest that survives on scarps too steep for access. Half of the land area is cleared and terraced, including slopes of 60 percent and more. This supports approximately 10,000 people with family farm sizes of 0.5 to 1 hectare. Much of the remainder is severely overgrazed and scarred with landslides.

Improvement plans with positive cost-benefit prospects were proposed in 1977. The forest department decided to work by persuasion. The project team proposed, in a series of neighborhood meetings, that free-range grazing should cease. Farmers would be employed to plant vigorous forage grasses in the eroded gullies and trees for firewood and forage on the steep wastelands above the terraces. The headmen of seven out of ten wards rejected these proposals outright. Progress was rapid in the three groups that accepted.

By 1979, plantations of Nepalese alder, which are nitrogen-fixing trees, were growing vigorously; elephant grass was providing good forage in the gullies so that there was spare grass from between the trees to sell to the neighboring wards. The soil is so exhausted from continuous cropping that farmers do not sow unless they can apply manure. The manure from the stall-feeding of all livestock permitted a winter wheat crop on terraces that had previously remained bare between the summer crops of hill rice. With stall-feeding, buffaloes became more useful on land too steep for them to graze. By trading three scrub cows that produced 0.5 liters of milk each per day for one buffalo that produced 4.0 liters of milk a day, the farmers also gained the opportunity to sell bull calves for meat (religious laws forbid the slaughter of cattle). Pruning of the vigorous alders gave early crops of firewood. Within three years the incomes of all three cooperating wards had increased four-fold. The seven remaining wards of the panchyat had by then applied to join the scheme. The forest department set up tree nurseries, and some groups began planting without waiting for enrollment.

Some practical lessons applicable elsewhere emerged from the project:

- The trigger was the availability of funds to employ the farmers to plant forage grasses as a prelude to stall-feeding.
- The changes were popular with women because cutting and carrying fodder grasses short distances took less labor than gathering manure scattered by grazing livestock on the steep hillsides.
- Fencing proved to be unnecessary. The change to complete stall-feeding, as a community decision, was effective, and neighboring wards respected the ward boundaries.
- Foresters need training in the growing and management of firewood and fodder species in cooperation with farmers. Land preparation, spacing, and pruning traditions for timber trees proved inappropriate to this program.
- Water supplies, high on the hillsides, were a critical factor. This last point is of great importance. Hill farmers will carry fodder to their livestock, but when water is only to be found downhill, the animals must be driven to it. Building stone-walled stock tanks to protect springs, lining the tanks with plastic sheeting, and using plastic piping to bring water by gravity from sources higher in the mountains, were practical solutions in the Phewa Tal watershed. They need modest capital input, and await assistance for general application around the valley.

From Pereira (1983).

ADMINISTRATIVE RESPONSIBILITIES. The concept of a watershed is physical and technical and often has no relationship to political boundaries. Thus, in countries such as India, Nepal, Colombia, Ecuador, Ethiopia, and Morocco several autonomous local government units operate within the same river basin or watershed. While these units may not interact politically, the physical processes—water flows, erosion and its effects, and pollution—know no boundaries within the local watershed. In some developed and developing countries, recognition of this has led to the establishment of institutions with powers to negotiate and arbitrate among local political units. Such entities include river basin commissions and regional development authorities, such as exist in Colombia, Kenya, India, and other countries.

Such interaction, and in some cases basinwide jurisdiction over water use, is needed if a river basin as a whole is to be protected. In many cases, the most important economic activities and largest population concentrations are found in the lower reaches of a river basin, sometimes at the mouth of the river. Activity on the rest of the watershed becomes critical to these areas. Controlling only one political unit upstream is not enough, because the condition of the river at its mouth is a direct result of the sum of land-use practices and pollution habits in all parts of the watershed.

While no single solution predominates, some principles fundamental to most situations apply:

- Communication and coordination mechanisms will have to be developed because several lines of authority, political entities, and administrative agencies are usually involved.
- While trained watershed managers may be directly involved in administering watershed activities, they are more likely to act as technical specialists, with other people, such as public administrators, engineers, and foresters, holding administrative responsibilities. This means that attention will have to be paid to training needs for watershed management. The administrators and specialists involved should at least understand the fundamental concepts of watershed management and how social forestry combined with agriculture and other land uses relates to these concepts.
- A country should strive to develop production-oriented watershed managers, rather than managers who identify with special interest environmental or conservation groups. Poor, rural communities participating in social forestry programs understand and accept conservation that increases production and income; they seldom accept environmental or conservation arguments that are put forth in isolation. Many project successes around the world indicate the merits of an approach that integrates conservation and production objectives. With proper planning and a truly multiple resource management approach, both objectives can be achieved. The Upland Agriculture and Conservation Project in Indonesia (box 2.4) is an example of the incorporation of these three principles in the design of a watershed improvement program.

COST SHARING AND COST ALLOCATIONS. Another issue relates to how downstream or off-site beneficiaries of watershed management practices, such as hydropower users and farmers with irrigation systems, can be made to share the costs for such activities, thereby helping to finance incentive payments to upstream landowners who have to undertake the practices. Communities in Japan recognized this issue some 90 years ago. Schemes exist whereby communities downstream compensate communities upstream for their conservation efforts (Kumazaki 1982). Colombian national law requires hydropower companies to provide a percentage of their gross revenues for upstream watershed management activities (box 2.5).

In many cases, direct benefits from sound conservation or land stabilization do accrue to the farmers undertaking the work, as demonstrated in the program in Nepal (box 2.3). The approach used in an Indonesian program (box 2.4) is to provide hill farmers with grants to compensate them for the loss of production during the initial improvement activities of soil conservation, tree planting, and fodder establishment. In this way, family incomes are not reduced during the crucial period of introducing changes in land use. Thereafter, credit is made available to participating farmers to suit the type of improved farming system and includes a range of credit packages for stall-feeding cattle or goats, and for food and tree crop production. The principle in this case is that the subsequent improved farming systems should be sufficiently financially attractive to farmers that they will not need further subsidies once the improved land-use changes have been put in place. Embodied in this principle is the judgment that the initial grants paid to the farmers are not subsidies, but rather payments for the off-site or downstream benefits that will arise as a consequence of the improvement work on upland farms.

Box 2.4 The Upland Agriculture and Conservation Project: Indonesia

Indonesia's Upland Agriculture and Conservation Project is located in two heavily populated watersheds. These watersheds are headwater areas of extensively irrigated cropland (cropping intensity of about 190 percent), in which heavy investments have been made in irrigation installations. Farms within the watersheds average 0.4 to 0.8 hectares and are characterized by low and declining crop yields because of soil infertility, excessive soil erosion, and inappropriate land-use practices. In addition to the impoverishment of the farmers, concern is growing about the high sedimentation rates of the reservoirs and irrigation channels, which adds to maintenance costs and threatens the design life of these investments.

Planners designed and organized the project based on experience gained in pilot projects in other parts of Java. Project components include:

- stabilizing soils using a variety of conservation techniques, for example, improved terracing; protection of risers with perennial grasses, shrubs, and trees; and the establishment of permanent vegetative cover on steeper slopes by planting income-generating crops such as cloves, coffee, and fruits;
- introducing a range of improved farming practices to suit each farmer's needs and land based on the best practice techniques covering improved cropping systems for annual food crops; improved fodder production; improved livestock production based on stall-feeding; and tree crop production using improved cultivars of coconut, clove, fruit, coffee, fodder, fuelwood, and timber trees;
- upgrading rural roads to facilitate access and marketing;
- providing a blend of subsidies to assist farmers with initial soil stabilization by terracing and planting tree crops, and commercial credit for subsequent adoption of improved cropping practices;
- introducing district-level management organization under which the local planning authority is responsible for
    - securing stability in the watershed by approving the budgets and coordinating the fieldwork programs of the line departments responsible for soil conservation, food crops, fodder and livestock, tree crops, and roads; and coordinating credit with the banking system;
    - organizing training for field staff, administrators, and farmers, and providing them with information;
    - monitoring and evaluating project performance and making design adjustments as necessary;
    - reinforcing the agricultural extension service network, which motivates and provides essential linkages with participating farmers;
- carrying out concurrent farming systems research in the project areas under a senior, full-time scientist from the national research organization that brings together research specialists in soils, food crops, livestock, tree crops, fodder, and socioeconomics to work with farmers and field practitioners to improve the different farming systems, to coordinate research with similar work in other provinces, and to provide a network that will maximize the spread of new information.

The project is expected to increase the productivity of low-yielding and rapidly eroding upland farms. It has an estimated economic rate of return of 12 percent. Indirect effects will be a reduction in sedimentation of downstream irrigation systems. In addition, the organizational approaches and technologies successfully developed and demonstrated will be incorporated into ongoing and future upland agriculture/watershed programs in other provinces, thereby improving their cost effectiveness.

From USAID/IBRD (1984).

Box 2.5 Cost Sharing in Watershed Management: Colombia

A model of cost sharing in watershed management, partly financed by the World Bank, is being tried with some initial success in Colombia's Upper Magdalena watershed project. Hydropower companies are required by law to contribute 4 percent of their gross revenues to upstream watershed management activity. A soil conservation fund, to which the National Institute of Natural Resources also contributes, has been established to finance upstream conservation activities. These funds are used to subsidize a portion of the debt service for the upstream farmers who borrow money to undertake such activities as substituting annual with permanent crops or reducing grazing on a given area of land.

From Gregersen and McGaughey (1985).

Arid Areas and Desertification

Maintaining productive and stable land-use and farming systems in the arid and semi-arid areas of the world presents a particularly difficult challenge. The areas currently affected and becoming affected by desertification are massive, and finding remedies when all the main facets of the production system (human and livestock populations, land, water, crops, and energy supplies) are under stress is difficult. The people in these areas face a rapid decline in their standard of living as the natural resource base becomes degraded and loses its ability to recover. Increasing numbers of environmental refugees migrate to other lands, which are then also endangered by overuse. Rehabilitating desertified areas is inherently difficult, involving costs that exceed the financial resources of most of the countries affected. Social forestry programs are a major element in many rehabilitation and protection strategies.

Quantifying and qualifying desertification

An estimated one-third of the earth's land surface is arid or semi-arid. Some 850 million people inhabit this land area of approximately 40 to 50 million square kilometers. The incidence and threat of desertification within this area is widespread. Since the 1977 United Nations Conference on Desertification, investigators have carried out systematic studies of the extent of desertification. Dregne (1983) estimated that approximately 80 percent of productive lands in arid and semi-arid areas suffer from moderate to severe desertification. Mabbut (1984) points out that the most severely desertified areas are in the drylands of Africa, Asia, and South America. The WRI (1986) estimates that 88 percent of productive drylands in the Sudano-Sahelian area of Africa are desertified.

A major cause for concern in many countries is that, with present land-use practices, the natural resources are not able to support the existing population, let alone provide for population increases. This is demonstrated in table 2.3 for the Sahelian and Sudanian zones of West Africa, which show a current fuelwood deficit of 50 percent and a very limited potential for additional food crop and livestock production to meet population increases. As the table demonstrates, current population growth rates cannot be sustained for long without a deterioration in living standards unless rural productivity or nonrural employment opportunities dramatically improve. Even if rural population increases by only 2 percent a year, in the year 2000 the rural population will exceed 40 million, as against a total sustainable rural population (for food and livestock) of 36 million.

Table 2.3 Actual and Sustainable Populations in Sahelian and Sudanian Zones of West Africa *(millions)*

Zone	*(1) Crop/livestock sustainable population*	*(2) Actual rural population*	*(1-2)*	*(3) Fuelwood sustainable population*	*(4) Actual total population*	*(3-4)*
Saharan		0.8			0.8	
Sahelo-	1.0		-0.8	0.1		-1.7
Saharan		1.0			1.0	
Sahelian	3.9	3.9	0	0.3	4.0	-3.7
Sahelo-Sudanian	8.7	11.1	-2.4	6.0	13.1	-7.1
Sudanian	8.9	6.6	2.3	7.4	8.1	-0.7
Sudano-Guinean	13.8	3.6	10.2	7.1	4.0	3.1
Total	*36.3*	*27.0*	*9.3*	*20.9*	*31.0*	*-10.1*

Source: World Bank (1985a).

The problem's exact dimensions are still unknown. However, satellite-based, remote-sensing techniques now make defining the problem with some precision possible. Without urgent remedial actions, the spread of desertification will continue to escalate, and hundreds of millions of people will become environmental refugees, dependent on humanitarian relief that may ultimately be inadequate. The drought and resulting famine during 1984 and 1985 in Sub-Saharan Africa was tragic. Before the drought, the millions of people who lived in desertified areas of this region had experienced declining crop and livestock yields. Consequently, they were not able to store enough food to carry them through the drought. It is axiomatic that desertification leaves people poorly prepared to cope with drought.

DROUGHT. Drought is not desertification, and the policies and practices employed to deal with the two problems must take this into account.

Drought is a climatic event. The weather systems that cause the extreme variability of rainfall in drought-prone areas are often the result of displaced wind and precipitation patterns induced by climatic circumstances occurring well beyond the affected areas. Little empirical data links the occurrence of drought to human activities, however, some researchers have suggested that clearing the land over extensive areas may induce drought conditions (Nicholson 1982).

In drought-prone areas, the average rainfall is a deceptive indicator for assessing production systems. Adopting a "probable case scenario" is fundamental in designing land-use interventions in these areas (World Bank 1985a). In brief, this means choosing crops and trees that can survive and grow under realistic assumptions of rainfall and its variability.

Governments can minimize the effects of drought by using improved climate impact assessments, crop forecasting, and systems that warn of famine early. Combined with strategic food stocks and short-term measures such as food aid and medical relief, these systems provide some insurance against the effects of drought. Social forestry activities can contribute substantially to building greater resilience into the farming systems in drought-prone areas through their positive impacts on soil and water conservation and on the supply of dry-season fodder. Governments should also emphasize programs that maintain the variable farming systems on the periphery of drought-affected areas because these areas must often absorb the brunt of nomadic and refugee influxes.

DESERTIFICATION. Desertification is an even more serious problem than drought in that it represents a long-term, pervasive loss of productivity in regions with increasing populations. Drought often exacerbates the impact of desertification, which is principally a result of poor stewardship of the land.

To place forestry activities in the proper perspective in combating desertification, a review of the causes of desertification is necessary. In physical terms, the principal cause is population pressure that induces increasingly intensified use of fragile resources, which leads to their degradation and destruction.

Under such circumstances, desertification can continue in years of better rainfall as well as in drought years. Removing the natural vegetative cover from the land when it is converted to other uses exposes the soil to the extremes of climate and breaks down the thin mantle of productive topsoil. Expanding and intensifying agriculture are the primary reasons for converting the land. For example, the modest gains in agricultural productivity achieved in the Sahelian countries of West Africa came from converting bushland to agricultural use. However, the gains were short-lived because the new farming was on soil too marginal to sustain production for more than a few years without soil conservation measures and fertilizer.

This agricultural expansion is particularly problematic when it takes place on sloping lands, which rapidly lose topsoil through erosion. Also, the water retention capability of sloping lands is reduced by the loss of vegetation and soil. Even when agriculture is intensified on better soil, the farming methods may include (a) inappropriate monoculture practices, often with particularly soil-exhausting crops; (b) mechanization that unduly disturbs the soil mantle; (c) shortened fallow periods; and (d) a disregard of basic soil conservation measures.

Uncontrolled burning, common in semi-arid areas, adds to the problem. Burning is closely associated with grazing and is often carried out to induce the growth of young and palatable forage. Overgrazing is another major cause of desertification. It destroys the vegetative cover, compacts the soil, and eventually eliminates palatable, annual forage species. Harvesting fuelwood and producing charcoal to supply domestic energy needs has also contributed substantially to desertification.

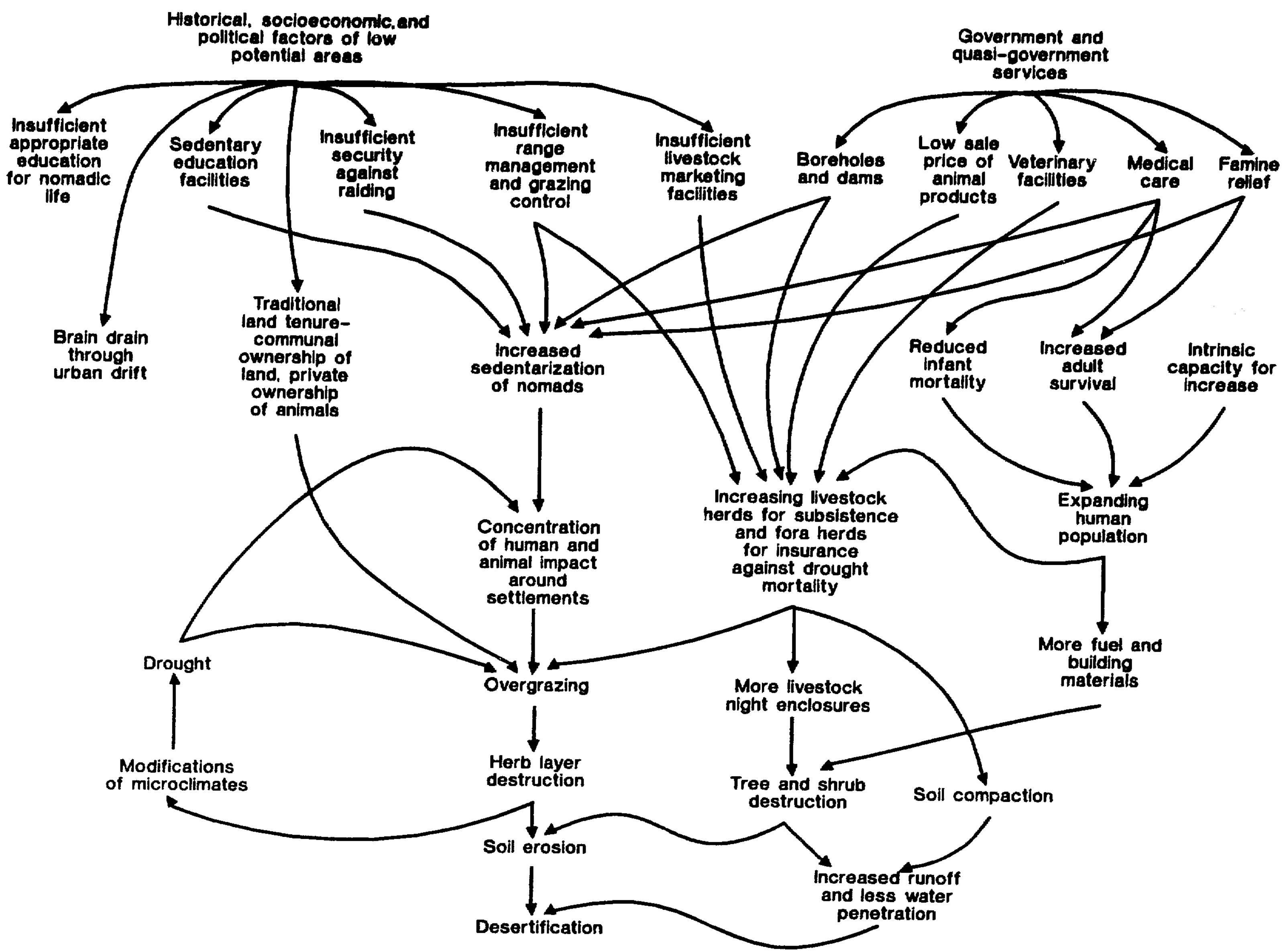
These causes—seemingly irrational behavior on the part of subsistence farmers—must be viewed in the context of the social, economic, and institutional factors that work against sustainable resource use and conservation. These include land and tree tenure issues; lack of access to agricultural production inputs and credit; limited rural development initiatives; conflict within communities and with local authorities (for example, with the forest service); changing political systems; civil war; restricted market outlets; lack of off-farm income opportunities; risk-coping strategies of rural people (for example, keeping large herds); migrating livestock herds; and lack of guaranteed benefits from land use. These socioeconomic and institutional issues are presented in figure 2.4 to show their interaction with the physical aspects of the process of desertification.

Past social forestry activities in semi-arid areas

Laudable efforts to contain the pace of deforestation and desertification have been launched throughout the world in the last 15 to 20 years. Many of these efforts have involved social forestry. Notable among them is the Majjia Valley windbreak project in Niger (box 2.6), which is providing greater understanding of the importance of trees for environmental stability in arid and semi-arid areas.

A number of other forestry approaches to combating desertification have not been as successful as originally hoped. The technical challenges are great and the alternatives with respect to species and methods of establishment are limited. Furthermore, successful interventions require strict attention to quality control in terms of timing of operations, seedling quality, plantation protection, maintenance, and follow-up by extension agents. Such control is difficult to obtain in many areas. The community dimensions (social, economic, political,

Figure 2.4 Some Causes of Desertification: Northern Kenya



Source: Based on Lamprey (1978), as presented by Burley (1982).

Box 2.6 The Majjia Valley Windbreak Project: Niger

Since 1974, CARE and the Forest Service of Niger have been engaged in an agroforestry project in the Majjia Valley. The valley comprises some 25,000 hectares and is within the Sudano-Sahelian zone, an area of shrub savanna with a mean annual rainfall of 500 millimeters. The valley's soils are comparatively rich and, as a result, population density is high (52 persons per square kilometer). The extension of agriculture (millet, sorghum, cotton, and groundnuts) throughout the valley destroyed the tree cover. Years of continuous cultivation, leading to declining soil fertility, and erratic rainfall had resulted in marked declines in crop productivity. The rate of soil erosion from both water and wind had been increasing.

In 1975, the first double-row windbreaks of neem *(Azadirachta indica)* were planted. Since then, more than half of the 6,000 hectares in the project area have been protected by almost 500 kilometers of windbreaks established in parallel rows, 100 meters apart across the breadth of the valley. The project also includes free distribution of seedlings to farmers, riverbank protection, and private and village woodlots. Since 1981, USAID has supported continuation of this project.

As early as 1980, studies documented a positive (23 percent increase) impact on crop production in the fields protected by windbreaks. Subsequently, a major evaluation of the project confirmed this positive impact. In 1984, a year of intense drought, crop yields in the protected fields were 18 percent higher than in adjacent, unprotected fields. In 1985, they were 20 percent higher.

The villagers of the surrounding areas have voluntarily provided the labor needed to plant the trees. Local enthusiasm for the project has flourished, and CARE has recently established a third nursery to help meet the demand for seedlings.

As part of the technical evaluation, experimental felling is being carried out on the older windbreaks to determine how best to manage them without seriously impairing their protection function. The government has agreed to a distribution scheme for the wood harvested. The landowners, those who participated in the cutting, and the village councils each get an equal share. This sharing has confirmed the genuine social forestry nature of this extremely successful project.

From Bognetteau-Verlindeu (1980); Delehauty et al. (1985); Dennison (1985).

legislative, and organizational) implicit in working with people and their problems have often proved to be the true limiting factors.

In the 1970s, reforestation was seen as the task of foresters, and they were encouraged to take up the challenge by large influxes of donor support. Their early plans focused on large-scale, capital-intensive, state-run block plantations—their traditional forte—and occasionally, village woodlots that involved the rural people.

Only since the early 1980s, as projects came under closer scrutiny and the lessons of social forestry began to emerge worldwide, have new, more people-oriented strategies been identified by many national and international governmental groups and NGOs and put in place. These include farm forestry and multipurpose natural forest management. Each strategy has advantages and disadvantages, and each is continuing to evolve, both conceptually and in application.

BLOCK PLANTATIONS. Block plantations for fuelwood and other products have several advantages, namely, a known technical approach, readily identifiable impact, ease of investment evaluation, economies of scale, and simplified monocultural silviculture.

The combination of disadvantages, however, can be significant. Important among the disadvantages are those related to economics. Despite the fact that fuelwood is now part of the cash economy, market prices for fuelwood are still relatively low in most areas. Plantation-grown fuelwood must compete with fuelwood that is harvested essentially free from natural stands. Other negative factors include slow growth as a result of climatic and soil conditions and poor species selection; the lack of quality control from seed collection to planting; and the lack of administrative and managerial arrangements required to establish and manage a large block plantation. These issues can, in time, be addressed; but it is more often underlying social issues that defeat this option.

Another major difficulty for block planting in semi-arid areas is the availability of land. Fuelwood scarcity is directly related to population pressures, and most land is cleared to produce food. Thus, most large tracts of suitable land capable of producing decent tree growth and returns are not generally available for plantations. More marginal soils or lands that have been degraded through intensive agriculture are similarly problematic because of poor tree survival and growth, while common or "barren" lands designated for block plantations may be subject to other pressures not readily apparent at the time of their selection. They may be sources of fuelwood and forest products, alternative grazing areas, or land banks or fallow areas for local villagers. Where these conflicts exist, the imposition of a large-scale, government-controlled plantation project may create conflict with the local people, which will exacerbate tree protection problems and increase costs. Where tree growth is slow—as is typical in areas subject to desertification—projects must bear high protection costs for a long period. The efficiency of plantation protection, and indeed the option itself, must be considered against a backdrop of the difficulties that developing countries have experienced in protecting their reserved forests.

Undue emphasis on state-controlled block plantations raises two other problems. First, it reinforces the ill-conceived notion that somehow foresters alone can resolve the fuelwood problem, when experience has shown that this is not practicable. From a financial standpoint, with plantation establishment costing more than US$1,000 per hectare in many areas, the demands on national budgets to make any impact on the fuelwood supply problem would be extraordinary. Second, concentration of scarce resources on block plantations has led to continuing neglect of the management of existing forests and woodlands and of farm forestry, both major social forestry strategies for combating desertification.

Despite the disadvantages, governments should not reject large-scale block plantations entirely. Select situations, adjacent to urban centers, where fuelwood demand and prices are high, offer opportunities. Careful design and planning based on sound information will be necessary.

VILLAGE (COMMUNAL) FORESTRY. As part of earlier efforts to ensure greater involvement of rural people in reforestation to combat desertification, village forestry or communal, *bois de village* projects were designed and put in place in a number of West African countries, including Burkina Faso, Mali, Niger, and Senegal; and in the Indian states of Gujarat and Rajusthan. Usually, these plantations were small scale (1 to 10 hectares a years) and established on village common lands. They generally involved—theoretically, at least—shared work for shared benefits.

The principal advantage of communal woodlots is that they involve rural people in helping to solve the desertification problem. However, village forestry in semi-arid areas shares many of the disadvantages of block plantations, particularly in terms of the technical issues mentioned earlier, although the costs may be lower than for block plantations. In practice, many problems have arisen related to joint responsibility for planting, maintaining, and protecting the plantations, and to the distribution of benefits. This option should always be explored to determine whether or not it is appropriate, although indications are that it does not have great potential.

FARM FORESTRY. Making an impact on the desertification problem will take large numbers of farmers using less capital-intensive methods, planting trees along field margins, in small uncultivatable patches, or in agroforestry configurations. They will be prepared to do so because they will obtain tangible and multiple benefits: trees will increase agricultural productivity through the shelter effect; their leaf litter will raise the organic matter levels in the fields; and their roots will tap nutrients from the deeper layers of the soil. Farmers also stand to gain from multipurpose trees that produce forage, medicines, fruit, and other foods (see chapter 3). Through these benefits, and by being able to sell firewood (or simply by avoiding cash expenditures or the laborious collection of fuelwood), farmers may be able to afford—and be willing to undertake—the soil and water conservation and land protection practices needed to check desertification in some regions.

These factors underscore the strengths of farm forestry as a strategy, not only to meet fuelwood needs, but also to contribute significantly to stabilizing or improving farm production in semi-arid areas. Farm forestry offers great opportunities through its potential for cost effectiveness, both at the macro-investment level (which is a major concern to governments) and on the level of families that take it up as part of their production activities. The multiplier or spread effect also offers an opportunity to widen the impact of fuelwood production projects, particularly the ameliorating effects of tree cover in combating desertification. Another advantage is the resultant integration of agriculture, including livestock production, and tree growing.

MULTIPURPOSE NATURAL FOREST MANAGEMENT. As discussed earlier in this chapter, multipurpose management of natural forests has also emerged as a promising strategy for the management and use of some arid and semi-arid areas. Rural people have long used natural forests and woodlands to provide food, firewood, fodder, building materials, medicines, and other products to meet household needs. Measured in terms of these products, or simply in terms of biomass productivity, small wonder that those forests and woodlands that remain are finally taking on new importance in the eyes of governments. Equally as important as their productive nature is their role in controlling desertification.

The advantages of natural forest management in semi-arid regions are many. The major contribution of natural forests to the fuelwood supply immediately suggests the development opportunity they represent. Even modest gains in productivity could have a significant impact on the fuelwood supply. Furthermore, the return to investment is potentially greater from natural forests than from plantations. Other important factors in their favor are (a) they already exist and, although they are under pressure of overexploitation in many areas, some respect for forest boundaries usually exists, which can serve as a basis for stabilization; (b) they are commonly located on important catchment areas; and (c) they are composed of species that are known to thrive, or at least survive, in the exacting climates of semi-arid areas.

As an example of the cost of upgrading natural forests, preliminary data, albeit for very limited trials in Niger, suggest that the costs may be as little as US$200 per hectare in the first year to restore the productive potential of fairly degraded forest areas to a level of production equivalent to that of plantations in the same area. This must be compared with the much larger establishment costs (US$800 to US$1,200) for plantations.

The strategy of natural forest management also has its disadvantages. At the outset, it is likely to be even more difficult to succeed because the areas of highest priority are probably those forests under the greatest social pressure. Authorities at the highest policy levels must understand the opportunity costs of clearing marginal land for agriculture to obtain short-term food production gains against the ultimately high costs of rehabilitating land for fuelwood, other tree products, and ecological purposes. This will be difficult because of the time it takes to achieve significant, demonstrable effects and their less dramatic visual impact, since the forest was already there before the management started.

At the same time, policymakers will have to come to grips with the need to involve local people so that they will understand and respect the production tradeoffs required to ensure that management efforts succeed. For example, a delicate and critical issue for many high-priority natural forest areas will be the need to determine livestock carrying capacity, and to control instrusions into the forest and the harvesting of forest products in certain areas at critical stages in the management scheme. The solution will have to be local participatory management schemes that involve the people from adjacent villages in the activities being undertaken and include them in the distribution of the expected benefits (Thomson 1981).

Species and technologies

While much more research is needed to reinforce social forestry programs in arid and semi-arid areas (see chapter 14), a range of species and technologies that can provide a sound basis for proceeding with programs already exists (see Weber and Stoney 1986). For example, the success of the Majjia Valley windbreak project (box 2.6) was achieved mainly by using *Azadirachta indica*, complemented by *Acacia scorpiodes* and *Prosopis juliflora*. In Chad and other countries, *Acacia albida* has proven to be a very successful species, attractive to farmers and adapted to semi-arid conditions. Work carried out under an FAO project at Kaduna, Nigeria, in the 1960s and 1970s developed species selection and establishment techniques that can be adapted to many semi-arid areas (for more details see National Academy of Sciences 1980a, 1983b; National Research Council 1983; USAID 1984; FAO 1985b, e; Weber and Stoney 1986).

Summing Up

The arguments presented in this chapter suggest that a nation's forests can represent the following:

- insurance against a depletion of water resources, both in quantity and quality;
- genetic potential of unknown value, both for flora and fauna;
- a least-cost supply of timber and many other subsistence and commercial forest products;
- a major source of livestock subsistence in many regions;
- areas of self-sustaining stability that absorb the extremes of rainfall, wind, heat, and cold and protect the fertility of the land they occupy;
- buffer zones that ameliorate the destabilizing effects of these same elemental forces on the land surrounding them;
- a source of capital wealth on which future generations can base their livelihood, and in some cases, survival.

Yet, the record of forest management and protection in the tropics and in the arid and semi-arid areas of the world is not good. Restoration of environmental stability will not happen by itself. It requires thoughtful planning, a strong appreciation of the costs of neglect and the value of action among all users of its products, and acceptance of regulatory practices by most users.

Prevention is far less costly than cure. For this reason, this chapter has outlined the potential contribution of social forestry to environmental stability. Establishing social forestry programs now in areas that are not yet under severe environmental stress can help to avert excessive suffering and the high cost of remedial actions in the future.

Environmental problems in the tropics generally take on a sharper focus than in temperate regions. Rainfall tends to be more intense, causing more physical damage to the soil surface. Soils are commonly less fertile and more easily eroded. Forestry types are more complex and more difficult to manage for maximum and sustained yield. Even where environmental pressures are slight, the people causing the pressure have little capital and time to develop innovative remedies; their options are limited.

These constraints underscore the need for strong leadership to put in place sustained yield-management systems that both commercial and noncommercial users of forests and woodlands will respect. Social forestry programs can make a significant contribution. The key factors are (a) a general acceptance of sustained yield-management systems by responsible local groups, (b) a clear definition of who is entitled to the yields of various products, and (c) a corresponding set of obligations to be undertaken by the local users to make sustained yield management work.

Proper management of upland watersheds is of vital concern because of potentially significant downstream effects. A wide range of technical, socioeconomic, and institutional problems face the planners of watershed management projects. Permanent vegetative cover, such as forests, is the best and most certain protection for watersheds. However, in practice, much of the land area is under cultivation because it must support local people. In many cases, cultivation practices are causing rapid environmental damage. The challenge for leaders is to induce watershed occupants to change their land-use systems to ones that will stabilize the environment and produce a sustained yield of products sufficient for their needs. Such changes invariably involve such strategies as introducing perennial crops, soil and water conservation measures, and new cropping systems for annual crops, and limiting animal grazing. This requires considerable investment and often foregone production while the stable and sustainable technologies are being developed.

Mismanagement of a watershed can adversely affect many more people than actually live in the watershed. Thus, the occupants of watersheds are not only responsible for their own livelihood, but to some extent the livelihoods of those who live downstream. This is a strong argument for justifying payments from downstream water users to upstream land users who undertake protective or remedial work and forego income while they do this. The payments should not be considered subsidies, but rather payments for services that produce the off-site benefits received downstream.

Even more radical changes in land use are required if the fight against desertification is to succeed. All the natural resources are under extreme stress. Experience has shown that concentrating efforts on one aspect of resource conservation without paying regard to others results in failure to achieve the objectives. A systems approach is needed. In improving farming systems, tree planting activities are recommended as part of—rather than substitutions for—the wide range of essential soil and water conservation and crop improvement measures that are needed to foster long-term, sustainable agricultural productivity in the arid and semi-arid areas of the world. Expanded efforts in soil conservation engineering (for example, terracing, bunding, and contour plowing), water runoff control (microcatchments and water harvesting), no-tillage techniques, and research to shorten crop cycles are all required to develop systems with greater resilience against drought and a capacity to check and then reverse desertification. Remedial programs require a broader based approach, combining changes in crop and livestock production and forestry technologies with changes in attitudes, customs, and institutions. In this sense, a rural development approach, trimmed of nonessential components to minimize complexity, is more likely to succeed.

Social forestry can have a major role in the protection, improved management, and systematic use of products from existing natural forests and open woodlands. Programs involving local communities must clearly establish citizens' rights and obligations. Farm forestry, as well as agroforestry, is also a promising strategy for stabilizing farming systems and for providing direct benefits to farmers in the short term. Community tree blocks are likely to be more difficult to establish, but project planners should not neglect them where they are appropriate (for example, where the land is too steep for permanent cultivation and where local customs are amenable to this form of shared work and benefits). In this respect, where extensive shelterbelts or windbreaks are being established as an integral part of desertification control, the wider use of community tree blocks may be a valuable method for demonstrating this work and training people in tree planting techniques.

To succeed, all these approaches require major changes in (a) attitudes and customs at the national, district, and farm level among decisionmakers, planners, technicians, and farm families; (b) land-use and farming practices among field officers, farmers, and graziers; and (c) priorities and ways of allocating budgets.

3

THE ROLE OF TREES IN AGRICULTURE

This chapter explores the contributions that trees can make when they are introduced into farming and livestock production systems. It reviews worldwide experience and raises policy issues related to social forestry in an agricultural development context.

While the systematic, scientific study of the contributions of trees to agriculture is the relatively new field of agroforestry research, the use of trees in farming systems is as old as agriculture itself. Indeed, many agricultural technologies evolved from the practices of forest dwellers who depended on trees and other forest plants for most of their needs. The relatively limited but solid information that has become available during the past decade or so reveals that the contributions of trees to farming systems and farmer welfare are widespread, varied, and significant.

Trees contribute to farming systems and farmer welfare in three main ways.

1. Trees can help **improve the productivity of farmland** by fixing nitrogen, providing green manure, and reducing wind erosion and soil moisture loss when trees are used in shelterbelts or windbreaks. Trees planted along contours and in other critical areas can act as effective barriers to the surface flow of water, and thus increase rainfall infiltration and reduce soil erosion and loss of soil nutrients. Finally, trees provide wood that can replace dung and crop residues as fuel for cooking and heating, so the dung and residues can go back into the soil and help crop and pasture productivity. Of course, trees can also compete for scarce moisture and, through shading and root competition, they can reduce crop productivity, although this can be reduced through judicious pruning. As in all agricultural practices, positive and negative aspects have to be considered and weighed.

2. Trees can **contribute to livestock production.** In many parts of the world, farm trees—as well as forest trees—provide fodder for livestock. They also provide shade for animals and can serve as living fences to keep livestock from crop areas.

3. Trees can **provide a great many products for on-farm consumption or for sale.** Chief among these products are fuelwood; fruits, nuts, and other edible products; medicines; gums; tannins; poles and posts for construction and other uses; and timber for housing, furniture, and implements.

Each of these three categories is treated separately in the following discussion. However, note that most trees are planted and managed in farming systems for multiple purposes, for example, for fuel, fodder, shade, and eventually timber. One of the errors in thinking in early social forestry projects was that farmers would plant trees only for fuelwood or some other single purpose. As agriculturists learned more about agroforestry systems, they realized that most trees have multiple functions in the farming systems of nearly all countries, and that fuelwood as an isolated product often is not the main concern of local communities.

Contributions to Agricultural Crop Productivity

Figure 3.1 indicates the ways in which trees introduced into the farming system can help improve crop productivity and outputs. Some evidence concerning these various contributions has been accumulated, for example, by ICRAF in Nairobi (see ICRAF 1986a,b). Spears (1986) and Winterbottom and Hazlewood (1987) provide recent summaries of the evidence. Sanchez (1987) provides a good overview of what we know about the relationships between agroforestry and soil productivity and sustainability. In general, the effects of trees in the farming system vary widely from one agroclimatic environment to another. Indeed, in some cases trees compete directly with food crops, for example, when water availability is limited, while in other cases trees actually help enhance agricultural production, for example, shelterbelts. The following discussion focuses on the positive contributions of trees, although some possible negative effects are mentioned.

Figure 3.1 Trees and Crop Productivity

Yield increases through

Shelterbelts

Minimize wind erosion of soil

Protect seed and seedlings

Reduce moisture loss through evaporation

Increase atmospheric humidity

Reduce frost damage

Reduce crop damage from lodging and bruising

Increase water infiltration and percolation

Reduce runoff

Reduce wind and water erosion

Add humus and improve soil structure

Potentially add nitrogen

Nitrogen-fixing trees

Increase available nitrogen in soil within vicinity of trees

Provide foliage for nitrogen-rich manure or mulch for field

Stabilizing soils

Tree crowns reduce shattering impact of rainfall

Tree roots bind soil, assist water percolation

Tree litter (leaves, twigs, bark) increases humus, improving soil's binding properties—and root development of other plants

Combinations of these three attributes contribute to sustainable farming systems by manipulation/generation of on-farm soil productivity.

Shelterbelts

The use of shelterbelts or windbreaks, composed of one or more rows of trees, to stabilize or reclaim farmland in semi-arid areas has been widely accepted; indeed,the Syrians practiced it more than two thousand years ago. Researchers have found that in areas of extreme stress in the balance of natural resources, trees used in this way are indispensible if land cultivation is to be sustained. What is less widely understood and practiced in developing countries is the use of shelterbelts in the more favorable farming areas.

Most of the literature describing the uses and benefits of shelterbelts concerns experience in developed countries. In temperate, developed countries shelterbelts are essential to sustain farming systems in areas of high winds combined with erodible soils. The first planted shelterbelts in Europe date from the 1700s, and the first big systems in the United States and the Soviet Union, intended to save extensive agricultural cropping areas, date from the 1930s. At about the same time, the use of planted shelterbelts was adapted to improve pasture and livestock production in New Zealand and Australia in areas of high winds.

BENEFITS OF SHELTERBELTS. Trees planted as windbreaks can reduce the velocity of the wind to a speed that is insufficient to move soil particles. This can keep seeds and newly germinated seeds from being blown away or dislodged, and can prevent "sand-blast" damage to growing crops. The reduction in wind speed leads to lower evaporation from both open water and soil surfaces, leaving more water available for plant growth. In turn, the increased amount of moisture in the soil surface can have a small, but positive, influence on crops by increasing atmospheric humidity, which coupled with the reduction in wilting, is also beneficial to plant growth. The cumulative effect is that, after allowing for the loss of cropping area planted to trees and the reduction in crop growth immediately next to the shelterbelt due to shading and competition for moisture and nutrients, crop production usually increases in the area protected by the shelterbelt. This is demonstrated schematically in figure 3.2. Shaded area A represents the reduction in crop yield in the area close to the shelterbelt. Shaded area B is the increase in crop yield in the sheltered area; this reaches a maximum at some distance from the shelterbelt and then declines to the yield of the unsheltered area.

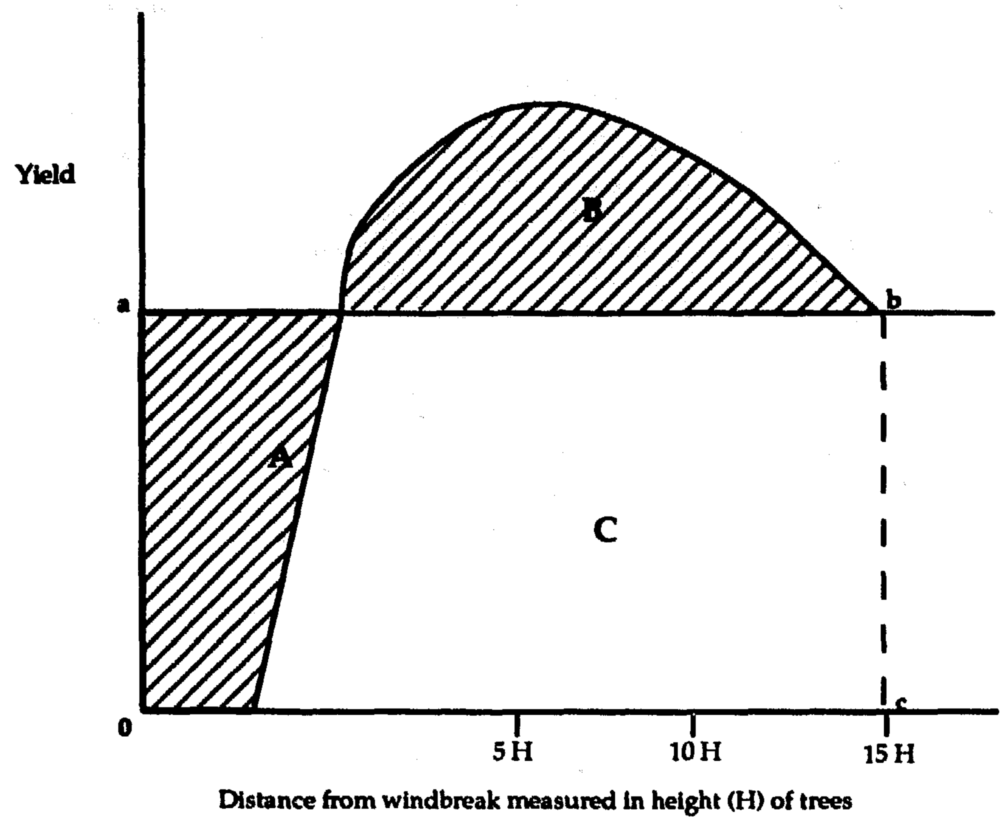
In addition to the increase in crop yield in the protected area, crop quality may also improve; for example, a reduction in lodging of straw crops and bruising of vegetable and fruit crops, which often occur as a result of severe storms. Another benefit is an improvement in soil condition caused by the increased organic matter content from the addition of leaf litter, and favorable influences of the cooler, moister conditions on soil microorganisms. Deep-rooted trees may also aid nutrient cycling and, if nitrogen-fixing tree species are used, can increase available nitrogen by fixing atmospheric nitrogen for plant use. Finally, shelterbelts can provide an additional flow of forest products: poles, fuelwood, fodder, and so on.

On the negative side, shelterbelt trees take up land, they can compete for scarce moisture, and their shade may slow crop growth. They may also be associated with increases in wildlife populations that can harm crops. Farmers must weigh the negative and positive aspects in each case.

The use of shelterbelts has been very successful in China, where they are an important part of the social forestry program. By 1984, shelterbelts were protecting some 6.6 million hectares of farmland in the western and northern plains. In the intensively farmed central plains, about 0.6 million hectares of shelterbelts protect 11 million hectares of farmland (Government of China 1985).

Research in China has confirmed that shelterbelts eight to nine years old can reduce wind velocity and evaporation by about 30 percent and 18 percent, respectively, and increase soil moisture and atmospheric humidity by around 20 percent and 9 percent, respectively. Besides the prime objective of stabilizing the soil, researchers report increased yields of a wide range of crops. Table 3.1 presents a range of crop yield increases attributable to shelterbelts taken from research results in various countries.

Figure 3.2 Effects of Windbreak on Crop Yield in Protected Area



Crop yield without windbreak is area A plus C
Crop yield increase with windbreak is area B minus area A

MAKING THE BEST USE OF SHELTERBELTS. As we have seen, under severe wind conditions, shelterbelts can greatly add to the stability of the farming system and improve crop production, both quantitatively and qualitatively. In addition, they can increase the flow of tree products, although extraction must be limited to maintain the shelterbelts. Under less severe conditions, shelterbelts are more likely to have a net beneficial effect on overall crop production than a negative one. Therefore, although the main objective of tree planting may be to provide more inputs to the farming system, such as fodder or wood products for self-sufficiency or sale, planting additional trees to serve as shelterbelts makes good sense.

More farmers in developing countries could use shelterbelts to prevent wind damage to soils and crops in severe wind situations, and to add stability and increase product flows in less extreme situations. The use of shelterbelts to improve the productivity of pastures and livestock can also be important. Their value can be extended by combining them with other conservation works, such as contour terraces and ditches, so that the tree roots and crowns strengthen and protect the earthworks. In this way, shelterbelts—in addition to reducing wind damage—can help reduce surface water runoff and increase the percolation of rainfall, hence, they help replenish soil moisture and underground water reserves. Streamflow will also be more stable.

The way in which farmers should design and lay out shelterbelts depends on local conditions related to wind speeds and characteristics, the eventual height and density of the tree species chosen for the shelterbelts, the spacing between the belts, the orientation of the belts, land ownership, and so forth. Some useful references are World Bank 1979, 1986d (annex IV); Bognetteau-Verlinden 1980; California Department of Conservation 1984.

Table 3.1 Net Increase in Crop Yields Attributable to Shelterbelts

Crop	*Location*	*Average increase in crop yield* (percent)*	*Remarks*
Cereals	U.S.A. (Great Plains)	5	High-yield potential land
		18	Low-yield potential land
Cotton	U.S.S.R.	10-20	
	Egypt	35	
	U.S.A. (lint)	23	Ranging from 46 percent at a distance from shelterbelt of 2x shelterbelt height to 13 percent at distance of 15x shelterbelt height
	U.S.A. (seed)	27	Ranging from 55 percent at a distance from shelterbelt of 2x shelterbelt height to 10 percent at distance of 15x shelterbelt height
Hay	U.S.S.R.	10-20	Good rainfall years
		40-100	Dry years
Maize	Romania	165	Increase from 1,139 to 3,015 kg/ha
	Egypt	13	Nile maize
		17-74	Summer maize
Melons, vegetables	U.S.S.R.	50-70	
Millet	Niger	23	
Potatoes	U.S.S.R.	71	
Rice	China	25	Ranging from minus 51 percent at a distance from shelterbelt of 0.5x shelterbelt height, through 49 percent at 6x shelterbelt height to 8 percent at 15x shelterbelt height
		30	Increase from 1,500 to 1,950 kg/ha
	Egypt	10	
Wheat	U.S.S.R.	17-25	Higher in dry years
	Egypt	38	
	Turkey	25	
	Romania	20-50	

* Yields for total cropland within sheltered area, including area occupied by shelterbelt, compared with unsheltered control crop.

Source: See sources cited in Magrath (1979).

Trees and soil fertility

The maintenance of soil fertility to assure sustained food output requires much more attention than this aspect of tropical farming systems has been given in the past, particularly as concerns rainfed cropping areas. The most successful programs for increasing food crop production in the tropics during the last 30 years have been in the lowlands, a large proportion of which have been under seasonal or controlled irrigation, for example, the Indus and Ganges basins in South Asia and the lowlands of Korea, Thailand, Java, and the Philippines. These plains areas possess deep, often fertile, alluvial soils that have accumulated over many years from soil eroded from surrounding or distant mountains and hillsides. The combination of deep, fertile soils, abundant water, and generally good communications provided the setting in which farming systems, using high-yielding varieties (HYV) that produce two or even three crops a year, have been successfully adopted without so far incorporating trees into the system. Even under these favorable soil and water conditions, problems of maintaining soil fertility may arise in which the incorporation of trees in the farming system would help greatly. In addition to the use of shelterbelts, already discussed, there are some special applications of trees in soil reclamation, including desalination of soils. These are discussed later.

Outside the irrigated plains areas, trees have a more important role in helping to maintain soil fertility. Much of the rainfed cropping areas in the tropics are on undulating or sloping land with relatively shallow soils, subject to some degree of erosion and nutrient leaching, and where soil moisture is insufficient for intensive, HYV technologies. Often the rainfed areas are remote from trading centers with poorer roads than in the irrigated areas; thus, the costs of distributing artificial fertilizers are higher, and their use is less clearly advantageous because of the soil moisture situation.

Because of increasing population, the area and the intensity of cropping in rainfed areas is increasing in most developing countries. Under these conditions, the greater use of trees in farming systems can have a dramatic, positive effect on maintaining soil fertility. Interesting programs using this approach as a major strategy are taking place in Malawi, Indonesia, and Nigeria, to cite a few examples (see box 3.1). Similar work is being carried out in Peru (Tropsoils 1985).

NITROGEN-FIXING TREES. The tree species most commonly chosen when the major objective is soil fertility maintenance are from the wide range of leguminous trees or other nitrogen-fixing trees such as *Alnus*, *Leucaena*, or *Acacia* species. These trees have the capacity to provide their own nitrogenous requirements because of symbiotic bacteria that live in nodules on their roots. The bacteria convert atmospheric nitrogen into compounds that plants can use. The nitrogen-fixing trees also benefit trees and crops that grow adjacent to them because their litter adds nitrogen to the soil as it decomposes. In this sense, these trees are directly analogous to annual legume crops commonly grown in temperate countries as green manure for plowing back into the soil. This practice has now largely been replaced with the widespread and large-scale use of chemical fertilizers. Table 3.2 gives an example of sustaining crop productivity using tree-generated nitrogen in Nigeria.

Table 3.2 Using Tree-Generated Nitrogen to Sustain Crop Productivity in Nigeria

		Year				
N rate (kg N/ha)	*Leucaena prunings*	*1979*	*1980*	*1981**	*1982*	*1983*
		(tons/ha)				
0	Removed	—	1.04	0.48	0.61	0.26
0	Retained	2.09	1.91	1.21	2.10	1.92
80	Retained	3.54	3.26	1.89	2.91	3.16

— = not measured

Note: Main season grain yield of maize variety IZPB, alley cropped with *Leucaena leucocephala* on Aponmu loamy sand (Psammentic Ustorthent), as affected by application of *Leucaena* prunings and nitrogen.

* Maize crop seriously affected by drought during early growth.

Source: Kand et al. (1984).

Box 3.1 Trees and Soil Fertility: Malawi, Indonesia, Nigeria

Malawi. Farmers on the southern shores of Lake Malawi were experiencing shortages of timber for construction and fuel, and declining crop yields through loss of soil fertility. They had experience in growing *Eucalyptus* species, but were apprehensive of planting more of this species on their farms because they feared that competition with their annual crops might further decrease yields. The farmers knew about the soil-improving properties of *Acacia albida*, although they had not grown it, and they were interested in, but unfamiliar with, *Leucaena leucocephalla*.

After consultation with the farmers, project planners and the community decided (a) to establish a community *Eucalyptus* woodlot on land set aside exclusively for the production of construction timber, poles, and fuelwood; and (b) to introduce demonstration planting of rows of *A. albida* and *L. leucocephalla* as contour plantings on annual cropland to stabilize and improve soil fertility, and to produce additional fodder, fuelwood, and small timber. After one year, farmers' responses have been very positive, and neighboring farmers are adopting similar agroforestry practices. The combination of minimizing soil erosion, improving moisture infiltration, and adding soil nutrients through leaf fall and mulching material harvested from the trees is expected to stabilize and even improve soil fertility.

Indonesia. In Sitiung, West Sumatra, a team of research specialists in soil science, agronomy, and tree/fodder species is working to devise sustainable farming systems for new settlers in areas of converted tropical forest with low natural soil fertility and high erosion risk. The soils cannot retain their fertility under continual annual cropping as do the soils in the plains of Java, where the settlers come from. While plantation crops such as rubber, oil palm, and coconuts are important in the cropping patterns being developed for the area, farmers must also grow food crops and raise livestock to provide local food supplies and animal traction, and also to spread their risks.

Results of trials using an alley cropping system and contour planting have shown that the incorporation of leguminous trees interspersed in the food cropping areas has a pronounced beneficial effect on preventing soil erosion and inducing better production of food crops. The results indicate that sustainable food cropping can be accomplished on these impoverished soils. A major finding is that the local problem of high aluminum toxicity can be abated by increasing soil organic matter, thereby reducing the need for costly soil amendment measures.

Nigeria. Results of trials by the IITA show that an agroforestry system of alley cropping provides an alternative, low-input soil management technology that can sustain improved food crop production on a continuous basis on soils of low fertility and high susceptibility to erosion typically used for shifting cultivation (one or two years of cropping followed by six or more years of bush fallow).

Using species of *Gliricidia* and *Leucaena* planted as hedgerows has achieved superior yields of interplanted maize, cowpea, and yam crops over the bush fallow system, and the hedgerows produce significant quantities of fodder and wood. The alley cropping system replicates the function of soil recuperation provided by the bush fallow system, but with the added advantages of (a) sustainable annual cropping, (b) higher crop yields, (c) minimized soil erosion, and (d) additional production of fodder, fuelwood, and poles. The IITA is obtaining similar results using cassava and pluvial rice in the cropping system.

From Casey (1985)—Malawi.
Sijarifuddin (1985); Soils Research Institute (1985); Wade (1985)—Indonesia.
Kund et al. (1984)—Nigeria.

The trees also provide benefits similar to those provided by shelterbelt trees, including filtered shade, soil moisture improvement, and soil stabilization, as well as adding to the flow of tree products. The choice of species depends upon the site condition, the farming system, farmers' preferences, and types of product flows needed. Work on nitrogen-fixing trees would benefit from closer collaboration between foresters, agriculturists, and farmers. Some useful references on the subject are National Academy of Sciences (1977, 1979, 1980a) and Rachie (1983). See also chapter 14.

SUBSTITUTING WOOD FOR DUNG AND CROP RESIDUE FUELS. A major way in which farm trees can contribute indirectly to agricultural productivity is by using wood from such trees instead of animal dung and crop residues for household fuel. The dung and residues can then go back into the soil to improve soil structure and fertility. The question is, how much of the available dung and residues needs to go back to the soil? In cases where farmers have a surplus, they should use it for fuel. At present, no hard and fast answers exist, only many interesting questions. For example, besides the general fertility improvement argument of retaining crop residues and dung in the farming system, would the additional humus also help to combat salinity as it has been shown to do in the case of aluminum toxicity in Indonesia (see box 3.1)?

Foresters and others engaged in energy sector assessments have drawn attention to the massive quantities of dung and agricultural residues currently being used as household fuel, and the loss in soil fertility and food crop production that this entails. These disclosures have sparked a debate. Some argue that farmers should continue to use dung and crop residues as fuel and should maintain crop production levels by using chemical fertilizers. A major factor in this argument is that with tropical soils, humus is rapidly lost, and in any event, the nutrient content of dung and residues is relatively low. However, the literature increasingly supports minimum tillage, mulching, and enhancing the moisture-absorbing capacity of tropical soils. It also emphasizes the importance of soil structure in plant growth, and both dung and residues help build structure. This supports retaining dung and crop residues in the farming system, quite apart from any nutrients they may add to the soil. We hope that agriculturalists and livestock specialists who advise farmers will give due consideration to these arguments.

Trees and on-farm soil erosion

Before farmers address the problem of sustainable soil fertility, they may have to deal with the problem of retaining the soil in their fields. Attempting to build up soil fertility makes little sense if a significant proportion of the surface soil containing the plant nutrients is lost through erosion.

In some parts of the world, farmers have planted trees as hedgerows at intervals along the contour to transform a degenerating, shifting cultivation system into a permanent cropping system with increased yields (see box 3.2 for an example). On more gently sloping land than that described in box 3.2, the planting of trees along the contours can have similar, though less dramatic, beneficial effects and avert incipient and long-term loss of soil and fertility.

Trees and Livestock Production

The contribution of trees to livestock production has many facets. Common ones associated with mixed food crop/livestock farming systems concern fodder supply, improved animal management, and animal welfare (see figure 3.3). In addition, more specialized applications have considerable local importance. For example, silk production is a village industry in parts of India and Pakistan. The silkworms feed on the leaves of the mulberry tree *(Morus alba)*, and many small farmers grow their own foliage for rearing silkworms. Much effort has gone into selecting varieties of mulberry that have superior foliage production for this purpose.

Fodder trees

Using trees to produce livestock fodder is important in many areas. Two examples illustrate this point: one from Indonesia, which is representative of farming systems on poor soils in many countries of Southeast Asia, and one from Africa, which is representative of humid regions (box

3.3). These and similar examples from other regions of the world show that tree fodder is more important than agriculturists had previously thought. Indeed, data from some Sahelian and Mediterranean countries indicate that fodder is as important as other forest products in many areas; as much as a third of the fodder consumed comes from trees in these regions.

Box 3.2 Using Trees to Control On-Farm Soil Erosion: Indonesia

In Sikka District, Flores, Indonesia, a process of planting *Leucaena* trees has been successfully implemented on more than 20,000 hectares of highly erodable, steep soils since 1973. This approach was introduced after it had been determined that constructing bench terraces was neither proceeding fast enough nor meeting the farmers' needs. In the program, *Leucaena* was planted as hedgerows on the contour to control erosion and provide animal feed, fixed nitrogen, fertilizer, and fuelwood.

The results of eight years of implementation include the following:

- swidden (shifting cultivation) farmers have become permanent farmers;
- estate crops of cloves, cacao, and coffee have been established on previously unused slopes where the slope angle is more than 30 percent;
- the Batik Weir River has flowed all year around since 1979, after being "dead" in the dry season for more than 50 years;
- floods have been eliminated in Maumere, the district capital;
- crop production between hedgerows has increased because of soil conservation and the use of coppiced herbage for green manure (for example, cassava production increased from 0.7 tons to 2.5 tons per hectare).

From Prussner (1981).

Figure 3.3 Trees and Livestock Productivity

Productivity increases through

Improved animal nutrition

Utilizing above ground space to produce more biomass

Higher volume of production

More nutritious fodder

Fodder in dry season when other farm grown fodder in short supply

Feed for silkworm production

Forage for honeybees

Improved animal management

Controlled grazing using trees as live hedges/fences or posts for fencing

Timber for constructing
- cattle, goat, sheep pens
- handling facilities for dipping, drenching milking
- pig housing
- poultry runs and housing
- rabbit hutches
- bee hives
- fish traps

Improved animal health

Shade from extremes of heat

Protection from cold winds and rain

Box 3.3 Examples of Fodder Trees in the Farming System

Indonesia. Under the government's smallholder livestock development project, which is supported by IFAD, some 50,000 head of the indigenous Bali cattle are being shipped from the cattle-rich provinces in the east and distributed among smallholders in western provinces, where cattle are scarce. Part of the program includes an undertaking by the farmers who receive the cattle to establish adequate fodder supplies.

Rainfall in the eastern provinces is significantly lower than in the western provinces, around 1,100 millimeters annually, compared with 2,000 millimeters annually. Farmers in the eastern provinces grow trees to provide fodder during the dry season, when crop residues and grasses are not available. In the western provinces, despite the higher rainfall, severe drought periods still occur when annual grasses, legumes, and crop residues are insufficient to meet cattle feed requirements. So, the program has organized the production of some 40 tons a year of tree legume seeds by the eastern farmers for distribution to farmers in the western provinces, successfully transferring fodder trees into their farming systems. The species used are mainly *Leucaena leucocephylla* (Cunningham variety) with some *Sesbania* species that, besides being prolific producers of high quality fodder, also improve soil fertility. An interesting feature of this program is that the initiatives taken by the staff of the livestock production department are based on a successful sustainable farming system technology developed in the eastern province during the past 30 years, which is now able to assist development in other provinces.

Africa. The International Livestock Centre for Africa, in collaboration with the IITA, has developed an alley cropping farming system for sustaining small ruminant production in combination with food crop production that is suitable for the humid regions of Africa. Species of *Leucaena* and *Gliricidia* have been used for the hedges that form the alleys. Results of trials are showing a 40 percent increase in maize yield compared to control plots, in addition to high levels of fodder production (equivalent to 2,400 sheep grazing days a hectare a year) and poles.

From International Fund for Agricultural Development (1984)—Indonesia
International Livestock Centre for Africa (1984)—Africa.

Fodder trees and shrubs have an important advantage over fodder grasses and herbaceous legumes; they can tap deep, underground moisture reserves when the upper soil layers have dried out. This means that trees can continue to produce fodder when grasses and annual crops have ceased to grow. For example, during the severe, six-month long dry season in Brazilian savanna areas, cattle obtain as much as 60 percent of their forage from leguminous shrubs and trees (National Academy of Sciences 1977). Furthermore, when certain tree species are used for living fences, an additional benefit is that the harvesting of branches can produce protein-rich fodder and can regulate the phenology by inducing the growth of new branches and leaves without going through the flowering and fruiting stages.

Much more work is needed, involving foresters, livestock specialists, agriculturists, and farmers, to incorporate tree growing effectively into farming and livestock systems by developing a variety of approaches that employ different species from which farmers can choose to suit their particular system. See Le Houerou (1978, 1980, 1987) for comprehensive references of work done on tree fodder crops for dry regions.

The management of fodder trees in agricultural systems can be very flexible. Fodder trees can use above-ground space and farmers can prune and pollard their crowns to control the degree of shade they cast on ground-level crops. If the farmers choose the right species and manage the trees correctly, they can produce large amounts of fodder. For example, annual yields of as much as 20 metric tons of dry matter per hectare have been recorded for *Leucaena* grown in pure stands under good growing conditions (National Academy of Sciences 1979). When intercropped as a hedgerow, with 4 meters between hedgerows in an alley cropping system, dry matter yields ranging from 0.5 to 8.5 metric tons per hectare a year have been recorded (Kand et al. 1984). Some species are very nutritious, for example, dry *Leucaena* contains almost four times as much protein as dry napier (elephant) grass (*Pennisetum purpureum*) and is equivalent or superior to alfalfa or lucerne (*Medicago sativa*) in total digestible nutrients and richer in vitamin A (Prussner 1981). Nitrogen-fixing trees may improve the nitrogen content of associated pastures.

Improving animal management

Almost all types of animal husbandry require the use of wood in one form or another, for livestock housing; for pens for animal handling, such as dipping and drenching, and for milking; and for many other husbandry practices. Of special importance is the enormous gap between the supply of and demand for suitable low-cost material for fencing.

In many parts of the world, it is becoming increasingly evident that an important strategy for improving agricultural production is containment of livestock, particularly goats, sheep, and cattle. In some countries, such as Costa Rica, living fences provide low-cost containment as well as fuelwood and minor forest products from branches. Throughout the world, farmers use poles and posts in fences and other containment structures such as corrals and stalls, where animals are fed with fodder brought in from fields and forest. On-farm production of these materials is often the cheapest method. For a discussion of the relative merits of live fences compared with wooden (posts or stakes) fences, see Budowski (1983).

Improved animal health

Animals in the tropics seek the shelter of trees to escape the extremes of temperature and inclement weather, however, little has been published about the effects of such shelter on productivity. There is evidence of the beneficial effects of shelterbelts on animal productivity in temperate regions (California Department of Conservation 1984). This aspect of trees in relation to livestock productivity can be important, for example, in improving the milk yield of cows and weight gain of beef cattle. Local data from livestock specialists and farmers' experience will guide assessment of its relative importance.

Tree Products for On-Farm Consumption or Sale

Table 3.3 summarizes some of the main tree products for on-farm use and sale. The range of products is enormous, and the listing does not attempt to be all inclusive.

Tree products are not always best produced on farms. In some situations, they may be better produced as more specialized items and marketed through existing channels. At the same time, many situations occur in which they are in short supply, their lack is a constraint to development, and their production on-farm (or on community land) is the most economical and practical approach. In terms of a farming system, the work involved is minimal, little or no financial outlay is involved, and the products are available when and where they are needed without any transport costs. Extra thought given to the choice of species and layout of the tree planting can improve the supply of these products and ensure many of the benefits of shelterbelts and soil fertility enhancement.

Meeting household needs

The most important household use of wood is for fuel (see chapter 4). However, farms need wood for many other critical uses, for example, to maintain housing standards (size and quality) and to build furniture. In many situations, local supplies of favored and durable construction wood have been exhausted. Faster-growing, introduced tree species are not yet particularly popular because their wood lacks durability. This complicates the problem. Farmers and project planners have to weigh the advantages and disadvantages of the long time lag in growing durable, local species, and of the less durable, but quicker-growing, exotic species. A way to help make that choice is to provide access to simple, low-cost technologies for timber preservation, which make the wood of quicker-growing species more durable. However, experience has shown that establishing and popularizing even simple technologies takes considerable expertise backed by sustained programs (Forest Products Research Centre 1975).

Trees produce many kinds of fruits and other food products. Assessment of their importance and interventions to assist in their development should be based on local knowledge. For example, the Indonesian farmer settlers discussed in box 3.3 also obtained planting stock of improved varieties of fruit, nut, and spice trees, including rambutan, citrus, jambolan, jackfruit, durian, mango, banana, coconut, clove, and others. The settlers had a high regard for the species chosen, both for their own consumption as well as for future sales.

The whole question of the contribution of trees to food security is one that has not received adequate attention. Recent work has attempted to provide a framework for looking at the subject (see Arnold and Falconer 1987a,b).

Table 3.3 Tree Products for On-Farm Use and Sale

Household needs	*Farm inputs*	*Off-farm sales*
Timber, poles for house construction, furniture	Poles, stakes for crop growing	Occasional timber trees for furniture, match production, etc., willow for sports equipment
	Shading for light-sensitive field crops	
Fuel for cooking, heating	Timber for hand tools, farm implements, (plows, rakes, cultivators, etc.), carts, product storage	Poles
Fruits, vegetables, nuts, spices	Fuel for processing chewing tobacco, brick making, sugar processing	Pulpwood
		Fuelwood
Medicines	Material for produce handling: bark for binding, foliage for wrapping, materials for crate and basket making	Fodder
Tannins, dyes		Bark for tanning
	Material for constructing foot bridges, revetted waterways, gates for irrigation channels	Gums (edible and nonedible)
		Oils
		Honey, beeswax
		Fruits, leaves

Supplying farm inputs

A vast variety and amount of tree products are needed for on-farm use. A shortage of these products constrains the efficiency of crop production. For example, adequate supplies of poles for yam cultivation in Nigeria and stakes for bean and banana growing in Latin America can increase the productivity of these crops dramatically. In many cases, they are an essential part of the crop-growing technology.

Planning ahead for future needs is also important. A tobacco improvement program in Malawi ran into a local shortage of fuelwood for curing the additional tobacco produced because the planners had omitted consideration of the fuelwood supply. Similarly, an apple production program in India faced a shortage of wood for making boxes for marketing the fruit when the apple trees came into production. Local assessment of supply and demand conditions is essential.

Off-farm sales

Distinguishing between incidental sales of farm-grown wood and farm tree production primarily for sale is useful when looking at the effects of tree growing on agricultural production. For example, most of the wood used to make matches in the northwest frontier province of Pakistan comes from the poplar trees farmers grow along the boundaries of their farms. These trees do not displace other crops. Similarly, in India, a significant volume of wood used to make plywood comes from farm fruit trees, particularly mango, that no longer provide economic returns from fruit production. Cumulatively, these wood supplies are important, both in terms of the farm income they generate and their contribution to the timber supply, but the effect such sales have on agricultural production is not likely to be significant.

More intensive types of farm tree production have direct and different effects on agricultural production. Three examples demonstrate different impacts: tree farming for pulpwood in the Philippines (the Paper Industries Corporation of the Philippines [PICOP] program, see box 5.4); private land reforestation in the Republic of Korea (see box 1.2); and social forestry in Gujarat, India. The Philippine example (PICOP) is more akin to other types of estate crop development, such as smallholder tree growing in Kenya, oil palm production in Malaysia, and rubber production in Indonesia, in which management is centralized and input supply and marketing are included in a closed system.

In the PICOP program, smallholders become tree farmers, undertaking to plant, on the average, 8 to 10 hectares to *Albizzia falcataria* plantations to supply pulpwood to an established industry. In this case, planners made a conscious decision to concentrate farmers' activities on wood production. However, the side benefits to agriculture of such a program could include the benefits shelterbelts provide for other crops and livestock grown on the farm, additional tree fodder or mulching material, and additional fuelwood for domestic use. These are factors to consider when designing such programs.

In the Korean program, a large part of the land planted with trees was steep, marginal land, some of which had been used for annual food crop production. Thus, the immediate effect was some loss in food production. However, crop yields on the marginal slopeland were exceedingly low and productivity gains from improved technology being practiced in the plains food-producing areas more than offset the loss of production on the marginal slopeland. Income-generation programs and marketing channels were in place for oak and pine mushrooms, fruits, nuts, and kudzu fiber for wallpaper that gave hill farmers the income to buy food from the surpluses grown in the plains. Thus, project planners decided to forego annual food crop production on the slopeland for the benefits of sustainable production systems in the hills (where plantings included a sizeable proportion of fruit and nut trees for annual income generation) and, through the watershed effects, more stable farm production in the plains.

Recent experience in India raises broader considerations that affect other countries. The popular response of farmers to plant trees in the Gujarat program, triggered by a strong market demand for poles and firewood, has resulted in some farmers planting eucalyptus species in their fields in place of other crops. However, some agriculturists argue that the eucalyptus could reduce yields of other field crops because of its high demand for water.

Among the ongoing debates about which species of trees should be used in different types of social forestry programs, none is more publicized than the one concerning eucalyptus species. Eucalyptus is criticized both on environmental and social grounds. However, despite the arguments, farmers in many different countries prefer to plant eucalyptus because of its potential for fast growth and quick production of poles and fuelwood. They like its ability to coppice and the fact that its leaves are unpalatable to goats and some other livestock. Since it grows well on a wide variety of sites, including many poor ones, it has an obvious potential for increasing income from poor quality agricultural wastelands that would otherwise remain unproductive.

The social complaints against eucalyptus start when it is planted on higher quality agricultural lands, which has been the case in a number of countries where pole markets are good. The result is a reduction of food crop outputs and, in some cases, reduction of agricultural employment for the landless. Less food production and fewer employment opportunities can spell increased hardship for the rural poor.

Quite a different kind of criticism comes from environmental groups that fear the ecological dangers of monoculture plantations and other negative effects of eucalyptus planting. The arguments against eucalyptus include (Spears 1987):

- its alleged excessive use of nutrients and the fact that eucalyptus species are nonleguminous;
- the negative impact of eucalyptus on the water balance;
- the alleopathic effects of eucalyptus species on some agricultural crops.

Some of these negative effects do occur in some situations. Thus, project planners and farmers should use caution and judgment in choosing a species to meet particular needs and site conditions. Others, which have been studied in some detail (see Poore and Fries 1985; Sharma et al. 1986), have been found to occur only under very specific conditions. Eucalyptus is not universally suited for all planting sites and conditions; and no one has ever advocated its use in all situations. Furthermore, several of the alleged negative effects also result from planting most other species; thus, the initial focus should be on whether or not trees should be introduced in the first place. For example, all trees use nutrients and water from the soil and thus reduce the amounts of nutrients and water available for other crops. In dry areas, the planting of any kind of tree can have a negative effect on the water balance. Species choice comes only after planners have decided whether or not trees fit in a given program.

Some controversies related to the use of eucalyptus remain and need to be given serious attention. For example, questions still remain about the diversion of cropland from food production to forestry, reduction in employment, and the taking over of common lands for eucalyptus growing by richer, more powerful, community members. The reason why eucalyptus is singled out is often because farmers themselves have chosen eucalyptus for planting over other species because of its positive features indicated earlier. From the farmer/entrepreneur's point of view, eucalyptus makes economic sense, while from the point of view of the landless poor, eucalyptus growing by farmers can mean increased hardship and reduced welfare. Land availability and distribution are critical issues that must be addressed, but in most cases, debating the merits and harms of eucalyptus is unlikely to be the most productive way to address these issues.

Strategies for Action: Plains Farmers and Hill Farmers

Experience with farm forestry programs in India, Pakistan, Turkey, and several other countries has revealed significant differences in attitudes toward trees, their management, and their use in farming systems between plains or savanna farmers and hill or forest farmers. Since these differences in perceptions and practices exist in many countries, the implications are likely to be of general interest. The differences stem from markedly different physical circumstances and age-old practices based upon those circumstances. They are important for deciding on approaches to tree planting and social forestry programs.

Among plains farmers, the energy supply system has relied heavily on crop residues and dung as well as some brushwood and lopped branches. In some countries, such systems have persisted for hundreds of years and are very much ingrained into the customs of the people. Fuel usage in the plains is mainly for cooking, and the quantities needed for this purpose are relatively small. Customary cooking methods have been adapted for dung and crop residue fuels. Because of relatively fertile soils that have been periodically replenished by alluvium from the hills, farmers have not seen the need to return all their residues and dung to the soil to maintain fertility. From the farmers' point of view, they have had sufficient fuel and therefore have not developed a strong tradition of planting trees for fuel. However, in some cases, there are sound technical arguments for retaining residues and dung in the farm production system and replacing them with homegrown firewood.

Hill, or upland, farmers have a different attitude toward trees. Traditionally, wood has been the main source of household fuel, for which the annual family requirement is several times that of a plains farm family because of the need for more heat at higher elevations. In addition to wood for fuel, tree foliage has traditionally comprised a significant proportion of cattle fodder. Soils suitable for annual food crops are scarce and often less fertile than in the plains, so that upland farmers value crop residues, dung, and even leaf litter from the forests for their contribution to maintaining the fertility of arable land. The cost of artificial fertilizers is likely to be higher than in the lowlands because of transport costs, thus making tree sources of nutrients even more critical.

A pragmatic approach to influencing farmers to accept changes in their farming systems is to build on their traditions, where necessary attempting to adjust these gradually, without introducing drastic changes.

In the hills, in addition to the farmers themselves being amenable to social forestry strategies, agriculturists who provide the farmers with technical advice on food crops also tend to be amenable to them because they see the soils being depleted. Livestock specialists also support social forestry to help overcome shortages of fodder; and irrigation and hydropower engineers support tree growing because they see expensive installations for irrigation and electricity generation being silted up with waterborne soil sediment, caused in part by poor land use and deforestation. Thus, while the farmers' main objective is self-sufficiency in tree products, other interest groups are likely to be strongly influenced by different objectives. However, all the objectives are valid and demonstrate the multipurpose function of trees when blended into the farming system.

When applied to the plains, the self-sufficiency strategy faces a different set of conditions and problems. In addition to farmers' reluctance to change their customary practices, many agriculturists and irrigation engineers lack the conviction that trees are necessary in farming systems. Agriculturists may place a higher priority on maximizing crop production for food security and see no sense in using valuable, irrigated areas for growing trees. Engineers may support this view and even argue that tree roots may damage the irrigation and drainage canal systems.

Specific arguments, however, support social forestry in the plains. For example, estimates suggest that some 2 million hectares of plains land in the Punjab province of Pakistan can no longer be used for food crop production because of water logging or salination. Foresters believe they can reclaim large parts of this unproductive area by planting suitable species of trees that will lower the water table through a pump-like action of absorbing water through the root systems and transpiring it through the foliage. Work along these lines is being carried out in Uttar Pradesh state in India.

Another example in which a long-established irrigated plains area is moving toward greater use of trees in the farming system is the Gezira scheme area, Sudan. Farmers grow trees primarily as shelterbelts and for much-needed tree products. The shelterbelt effects are estimated to increase the overall output of agricultural crops by at least 20 percent. Because of these benefits, the government is now proposing to increase the original area of some 2,500 hectares of shelterbelts to about 8,500 hectares. Similar uses of trees are found in China and other countries.

The contribution of these types of plains areas to food production is crucial. In Pakistan, for instance, the superior crop yields obtained from HYV food crops in the irrigated plains (which represent only about 25 percent of the food cropping area) provide some 80 percent of that country's food production.

Trees and Land Reclamation for Agriculture

Bangladeshi farmers are using mangrove species to stabilize tidal mudbanks. Indian farmers are using *Terminalia* species to reclaim salinized areas. Indonesian farmers are using *Glyricidia* species to suppress pernicious weed growth. These examples represent the types of initiatives that can have a significant impact on food production.

Under the Mangrove Afforestation Program being implemented by the forest department in Bangladesh, areas of tidal mudbanks that are being formed by the silt deposited by the river systems that discharge into the Bay of Bengal are being stabilized by planting them with mangrove trees. The species chosen are fast growing and adapted to the sites with respect to water levels and soil type. A rotation period of about 20 years is programmed, after which program planners expect that the land to the landward side of the planted mangroves will have dried out sufficiently for use, initially for permanent pasture, and eventually for food crop production. Planners expect to treat subsequent accretions of silt on the seaward side of the mangroves in the same way. Thus, the program addresses three important objectives: reduction in crop losses from existing cropland through stabilization of the coastal environment; additions to forest product flows from the mangrove plantings; and additions to land for agriculture.

In Uttar Pradesh state in India, the forest department is carrying out a program to reclaim land that has gone out of food crop production and grazing because of high soil salinity. Forest department researchers and field staff developed the technology, which consists of planting the salinized areas with saline-tolerant tree species. Examples of species and uses include *Albizzia labeck* (timber, fodder), *Prosopis guliflora* (fuelwood), *Pongamia pinnata* (oil from seeds), and *Terminalia arjuna* (foliage to feed silkworms). Income-generating activity can thus be established a few years after the trees are planted. The expectation is that after about 25 years, the salinity of some of the area will be sufficiently reduced to enable a return to food crop production (Ljungman 1985; Govil 1987).

In Indonesia, the corporation responsible for forestry in Java, Perum Perhutani, has established the use of *Glyricidia* species as an outside protection belt to its commercial forest plantations with a dual objective, first, to shade out the rampant growth of alang alang grass (*Imperata cylindrica*), which is regarded as a pernicious weed and a great fire risk (it carries ground fire into the plantations during the dry season); and second, to provide local farmers with foliage for cattle fodder and fuelwood from controlled coppicing and pollarding of the *Glyricidia* (Perum Perhutani 1982).

The foregoing are examples in which project and program planners have used local knowledge and local expertise to adapt the use of trees in close relationship with agriculture for the benefit of both forestry and agriculture. Many other examples are cited in the literature (FAO 1974; CATIE 1979, 1984; Burley 1980a; MacDonald 1982; ICRAF 1986a; IDRC various). Although these systems are difficult to transfer directly from one country to another, they show what social forestry programs can do.

Avoiding Adverse Effects of Trees on Crops

Concluding this chapter without pointing out some situations in which tree growing can adversely affect food crop production if appropriate measures are not taken would be misleading. A clear case is where cropping practices require land to be fully cleared of vegetation to facilitate mechanical cultivation, crop protection (including both ground operations and aerial spraying), and harvesting. Even then the planting of trees in rows or shelterbelts can be a valuable addition to the farming system, provided they are judiciously spaced and the species selected have crown and rooting characteristics that do not impair crop growth.

Another major concern to farmers is when forest land adjacent to cropland is left in its natural state and continues to serve as a habitat for wildlife that damage crops. This can be a problem of disastrous proportions for farmers who lose their entire crop. It is a particular problem in newly settled areas in which a balance of sharing the natural resources between the human and wildlife populations is still evolving. In these circumstances, farmers have an antipathy toward trees, blaming the forests for sheltering the wildlife that cause the damage.

Unfortunately, no quick solution exists. Clearing the forest in the belief that this will solve the problem is not an effective option; natural regrowth of scrub vegetation will quickly provide a habitat for the wildlife, particularly wild pigs and rats that cause much crop damage. A more effective, sustainable approach is to change the management system in the forest immediately adjacent to the cropland so that the forest floor is maintained in a cleared condition, thus robbing the wildlife of ground cover. This creates a buffer strip that separates the wildlife area from the settled area. Other appropriate measures can be introduced—fencing, ditching, trapping, and so on—in combination with a sensible program of wildlife culling, reducing animal numbers to the carrying capacity of their smaller habitat. This approach is being used in the Upang Delta in south Sumatra, Indonesia, where researchers are working with field practioners and farmers to solve a problem of this type.

Other ways in which trees may reduce crop yields, such as casting too much shade, competing for limited soil moisture and nutrients, toxic effects of leaf fall, and occupying too much ground space, are usually solvable by judicious siting and spacing, selecting suitable tree species, and following appropriate tree management practices such as pruning, coppicing, and pollarding.

None of these disadvantages justify outright rejection of trees within the farming system. Rather, social foresters, governments, project planners, and farmers should always ask: "How can trees most effectively be used to improve the overall farming system in terms of its sustainability, to increase its capital worth and productivity, and to spread farmers' risks?" This area of study has so far received insufficient attention in developing countries because it falls between the disciplines of forestry, agronomy, and animal husbandry. Now is the time for specialists in these three fields to broaden their knowledge of farm forestry practices so that they can guide farmers constructively in this task. In this respect, agroforestry work being carried out in combination with participating countries, for example, by CATIE, ICRAF, IITA, and the Tropsoils program is very encouraging, and these research centers are now disseminating improved knowledge.

Summing Up

The judicious blending of trees into farming systems can materially benefit crop and livestock production and has important implications for food security. First, stabilizing the micro-environment at the farm level provides the basis for sustained agricultural production. Second, trees and their products can be managed to obtain increases in crop yields through their shelter and fertilizer effects. Third, farm-grown trees are likely to be the least-cost source of a wide array of household supplies and essential farm inputs to maintain existing output and to advance crop and livestock technology. Finally, income generation from trees may add stability to a farm's cash flow and thereby contribute to its continuation as a food production system.

4

SOCIAL FORESTRY AND THE FUELWOOD CRISIS

This chapter discusses the contribution of fuelwood to total energy used. It emphasizes assessment of present energy usage to provide a basis for projecting the most likely energy supply sources for the foreseeable future. From these data, priorities can be apportioned to the various energy sources, including fuelwood, within a framework that attempts to give due consideration to the effects of using alternative energy sources on economic activity, on people's welfare, and on the stability of the environment. The contribution that social forestry can make to the future fuelwood supply can then be defined more clearly.

The chapter also covers the potential for reducing fuelwood demand through the introduction of more efficient stoves. Past programs are reviewed, their weaknesses highlighted, and suggestions made for future program orientation.

Fuelwood Supply and Consumption

Fuelwood production is the main objective of most social forestry programs. Environmental instability and the growing shortage of fuelwood are closely linked in many countries. Thus, steps taken to improve environmental stability and encourage sustainable farming systems through the introduction of trees should also help solve the problem of fuelwood shortages. A review of the relative importance of fuelwood in comparison with the total energy currently used in different countries and estimated usage patterns for the next two decades puts the situation into perspective.

Fuelwood in the energy balance

Wood is the major source of energy in rural areas of the developing world, both for domestic uses and for use in small-scale, traditional industries, such as baking, pottery making, and coffee and tobacco drying. In some areas, particularly in towns and cities, fossil fuels such as oil, kerosene, and electric energy compete with wood and charcoal as sources of energy.

GLOBAL FUELWOOD SUPPLY. In August 1981, the FAO prepared a comprehensive review of the status of fuelwood supplies in developing countries for the United Nations Conference on New and Renewable Energy (FAO 1981). This is in the form of a map that shows the status of supplies in developing countries according to six categories, ranging from abundance to desperate shortage. Some countries have areas in a number of categories. A follow-up FAO report provides more detail on a regional basis (FAO 1982a).

The two reports highlight the existence of an alarming number of deficit situations. Even more disturbing is the prediction of an enormous growth in deficit situations in the future unless urgent corrective actions are taken. The reports' main findings were:

- In 1980, 2,000 million people in developing countries were dependent on fuelwood.
- Of this number, some 100 million were experiencing acute fuelwood scarcity and were unable to obtain the minimum fuel required for cooking and heating, which was a significant factor in perpetuating their poverty.
- An additional 1,050 million people did not have access to sufficient supplies of fuelwood and were facing fuelwood shortages.

• By the year 2000, the number of people in situations of acute shortages will increase to 2,400 million unless major action is taken to improve the management of existing wood resources, and at the same time to increase reforestation and tree planting on farms substantially.

Despite this crisis, farmers will probably not grow trees solely for fuelwood except in special cases. Also, natural forests are rarely, if ever, managed solely for fuelwood production, and in only a few cases have plantations been established solely for fuelwood. Therefore, production of most of the additional fuelwood in combination with other forest products is more likely. Those working in the field of energy must bear this in mind when considering the different options for increasing fuelwood supplies.

COUNTRY SITUATIONS. In 1980, UNDP and the World Bank began a program of energy sector assessments to help governments in 60 countries evaluate their main energy issues and options. The results of these assessments for the first 30 countries analyzed are summarized in an UNDP/World Bank report (FAO/World Bank 1984). Tables 4.1 and 4.2 present some of the important data to illustrate the present contribution of fuelwood to the total energy supplies of those countries and the expected contribution of fuelwood in the future. Table 4.2 also includes details of the fuelwood supply categories as defined in the 1981 FAO report.

As a large proportion of the fuelwood used is noncommercial and no records of production or statistics on imports exist, consumption data must be estimated. A good deal of work has been done during the past ten years to assemble reliable data for estimating consumption. Many of these data have been incorporated in the regional estimates of fuelwood use contained in the 1981 FAO report. Table 4.3 summarizes the estimated per capita consumption by region given in that report.

RELIANCE ON FUELWOOD. The data demonstrate the enormous importance of fuelwood on a regional and country basis. Of the 30 countries listed in tables 4.1 and 4.2, 28 rely heavily on fuelwood. In 19 countries, fuelwood contributes 50 tc 95 percent of the total energy used, and between 20 and 50 percent of the total used in 9 countries. In many other countries not included in the survey, fuelwood also makes up a high proportion of total energy used; for example, 32 percent in India, 30 percent in Thailand, and 40 percent in the Philippines. The results of the energy sector assessments for these and other countries have not been published yet, and the discussion here is confined to the data included in the tables because these provide a firmer basis for examining the importance of fuelwood.

Even in the four countries listed in the tables as net exporters of fossil fuels (or commercial energy), fuelwood still constitutes a significant proportion of the total energy used: in Bolivia, 42 percent; Indonesia, 34 percent; Nigeria, 59 percent; and Peru, 26 percent. Moreover, fuelwood-deficit situations have occurred in areas within these countries (see table 4.2).

Most of the fuelwood used is for household energy. In the case of rural families, fuelwood is collected mainly by the users and does not enter the cash economy. For example, of the estimated 51 million cubic meters of fuelwood used annually in Nigeria, some 46 million cubic meters are used in the rural areas and are collected mainly by the users. Only about 5 million cubic meters are marketed in urban areas. The small proportion that enters the cash economy usually does so through informal marketing arrangements, with small, independent producers selling to wholesalers, who in turn sell to retailers for distribution in smaller bundles. Many of these small producers are rural people with very low incomes who are anxious to earn cash. Their concern is for immediate needs. Whether they have obtained the fuelwood from farmland, common land, or government forests, whether the removals were legal or unauthorized, their activities have proceeded with little official attention. To a large extent, this explains why energy planners did not recognize the importance of fuelwood sooner and why past programs for energy development have largely neglected fuelwood.

Table 4.1 Net Supply of and Demand for Energy in 30 Developing Countries

Country	Population (millions)	Year of assessment	Cost of imported energy as percentage of foreign exchange earnings	Thousand metric tons of oil equivalent: Fossil fuels	Electricity	Subtotal	Wood and charcoal	Agricultural residues, dung bagasse	Subtotal	Estimated total supply/demand	Biomass as percentage of total supply/demand
Bangladesh	90.0	1979/80	60	2,092	115	2,207	over 66 percent of total		4,413	6,620	66
Bolivia	5.7	1981	net exporter	1,130	124	1,254	765	126	891	2,145	42
Burundi	4.2	1980	n.a.	36	12	48	about 92 percent of total		592	640	93
Costa Rica	2.3	1981	23	682	182	864	441	128	569	1,433	40
Ethiopia	32.0	1982	n.a.	520	64	584	3,060	4,372	7,432	8,016	93
Fiji	0.65	1982	n.a.	194	46	240	73	244	317	557	57
The Gambia	0.6	1982	22 to 70	44	3	47	125	2	127	174	73
Haiti	5.0	1979	23 to 29	207	16	223	873	64	937	1,160	81
Indonesia	150.0	1979/80	net exporter	20,709	1,337	22,046	11,525 [a]	n.a.	11,525	33,571	34
Kenya	16.6	1979	36 to 57	1,302	117	1,419	n.a. 4,700	n.a.	4,700	6,119	77
Lesotho	1.4	1981	12	111	22	133	n.a. 168	n.a.	168	301	56
Malawi	6.2	1980	n.a.	178	30	208	3,029	83	3,112	3,320	94
Mauritius	1.0	1979	16	169	5	174	n.a.	204	204	378	54
Morocco	21.3	1981	40	3,069	1,171	4,240	2,362	n.a.	2,362	6,602	36
Nepal	15.0	1980/81	n.a.	155	13	168	2,723	84	2,807	2,975	94
Niger	5.8	1981	31	115	22	137	827	n.a.	827	964	86
Nigeria	87.0	1980	net exporter	8,226	402	8,628	12,245 [a]	n.a.	12,245	20,873	59
Papua New Guinea	3.0	1980	24	371	102	473	n.a. 434	n.a.	434	907	48
Peru	17.0	1981	net exporter	5,812	2,274	8,086	n.a. 3,155	n.a.	3,155	11,241	28
Portugal	10.0	1982	30	7,671	1,323	8,994	515 [a]		515	9,509	5
Rwanda	5.0	1979	10	46	13	59	776	170	946	1,005	94
Senegal	6.0	1981	50	551	47	598	961	120	1,081	1,679	64
Seychelles	0.01	1982	42	16	4	20	2	1	3	23	13
Solomon Islands	0.02	1981	n.a.	33	1	34	46	26	72	106	68
Sri Lanka	15.0	1980	33	1,090	120	1,210	2,040	n.a.	2,040	3,250	63
Sudan	19.0	1981	n.a.	1,033	60	1,093	4,529	526	5,055	6,148	82
Turkey	45.0	1980	50+	18,000	5,200	23,200	4,700	2,500	7,200	30,400	24
Uganda	13.0	1980	n.a.	213	21	234	4,222	n.a.	4,222	4,456	95
Zambia	5.7	1980/81	19	1,070	1,390	2,460	2,000	32	2,032	4,492	45
Zimbabwe	7.0	1980	23	2,168	1,687	3,855	1,645	n.a.	1,645	5,500	30

n.a. = not available

Note: Figures exclude transformation and energy losses.

a. Estimated on basis of World Bank and FAO reports as follows:

Indonesia:	estimated fuelwood consumption:	48	million cubic meters (x.7)	=	33.6	million metric tons (x0.343)	=	11.525	million tons of oil equivalent
Lesotho:	estimated fuelwood consumption:	0.7	million cubic meters (x.7)	=	0.49	million metric tons (x0.343)	=	0.168	million tons of oil equivalent
Nigeria:	estimated fuelwood consumption:	51	million cubic meters (x.7)	=	35.7	million metric tons (x0.343)	=	12.245	million tons of oil equivalent
Portugal:	estimated fuelwood consumptionn:			=	1.5	million metric tons (x0.343)	=	0.515	million tons of oil equivalent

Source: UNDP/World Bank (1984).

Table 4.2 Fuelwood Supply Situation and Recommended Action in 30 Developing Countries

Country	FAO [a] fuelwood classification	Situation	Recommended action
Bangladesh	4	Large-scale depletion of existing forests. Fuelwood prices increased by 22% a year, 1971 to 1978	Large-scale reforestation and tree planting. Improved charcoal and fuelwood usage.
Bolivia	1,4,5	Huge deficit in Altiplano area causing widespread soil degradation.	Reforestation essential for energy and stability of farming systems.
Burundi	5	Principle issue is rapidly dwindling supply of fuelwood.	Concentrate on fuelwood supply by reforestation and conservation by improved utilization.
Costa Rica	2	Possible shift to increased fuelwood for household and industry but alarming rate of deforestation.	Better management of existing forests and reforestation, including private forestry.
Ethiopia	4,5,6	Deforestation for fuel biggest issue facing country.	Reforestation and farm tree planting is key to future economic survival.
Fiji	—	Energy Department successful in developing improved household wood and charcoal stoves.	
The Gambia	—	Not assessed. Bilateral assisted reforestation projects making progress.	
Haiti	5	Depletion of forests threatens long-term productive capacity of nation.	Determined reforestation and tree planting programs imperative.
Indonesia	1,2,3,4	Not assessed.	
Kenya	4,6	Forests being overexploited by about four times sustainable growth for fuelwood.	Reforestation and tree planting should be increased by five times present rate.
Lesotho	5	Fuelwood currently only viable alternative to imported fuelwood.	Despite harsh growing conditions, reforestation should be given higher priority.
Malawi	4	Fuelwood consumption greater than sustainable supply.	Government initiatives for reforestation, farm tree planting and improved utilization should be fully supported.
Mauritius	4	Not assessed.	
Morocco	2,3,6	Severe problem of forests being exploited by three times sustainable fuelwood production.	Increase in rate of reforestation and improved management of exiting forests.
Nepal	4,5	Fuelwood shortages in all districts.	Highest priority is for reforestation and improved management of existing forests.
Niger	3,4,5,6	Severe shortage of fuelwood causing massive overexploitation of forest particularly near population centers.	Imperative to expand reforestation, improve management of existing forests and utilization of fuelwood for energy.
Nigeria	2,4,5	Shortage of fuelwood serious problem throughout country with severe imbalances in northern states.	Wood predominant domestic energy source for 80% of population. Vigorous programs for farm and community forestry and improved utilization.
Papua New Guinea	1	Eighty percent of total population is rural but consumes only 1 percent of commercial energy.	Supply does not appear to be a problem.
Peru	1,4,5	Sixty percent of households use mainly wood for cooking; forests being depleted.	Vigorous acceleration of reforestation to bring supply into balance with demand.
Portugal	—	Not assessed.	Significant potential for increasing use of wood residues.
Rwanda	4,5	Severe shortage of fuelwood. Fuelwood expected to provide over 50% of total energy in forseeable future.	First priority is to strengthen program for reforestation, agroforestry, better forest management, and wood utilization.
Senegal	4,6	Overexploitation of forests for fuelwood has resulted in loss of 90% of forest area.	Essential to expand reforestation and improve management of existing forests and wood utilization.
Seychelles	—	Biomass regarded as the only feasible domestic alternative to imported oil.	Working out technical and economic approaches should be addressed.
Solomon Islands	—	Same local supply problems, but not critical.	Important to strengthen reforestation extension and management of natural forest. Possible use of wood for power generation.
Sri Lanka	4	Large proportion of fuelwood derived from denudation of forests.	Expansion of reforestation and improved wood utilization.
Sudan	1,3,6	Existing forest resources rapidly declining and causing localized shortages for fuelwood.	Urgent measures necessary to improve management of existing forests; for reforestation; farm forestry; community woodlots; better wood utilization.

Table 4.2 (continued)

Country	FAO [a] fuelwood classification	Situation	Recommended action
Turkey	2,3,5	Demand for fuelwood expected to grow at 14% a year to 1990.	High priority be given to improved management for increased production of existing forests, energy plantation and village woodlots.
Uganda	4	Forest capital being eroded and local fuelwood supplies nearly exhausted in some areas.	Major emphasis on fuelwood production for industrial and household use. High priority to improved management of existing forests, fuelwood plantations, farm forestry, and better utilization.
Zambia	4	Fuelwood expected to continue to be major household energy for some years, local excessive fuelwood cutting leading to widespread deforestation.	Improved management of savanna woodlands, fuelwood plantation, farm forestry, and improved wood utilization.
Zimbabwe	3	Fuelwood most important source of urban and rural household energy; forest resources depleted to critical levels in some areas.	Afforestation in wood deficit areas.

a. Classification 1: Satisfactory situation; resources considerably exceed present and forseeable needs.
Classification 2: Satisfactory situation, but decreasing resources could become inadequate, at least locally in forseeable future.
Classification 3: Prospective deficit; present resources higher than requirements, but evolving toward crisis situation in year 2000.
Classification 4: Deficit situation; present resources below requirements obliging population to overexploit.
Classification 5: Acute scarcity; resources so reduced that population no longer able to ensure minimum supply.
Classification 6: Desert and arid areas in scarcity situation with few resources and low population.

Source: FAO (1981); FAO/World Bank (1984).

Table 4.3 Estimated Household Fuelwood Requirements in Developing Countries by Region

Region	Population (1980) (millions)			Percentage of fuelwood in total domestic energy		Present fuelwood needs including charcoal (cubic meters/person/year)		Estimated fuelwood used in 1980 (million cubic meters)	Forecast net increase in total fuelwood requirements by year 2000 (percent)
	Urban	Rural	Total	Urban	Rural	Urban	Rural		
Africa, south of the Sahara	32	288	320	67 to 75	90 to 98	0.7 to 1.4	1.0 to 1.9	376	66
North Africa and the Middle East	56	104	160	n.a.	n.a.			9	
Egypt, Jordan, Lebanon, Syria						0.01 to 0.02	0.05 to 0.1		32
Algeria, Iraq, Morocco, Tunisia, Turkey						0.1	0.5 to 0.8		47
Asia and tropical Far East [a]	160	1,036	1,196	15 to 20	30 to 86			570	57
Desert and subdesert areas							0.3 to 0.5		
Dry tropical zones							0.2 to 0.8		
Moist tropical zones							0.3 to 0.9		
Shifting agriculture in moist forest							0.9 to 1.3		
Mountainous regions							1.2 to 1.8		
Latin American & Caribbean	137	223	360					285	over 50
Hot region				n.a.	50 to 60		0.5 to 0.9		
Temperate region				n.a.	55 to 65		0.7 to 1.2		
Cold region				n.a.	50 to 65		0.9 to 1.6		
			2,036					1,240	

Average consumption 0.62 cubic meters per capita per year

n.a. = not available
a. Excludes China.

Source: FAO (1981).

Constraints on fuelwood substitution

Another major reason for the neglect of fuelwood in energy development programs has been a strong presumption on the part of energy planners that family incomes would increase as a result of national development programs. They also assumed that as in all developed countries, more modern forms of energy, such as oil, liquid petroleum gas (LPG), electricity, and coal, would be substituted for wood. This view is proving to be wrong in many countries, mainly because of the costs involved. All the fuelwood substitutes require cash payment or are higher priced per unit of energy. Besides the cost of the energy used, users must buy and maintain household appliances that use these energy sources.

An approximation of the implications of substituting fuelwood with other forms of commercial energy, both in terms of the foreign exchange required for purchasing the alternative energy and the additional household expenditures, is presented in box 4.1. The calculations are based on the FAO data summarized in table 4.3 and the data used to calculate comparative fuel coefficients in table 4.1. The calculations are indicative only and may not portray the actual situation. They depend on assumptions about the availability of products, the existence of distribution networks for energy supplies, and prices. Still, they help to demonstrate in a global context the enormous additional foreign exchange costs and household expenditures involved. Assuming oil could be used to replace all fuelwood, the additional foreign exchange needed to cover procurements would be approximately US$30,000 million a year. At the household level, assuming kerosene could be substituted for wood, the increase in expenditures for minimum energy needs might be between US$44 and US$100 a year per household. The prospects of financing additional costs of these magnitudes are not promising.

An indication of expenditures for energy supplies by various countries, expressed as a percentage of total foreign exchange expenditure, is given in table 4.1. The percentages range from 12 to 70 percent. These data demonstrate the heavy strain on the foreign exchange available to these countries, even at present levels of imported commercial energy. Even those countries that are net exporters of commercial energy would face great difficulties in switching exports to domestic consumption because their trade balances rely heavily on maintaining foreign exchange earnings from exported energy.

An equally difficult problem is seeing how household incomes could be increased to enable families who now collect their wood energy supplies for free to switch to purchased energy. The majority of these households are in the lowest income brackets in their countries with limited prospects of substantially increasing their cash incomes, either from farm income or paid employment. So, expecting households to pay some US $100 per year for purchased energy is unreasonable. A more realistic expectation would be a gradual shift in household energy use, with families adopting commercial energy, such as electricity, kerosene, and LPG, on a selective and limited scale, with fuelwood meeting the bulk of energy requirements for the foreseeable future. A gradual change of this type would also be more realistic with respect to the expansion of public and private agencies responsible for producing and distributing commercial energy. Especially in rural areas, distribution is usually unreliable.

Developing commercial energy alternatives

None of the thirty countries listed in table 4.1 has surplus capacity to produce commercial energy. Most have programs to develop various types of domestic energy supplies, including expanding hydropower and increasing the production and/or processing of domestic oil, LPG, natural gas, coal, peat, and energy derivatives from these sources. These energy development programs emphasize meeting commercial demand to support economic activity. They are a heavy burden on the financial resources available for investment. Given the already high allocation of funds for commercial energy investment, many countries are unlikely to be able to expand these programs further to provide a significant contribution to fuelwood substitution in the short term, particularly in view of the inability of many domestic users to pay for commercial energy sources.

The recommendations for fuelwood to balance national energy supplies and demands, as shown in table 4.2, are formulated against this background. With respect to the fuelwood supply situation, of the 26 countries assessed, only two—Fiji and Papua New Guinea—were found to be in a satisfactory position. The other 24 countries face deficit situations ranging from local shortages to countrywide deficits. For the four countries that were not assessed, FAO data show that three of these—The Gambia, Mauritius, and parts of Indonesia—are in a fuelwood-deficit situation.

Box 4.1 Costs of Fuelwood Substitution in Developing Countries

Noncommercial fuelwood use

Two thousand million people use 1,240 million cubic meters of fuelwood as their main source of energy, of which approximately 80 percent is collected by users (noncommercial). Therefore, some 992 million cubic meters (x 0.7), or 694 million metric tons of noncommercial woodfuel are used.

Additional foreign exchange costs if oil is substituted.

On the average, 1 metric ton of fuelwood has the energy equivalent of 0.343 tons of oil or 7.33 barrels of oil. Then

694 million metric tons of fuelwood x 0.343 = 238 million metric tons of oil equivalent

694 million metric tons of fuelwood x 7.33 = 1,745 million barrels of oil equivalent

At US$18/barrel, the result is US$31,400 million/year additional foreign exchange outlay (assuming all oil is imported)

Additional cash outlays by rural families if kerosene is substituted.

Average quantity fuelwood consumed per family = 3.1 cubic meters/year or 2.17 metric tons

Assume
1 ton of wood has 3.5 million kilocalories (Kcal), burnt at 7.5 percent efficiency = 262,500 Kcal

Assume
1 liter kerosene has 8,300 million Kcal, burnt at 35 percent efficiency = 2,900 Kcal

Then
1 metric ton of fuelwood = 90.5 liters of kerosene
2.17 metric tons of fuelwood = 196 liters of kerosene

At US$0.20-0.40/liter, the cost is US$39-78/year/family
Plus estimated cost of cooking/heating appliance = US$5-22/year/family
Thus total cost is US$44-100/year/family, or US$9-20/capita/year

Notes:

1. Estimated per capita fuelwood consumption is 0.62 cubic meters/year (see table 4.3).
2. Costs highly sensitive to international oil price.
3. Cost of transformation and loss from crude oil to usable domestic energy not included.
4. Conversion factors for comparing wood with oil and kerosene are those commonly used in energy assessments.

The recommended actions, which take into account future options for developing commercial energy supplies such as coal, oil, natural gas, and electricity, strongly favor increasing fuelwood supplies for the 24 countries in deficit situations. Indeed, securing adequate supplies of fuelwood is as imperative for future economic survival in countries such as Ethiopia, Haiti, Lesotho, Nepal, Niger, Rwanda, Senegal, the Seychelles, Sudan, and Uganda. Recommendations are also made for some countries to develop fuelwood for industrial energy as well as for household needs. The recommendations for increasing supplies include farm forestry, improving the management of existing forests and woodlands to increase their productivity, and establishing new plantations, both public and private. Another important aspect that the assessment highlights is achieving savings in fuelwood consumption by promoting improved methods of charcoal production and more efficient stoves.

Other renewable energy sources

The potential contribution of other renewable energy sources—wind, solar, and biogas—were also evaluated as part of the energy assessments for the 30 countries studied. The study revealed that generally, these alternative sources could not be expected to make a significant impact on future energy supplies, particularly for household energy. This is partly because, at the present stage of technology, the capital and maintenance cost of the equipment needed is beyond the capability of most potential users, and partly because of the unreliability of these sources for sustainable energy supplies. Their use is more appropriate for larger users who can afford the capital and upkeep costs and who can use these sources to supplement existing commercial energy sources. While these other renewable energy sources can be important locally, they are not expected to contribute significantly to total commercial energy supplies.

Contribution of social forestry to energy supplies

Thus, as demonstrated, fuelwood provides the most realistic option for meeting a significant proportion of the energy demand in the foreseeable future, both globally and regionally. By far the greater part of the fuelwood demand will come from rural households. Therefore, promoting social forestry programs that increase fuelwood production for rural use, but that will also contribute to an environmental balance, makes good sense. Better management of existing forests and woodlands to increase their total productivity, and thereby the proportion of small-dimension timber and forest residues suitable for fuelwood, can play an important part. So too can fuelwood plantations if satisfactory marketing arrangements can be set up. However, most users of fuelwood will be farm families. Their efforts to grow sufficient trees to meet their own requirements and to generate surpluses for sale are likely to be the key to solving the fuelwood problem.

As indicated in chapter 3, farmers view farm forestry as an activity with a number of objectives, with fuelwood production being only one of the benefits of tree growing. Therefore, securing greater participation of farmers in fuelwood production will involve taking into account the wider use of trees in the farming systems as perceived and understood by farmers.

Planners involved in social forestry projects to supply energy should view fuelwood as a valuable energy source and not as an inferior fuel tied to the fuelwood-poverty syndrome. This point is important because, where energy-deficit situations exist, a negative attitude toward fuelwood makes the situation worse.

Governments must evaluate the relative importance of fuelwood in their total energy use and then decide, on the basis of empirical evidence, what programs they need to ensure adequate future supplies. There is simply no place for derogatory attitudes toward fuelwood. Whether fuelwood can or should be replaced by other energy sources then becomes a question of evaluating the availability and relative costs of the alternatives, and developing realistic investment programs for each type of energy. This was done by the energy assessment teams working with in-country specialists in 26 of the countries listed in table 4.1. In every one of these assessments, fuelwood emerged as a valuable energy source that countries must rely on for its current and foreseeable contribution to the total energy supply.

The World Bank's Energy Department has prepared a *Household Energy Handbook* that provides a guide for household energy assessment. In addition to providing much basic data on household energy consumption and supplies, the handbook describes methodologies for estimating supply and demand trends and preparing overall assessments (World Bank 1986e).

Urban and rural fuelwood users

A practical step in assessing how social forestry can be used as part of a strategy to improve the energy situation is to distinguish between urban and rural fuelwood use. The differences occur with respect to the type of fuelwood used, the supply source, the incidence of traded fuelwood, and the potential for substitution, as indicated in table 4.4.

Table 4.4 Differences in Fuelwood Use in Rural and Urban Areas

Item	*Rural*	*Urban*
Type of fuel	Mainly twigs, branches, leaves, dung, and agricultural crop waste	Fuelwood and charcoal
Burning apparatus	Improved or efficient stoves may be rare	Stoves commonly used
Supply source	Mainly collected locally	Both local and widely dispersed
Commercially traded	Generally not	Generally so
Substitution by other energy	Limited potential because of supply problems and lack of cash incomes to purchase fuel	Possibly large potential, depending on relative prices of other energy sources

RURAL USERS. For rural people, social forestry has great potential for expanding the fuelwood supply. Measures that can have an immediate effect on improving the supply include the following:

- increasing the production of natural forest and woodlands through improved management systems;
- convincing farmers to include more fast-growing trees and shrubs in their farming systems and to use coppicing systems for early yields to meet their energy needs;
- in the longer term, working out programs with local populations to sustain fuelwood supplies, taking into account their other requirements for tree products, including (a) incorporating more trees that yield fuelwood in farming systems; (b) planting road, rail, and canal reserves with multipurpose tree species, either individually or jointly owned; and (c) encouraging community plantations, where appropriate (for example, tree blocks on public land, in unproductive forest reserves, and on the grounds of schools and other public buildings).

To the energy planner, these approaches may seem to be an untidy way of tackling the fuelwood supply problem because they mix fuelwood with other tree products. However, while rural people agree to plant and manage trees solely for fuelwood production in some situations fuelwood has traditionally been a by-product of growing trees for more than one purpose since, in the majority of fuelwood-deficit situations, other forest products are also in short supply. Therefore, while these strategies may appear to be second-best solutions, they are likely to secure the best results in initial programs to rectify deficit situations in rural areas. Only when the demand/supply situation has stabilized for various forest products—timber, poles, fodder, food, fuelwood—will it become possible to introduce specific management systems for a particular product, such as fuelwood.

URBAN USERS. For urban people, the potential of social forestry to expand the fuelwood supply is closely linked to the cash income that rural families can generate by growing, collecting, and selling fuelwood and charcoal. Indeed, in most countries, the generation of rural cash income is the main motivation that provides fuelwood to urban markets. The market traders and transport contractors who supply urban fuelwood would turn to other business activities if fuelwood ceased to be traded, but the rural families who cut and gather fuelwood have few, if any, alternative job opportunities. Thus, their motivation to continue the trade is strong. Unfortunately, the uncontrolled exploitation of forest and tree resources for fuelwood is proceeding without regard to sustainability in many countries. In Africa this is one of the main causes of desertification (World Bank 1985d).

Once energy planners recognize that fuelwood can make a continuing contribution to urban energy supplies, they will realize the importance of planning to safeguard future fuelwood resources. They can then use social forestry programs as part of the strategy to help achieve sustainable future supplies through the incentive of creating sustainable rural income-generation opportunities.

Rural communities could become much more actively involved with the forests that exist near them. For example, local people could be authorized to exploit specific areas for fuelwood on the clear understanding that they must maintain tree capital stocks to ensure sustainability of supply. They could then be expected to assist substantially in preventing indiscriminate removals because these would threaten their livelihood. At the same time, they would be subject to the supervision that forest departments usually carry out for all exploitation activities in public forests and woodlands. This approach is an essential element in the success of Korea's forestry program, in which the local village forestry association has substantial rights over the forest product flows, but is also obliged to maintain the capital stocks. It is also an integral part of the strategy being developed in the Nepal forestry program, whereby local (panchayat) council members are delegated authority for the proper management of selected forests within their jurisdiction under the technical guidance of the state forest service.

Farm forestry and community tree blocks can also have a large potential for sustained urban fuelwood supplies. For example, in Yogyakarta, Indonesia, small farmers regularly supply bundles of fuelwood produced on their land to well-established markets, food processing industries, restaurants, and lime-burning and brickmaking industries, as well as to households. The same is true in several Central American countries. In many countries, however, the development of this type of supply is being hampered because of the uncontrolled or poorly controlled exploitation of natural forests and woodlands. The fuelwood is either collected without cash payment or the price for collection is set so low that farmers have no incentive to grow fuelwood to sell. The result is that the capital stocks of the natural forests are being liquidated and farmers are not establishing fuelwood plantings. In circumstances like these, a first step is to stabilize fuelwood flows from natural forests at prices that reflect the cost of producing replacement supplies at the anticipated volumes required by the market. Planners must then decide what proportion of the future supply should be produced in state forests or on large commercial plantations, what proportion farmers should be encouraged to grow, and what type of social forestry program would be needed to help them do so. This is the approach being taken in the Malawi forestry program, where three strategies are being implemented concurrently (box 4.2).

Commercial fuelwood plantations

Although this book does not deal with commercial forestry, commercial fuelwood plantations are considered briefly to balance the discussion of energy options and to demonstrate a possible linkage with social forestry.

During the period of rapid increases in oil prices in the 1970s, governments emphasized commercial fuelwood plantations to reduce dependence on oil, both as a primary energy source and as a possible source of distillates. Indeed, some of the larger-scale wood energy programs that gained strength during that period have continued apace and are now successfully contributing to energy supplies. For example, the private commercial wood energy plantations that extend over more than 200,000 hectares in the state of Minas Gerais, Brazil, provide the bulk of the energy for the iron and steel industry. Also in Rondonia, Brazil, a private company is using fuelwood plantations to manufacture electric power for the city of Ariquemas, which is isolated from the national grid. In the Philippines, which like Brazil is heavily dependent on imported oil, a "dendrothermal" program was launched around 1980 to produce electricity from fuelwood. This program also aims to stimulate rural incomes by contracting with small farmers to produce fuelwood. It provided the farmers with a guaranteed market and price and made advance payments from the first year of planting (World Bank 1985c). A paper by the National Academy of Sciences (1980b) introduces different technologies for fuelwood production.

Box 4.2 Strategies for Sustainable Fuelwood Supplies: Malawi

The strategies used in Malawi are

- managing existing forests better to institute sustained yield management and at the same time increase stumpage fees to reflect replacement costs for all commercial exploitation;
- establishing commercial fuelwood plantations (and government plantations in ecologically fragile areas) for specific markets such as tobacco curing;
- helping small farmers to expand their farm forestry activities to supply markets that would otherwise be in a deficit situation in the future by supplying technical assistance, seedlings, and small subsidy payments.

From World Bank (1986c).

The attractiveness of the commercial plantation as an energy source varies considerably from country to country, depending upon the energy options available and the relative, long-term costs of different energy sources. For example, in Nigeria, which is richly endowed with a wide range of energy sources, commercial energy plantations do not rank high among the available options, whereas in Brazil, they continue to be an attractive economic choice. Decisions to invest in commercial fuelwood plantations will likely be made outside the context of social forestry programs. Normally, commercial plantations involve situations in which energy is to be used by an enterprise that requires full control over the supply, as in the case of the Brazilian iron and steel industry. However, the Philippine dendrothermal program demonstrates an approach that, while commercially operated, involves the participation of small farmers.

Including fuelwood in energy planning

A key issue for both rural and urban energy supplies is how to incorporate fuelwood into energy sector planning so that effective programs to ensure future supplies can be put in place. Energy sector assessments that quantify the present and estimated future contribution of fuelwood to total energy consumption provide a basis for considering various strategies. Such assessments require the combined expertise of energy specialists, planning economists, foresters, and other persons with knowledge of energy consumption patterns in households.

Some of the early national energy assessments omitted the contribution of fuelwood to both urban and rural energy use. In these cases, reassessments are needed. Energy planners should evaluate the fuelwood option together with other energy options before deciding on a strategy to implement development programs for the various energy sources.

Including fuelwood in the energy sector assessment is in itself a step in the right direction because this highlights the importance of fuelwood in relation to other investment possibilities. Developing strategies for commercial energy plantations should not present undue problems. Both the market for fuelwood and the management entity responsible for developing the plantations can be clearly defined. It is the noncommercial and farm-forestry fuelwood production for unspecified markets that are likely to present problems in selecting appropriate strategies. In many countries, these systems are outside the normal responsibilities of forest departments and are not yet firmly allocated to other agencies of government.

The solutions to the problem of deciding on appropriate strategies and apportioning responsibility for their implementation among agencies will vary according to the organization and relative strengths of different government departments in a particular country. The forestry department generally has the technical expertise to select species and management systems for fuelwood production, but usually does not have expertise in energy sector planning and in identifying the comparative advantages of different energy options. Moreover, where project planners and implementers desire a large measure of farmer participation in farm-forestry activities, the agricultural department may be the most effective agency to secure that participation. Therefore, several agencies are likely to be involved in developing strategies for a coordinated fuelwood program, with each assuming responsibilities for implementing specific parts of the program.

The agency responsible for carrying out the initial energy sector survey should have a continuing role in the periodic review of the national energy situation. It should also be competent in advising the government on the appropriate balance between the energy source options available for future economic development. The forest department would be the appropriate agency for assessing existing stocks of fuelwood in the natural forests, plantations, and on farms. It should also monitor the supply and demand position of stocks and flows of tree products on a regular basis. The resulting data could then provide the basis for preparing systematic programs, including social forestry, to promote fuelwood production. If these two steps are accomplished, the task of selecting priority areas for attention and choosing appropriate strategies for implementing social forestry programs to deal with fuelwood deficits becomes more manageable.

Outlook

The recent downward trend in the international price of oil has tended to weaken some of the earlier attention given to fuelwood as an energy source. However, this trend in no way resolves the long-term problems of energy supplies. Most countries still need to develop fuelwood production capabilities to meet future energy requirements. In considering the options for future energy supplies, the evidence is strong that fuelwood will continue to be a major energy source in the foreseeable future for most developing countries. This is particularly true for rural energy, which, in addition to household energy, includes the energy used by a large number of rural service industries and small-scale works, such as brick and tile plants. Social forestry programs can have an important, even dominant, role in ensuring a sustainable output of fuelwood.

Urban areas provide greater opportunities for substituting other fuels for fuelwood because the alternatives are more accessible and urban dwellers are accustomed to paying cash for energy. Even so, in many countries, fuelwood will continue to be an important source of urban energy. To sustain fuelwood supplies for urban use, price policies are needed to set fuelwood prices at levels that are sufficient to cover the cost of replacing the fuelwood that is taken (generally for free) from the natural forest. Questions that governments must face include how large a contribution they expect fuelwood to make to future urban energy, what proportion of fuelwood demand should be met from state forests or commercial plantations, what quantity small farmers and rural dwellers should be encouraged to supply, and which social forestry programs are appropriate to achieve that objective.

In short, many countries' energy supply problems will only be resolved by careful selection of a combination of fossil fuels, electricity, and fuelwood to ensure sustainable supplies. Governments should make this selection by analyzing energy options thoroughly and by developing parallel, but linked, programs for each type of energy source. For the fuelwood source, social forestry is likely to be the dominant strategy.

Fuelwood Conservation: Improved Cookstoves

Improved cookstoves (ICS) deserve special consideration because the use of more efficient stoves can achieve significant savings of fuelwood and charcoal. Energy planners should pursue these potential savings seriously in the context of social forestry programs in fuelwood-scarce areas. In addition, technologies for better use of waste wood and more economical methods of charcoal production can contribute to energy savings. They can be an important part of energy sector planning and are likely to be promoted by the same agencies that will handle the development of improved wood and charcoal stoves. Indeed, one of the major reasons why programs to improve the use of fuelwood have been disappointing so far is because they have generally lacked the attention and expertise of energy specialists.

Besides the potential economies in the quantities of fuel used, improved stoves are needed for other reasons, for example, to reduce injuries from burns, which are widespread among small children, and to reduce the number of lung and eye ailments associated with excessive smoke in the living area. In Nepal, for example, lung ailments caused by inhaling smoke are a major medical problem, resulting in widespread loss of health and vigor among rural people. These health and safety aspects demonstrate that agencies concerned with human health should also have a strong interest in promoting ICS programs.

In the late 1970s, considerable attention was given to introducing ICS as a way to reduce the quantity of fuelwood required for domestic use. Initially, it was hoped that the development of appropriate ICS programs would be rapid and that their adoption would be widespread. So far, this has not happened. Nearly all ICS programs initiated in recent years have consisted of protracted, iterative processes of product development based on extensive user participation. These aimed to identify the most appropriate stove for each group of homogeneous users. Owing to the highly innovative nature of the ICS technology and the intervention process selected, the initial programs—from surveys to the identification of stove designs—took as long as three years to complete (Joseph and Shanahan 1980; Ki-Zerbo 1980; Dutt 1981). Given the main type of stove that was being promoted (the rural mud stove), the promotion work, involving mainly field testing and limited demonstration, took another two years. The slowness of this procedure to yield results prompted some stove promotion groups to take a more direct approach, emphasizing field trials and distribution. Only about five ICS programs have tried to distribute large numbers of stoves; however, since these programs were not consistently monitored and evaluated, we know very little about them (see Manibog 1984).

No matter what energy source is used, full use of the fuel's latent energy is never achieved. For example, with gas cooking stoves, only about 30 to 60 percent of the heat gets into the cooking utensil; the rest escapes to the air. Moreover, when using fuelwood and charcoal, some energy is used initially to heat the stove before cooking takes place, and the fuel's residual heat is wasted after cooking has been completed. Table 4.5 summarizes actual economies that have been realized in Niger through the use of various ICSs.

Countries involved

Stove programs are currently underway in three categories of countries:

- those in which well-established stove programs have distributed or sold more than 30,000 improved cooking stoves (programs in southern India, Kenya, and Niger, for example);

• those in which active stove programs have yet to distribute or sell a significant number of stoves (for example, in Burundi, Guatemala, Indonesia, Malawi, Mali, Nepal, Papua New Guinea, Senegal, Somalia, and Sri Lanka);

• those in which smaller initiatives are being taken (for example, in Bangladesh, Botswana, Fiji, The Gambia, Lesotho, Liberia, and a few Central American and Caribbean countries).

Table 4.5 Fuel Economies through Improved Stove Design: Niger

Fuel/stove design	*Monthly fuel consumption*	*Fuel price (US$)*	*Monthly cost to household (US$)*
Wood/open fire	160 kilograms	0.05/kg	8.0
Wood/Foyers Malgaches	128 kilograms	0.05/kg	6.4
Wood/Foyers Mai Sauki	102 kilograms	0.05/kg	5.1
LPG/Foyer "Dore"	20 kilograms	1.54/kg	30.9
Kerosene/Foyer "Indonesian"	33 liters	0.43/L	14.2

Source: UNDP/World Bank (1988).

Stove types

De Lepeleire et al. (1981) classified stove designs into three categories:

1. shielded, lightweight stoves, which includes all portable metal and ceramic cookers;

2. shielded, heavyweight stoves, which are made of mud, bricks, concrete, clay, sand, or any combination of these materials;

3. closed, heavyweight stoves, which have airflow controls such as dampers, fire doors, and chimneys.

All shielded stove designs are based on the principle of enclosing the combustion area as an improvement over an uncontrolled open fire. The traditional, open-fire method of cooking over three stones yields an average of 13 percent useful energy output, indicating that vast amounts of fuelwood are being extracted and burned at considerable cost for very little gain. Stove designers and testers focus on improving the very low combustion and heat-transfer efficiencies of the open fire, and they define an improved stove as having a measurably improved net fuel performance.

Obstacles to improved cooking stove programs

The generally discouraging experience with ICS promotion programs stems from two main types of problems: first, technical, economic, and sociocultural difficulties and those inherent to the stove technology itself; and, second, inadequacies in program formulation and implementation.

The programs had a number of faults. First, the stove developers did not analyze the functions and actual operation of an open fire. Second, they did not analyze the effect of pot size and material and of the turndown ability (the ability to reduce the rate of heat output) on potential wood savings. Third, they almost invariably ignored the consumer's role and perceptions and the importance of the types of food cooked. Fourth, they did not analyze the system required to disseminate enough stoves within a given period of time to make a noticeable contribution to efforts to reduce deforestation. Finally, most programs were started in rural areas, where the perception of an energy crisis is weak or is not considered a high priority, rather than in urban areas, where a monetary incentive as well as a perception of the energy crisis are more likely to exist.

Factors affecting cooking efficiency

Efficiency is the amount of useful energy produced by the conversion technology—cookstoves, in this case—in relation to the amount of energy input. The output is the heat absorbed by the food, and the input is the calorific value of the fuel. However, efficiency is only one factor that decides fuel consumption. Another factor is the turndown ratio, or the measure by which the heat output rate can be diminished. This means that a high-efficiency stove with a high heat output rate that cannot be turned down uses more fuel than a similar stove with a turndown capability. For example, good gas ranges have a valve that allows the heat output to be lowered to a minimum without extinguishing the fire. Therefore, fuel consumption is determined by the maximum power of a stove, its efficiency, and its turndown ratio.

Efficiency can be enhanced by both the cooking pan's diameter and the material from which it is made. Tests have shown that increasing the pan's diameter increases energy efficiency, although the optimum size has yet to be determined. Pan materials also play an important role. In a study in India, Geller (1982) found aluminum increased efficiency significantly compared to clay pots. The Ethiopian energy assessment found that aluminum pots are at least 50 percent more efficient than traditional clay pots. Some evidence suggests that pans with straight sides and flat bottoms are more efficient. Also, using a lid on the pan to prevent evaporation improves efficiency.

Discussions about stoves usually focus on energy savings and do not take into account consumer expectations of comfort, convenience, and energy efficiency. Therefore, the overall desirability of a stove to a user is a function not only of fuel savings, but of convenience, status, and time savings as well. If these consumer preferences are satisfied, the likelihood of ICS acceptance is greater.

The method of food preparation (boiling, baking, frying, steaming, grilling, or roasting) is also an important variable. For example, soaking beans and pulses reduces cooking time and fuel use. Several ways of cooking rice are very energy-inefficient because they use a large amount of water. Potatoes and other tubers can be cooked with less fuel if they are cut into small pieces. Pressure cookers can also reduce energy requirements.

Materials and manufacturing techniques also affect the performance of a given type of stove. For example, clay is a traditional material, but one that has many shortcomings, including considerable variation in properties, high thermal absorption, long periods required for drying, poor strength, a propensity to crack, and high mass, which is inappropriate where portable stoves are preferred. Deschambre (1983) discussed similar disadvantages with cement or "banco" (sand/clay mix) African stoves. Ceramic and metal construction materials overcome many of the disadvantages of clay. They offer better quality control and marketing possibilities and are ideal for portable stoves. However, these materials are less available and their use requires special kilns or more technologically advanced equipment.

Costs and cost constraints

One major obstacle to rapid ICS diffusion has been the cost of stoves. Clay or ceramic models can cost US$15-20, while metal models may cost only US$2-10. Mud/sand stoves cost US$10-30, but must be replaced frequently and do not reflect the high costs of extension work. Even if these stoves were subsidized, as nearly all the rural mud stoves have been, the large initial outlay is not justified from the viewpoint of noncommercial fuelwood users who can construct an open-fire stove at no cash cost. Still, the need is for—and the trend is toward—more sophisticated, improved cooking stoves, however, these will cost more.

A 1981 study by Zango (quoted by Bussmann 1984) concluded that an investment of US$16 for a stove is too high for most people in Ouagadougou, Burkina Faso, regardless of the fuel savings obtained. The metal stove, which costs only one-fifth as much as the Nouna mud stoves, offers an alternative that more people can afford.

Production and delivery system alternatives

The delivery system for an ICS program is very important. The objective of dissemination is to reduce household fuel consumption significantly by building and marketing millions of stoves within the next 20 years. There are three basic approaches to dissemination of ICSs:

- owner-built stoves using advice from extension personnel,
- artisan-built stoves,
- commercially produced stoves.

Most ICS programs so far have used the first two approaches.

The first approach is based on the belief that anyone can build a stove. This is the view in Burkina Faso, Mali, and Senegal. Proponents of this approach soon come face to face with the scale of the effort required to reach all potential clients, both in terms of capital and human energy. Many programs improved on this approach by providing molds and by employing local artisans to build stoves. This was done, for example, in Ethiopia.

In Guatemala, the second approach—artisan-built stoves—was used from the beginning. This worked reasonably well as long as demand was low. However, when the government adopted the stove program and wanted to step up dissemination, this approach soon reached its limits.

Commercial production seems to be the best approach. It is the one taken by Kenya and Niger. Its superiority results from better control over the three elements that determine the viability of a production system: a regular supply of raw material, labor productivity, and quality control. With mud stoves, materials are usually available, while supply problems can hamper ceramic and metal stove programs. However, labor productivity is much higher and quality control easier to achieve with both ceramic and metal stoves.

Table 4.6 reviews the various methods of producing stoves and their costs in Sahelian countries and demonstrates that in this region, the cheapest method is the production of metal stoves in foundries. The table also shows that the cost of manufacturing ceramic stoves is very high. The choice of production method should depend on the local availability of labor, local craft traditions, possibilities of distributing the stoves, and availability of raw materials.

Most experts agree that the quickest way to accelerate ICS dissemination and realize significant savings in the short term is to focus on centrally fabricated, portable stoves, frequently of metal construction, for commercial fuelwood users in and near urban areas, and possibly in more developed rural communities. Diffusion should be through market channels, with cash savings from fuelwood purchases as the incentive for stove purchase. The profit motive is expected to make dissemination through either central facilities or artisan networks self-sustaining. The Kenyan and Nigerian ICS programs demonstrate that stove diffusion in this manner can be an employment-generating and profitable activity that requires no subsidy.

Nearly all ICS programs have promoted shielded or closed, heavyweight, mud stoves in rural areas and are still experimenting on modifications to increase their acceptability. Strong interest in such stoves stems partly from the possibility of being able to use cheap and locally available materials, which is fully consistent with the self-reliance objective of the appropriate technology approach. However, in view of the magnitude of the fuelwood crisis, this dissemination alternative may be a questionable choice.

Experience shows that mud stoves are difficult to diffuse rapidly and are fraught with problems, namely:

- the stove body absorbs a lot of heat, making it unsuitable for applications of short duration;
- construction to specifications requires skills that rural users normally lack;
- quality control is almost impossible, particularly for owner-built units;
- the stoves tend to crack or deteriorate rapidly when exposed to water;

• even when the stoves are custom built, the difficulty of procuring materials may prevent product standardization;

• a considerable infrastructure for extension assistance, construction, repair, and replacement may be required;

• stoves cannot be produced quickly enough to achieve measurable fuelwood savings.

Table 4.6 Alternative Cookstove Production Methods: Sahelian Countries

Production method	*Annual production (units)*	*Total cost (US$ 1980)*	*Personnel needed*	*Cost per unit (US$)*
User	1	—	1	—
Traveling artisan	24	—	1	—
Local workshop				
Metal sheetwork	1,000	3,275	4	3.28
Foundry (metal)	8,750	22,600	30	2.58
Pottery (ceramic)	3,600	—	15	—
Regional workshop				
Metal sheetwork	35,000	71,000	65	2.03
Foundry (metal)	30,000	40,150	60	1.34
Pottery (ceramic)	30,000	180,000	80	6.00
Central workshop				
Metal sheetwork	150,000	300,000	265	2.00
Foundry (metal)	150,000	140,000	226	0.93
Pottery (ceramic)	150,000	1,300,000	450	8.67

— = not applicable
Source: Bossché (1983).

As a result, metal stoves have gained more attention recently because they permit much better quality control, design flexibility, mass manufacture, and economy of scale (see Micuta 1984 for a discussion of some models of these stoves). As long as the designs prove acceptable, use of market channels rather than extension channels can permit more rapid diffusion. This is done in Niger and in Kenya by door-to-door sales by artisans. ICS programs in Sri Lanka and Nepal are considering a shift toward portable stoves for urban consumers. However, enthusiasm for metal stoves should not unjustifiably discredit mud-stove programs.

Four factors accounts for the success of ICS projects in Kenya and in Niger (where more than 35,000 stoves have been sold since 1985):

• an appropriate stove design and production system (including quality control);

• price setting that meets both producers' and consumers' needs and provides real accruing benefits;

• extensive sensitization, promotion, and publicity campaigns;

• use of both traditional and modern disseminating and marketing channels.

Rural versus urban markets

One of the reasons given for focusing on ICS diffusion in rural areas is the belief that fuelwood use in rural households is responsible for unsustainable fuelwood collection and eventual deforestation. A number of rural energy surveys support this belief (National

Academy of Sciences 1980b). However, available estimates (see table 4.3) indicate that fuelwood consumption by urban or peri-urban households and informal, commercial, service, and even industrial subsectors can be significant and, in some cases, may be more responsible for drawing fuelwood supplies from rural areas than use by local rural residents. Examples include restaurants, mobile eating stalls, beverage houses, breweries, bakeries, laundries, brick and lime manufacturers, tile and pottery makers, metalworkers, tea- and tobacco-drying facilities, hospitals, military posts, schools, and community centers.

Therefore, if immediate and measurable savings are the objective, seeking out these large users of fuelwood and charcoal, who are likely to have cash-savings incentives for ICS adoption, may be more productive. Furthermore, the demand of these users for improved stoves or other wood-burning devices is more easily met on a sustained basis through market mechanisms by profit motivated, private stove manufacturers. Quality control is not only more feasible, but commercial and industrial consumers will demand it. However, stove designers have so far focused only on domestic models. Almost no attention has been given in developing countries to more energy efficient, nonresidential, wood-burning devices.

While urban ICS programs normally will be oriented toward conservation objectives and market approaches, rural programs will tend to have broader, social forestry-related development objectives and will need to depend on extension channels. Some hypothesize that in Africa, urban metal stove programs based on semicentralized manufacturing facilities may be more appropriate for rural areas because of the relative weakness of artisan networks in rural areas. In this case, demonstration and direct stimulation of urban-to-rural and artisan-to-artisan transfer of skills would be used to promote the ICS technology among rural users. Another suggestion is that in Asia, both urban and rural ICS programs featuring a wide range of models can make progress because of the strong innovative traditions and pervasive informal sectors. In most Central and South American countries, for the rural poor the high-mass stove—which Guatemalan artisans are successfully building and marketing—may be most appropriate because urban areas use modern fuels almost exclusively, except for small amounts of charcoal for grilling.

Delivery systems for future programs

Some ICS groups favor concentrating efforts to demonstrate clear success before large-scale diffusion within the framework of existing programs. Other groups argue that large-scale dissemination is already possible through new programs featuring metal stoves and market approaches aimed at commercial fuelwood users. Each national situation will determine which approach is warranted. However, for new programs, a prior step is essential: planners should conduct a careful review of areas that are experiencing a fuelwood shortage to determine whether local capacity for successful stove dissemination is adequate and, if not, whether it can be strengthened within a short time. A common denominator among the handful of most promising ICS programs is the initial and continued attention to identifying and strengthening local capacity prerequisites for successful stove promotion.

For an urban-oriented program, program planners must start by:

- assessing fuelwood needs, sources, price, and market structure;
- establishing technical facilities to develop and test alternative ICS designs and to improve models already being marketed;
- establishing adequate production capacity, either by working through the existing artisan network or by creating new fabrication units;
- creating profit incentives and providing financial support for stove manufacturers;
- identifying sufficient and assured sources of construction materials;
- establishing repair and replacement capabilities;
- determining priority target markets and incentives to ICS buyers;
- outlining publicity campaigns and commercialization strategies;
- assessing the potential demonstration effect of ICSs to rural areas.

In rural areas, program planners must start obtaining the following information before they can design an effective ICS program:

- fuelwood needs and gathering practices;
- local perception of the fuelwood supply problem and what initiatives have already been taken;
- effectiveness of extension channels;
- extent and strength of the informal sector as a possible diffusion vehicle;
- previous experience with rural development activities or the introduction of incentives, including subsidies;
- existence of possible demonstration units;
- availability of materials;
- extent of the infrastructure required for stove construction and maintenance;
- scope for monitoring and evaluation;
- need and scope for coordination with local groups;
- potential for, and constraints to, the process of ICS diffusion becoming self-sustaining.

Summing Up

Some two thousand million people depend on wood as their main or only source of household energy. Fuelwood is also important for small-scale, traditional industries in developing countries. In some countries, as much as 95 percent of energy consumed comes from wood and charcoal; an average figure in the developing world is between 30 and 50 percent.

The dependence on wood for energy is much greater in rural than in urban areas. Wood has been freely available from the forests and woodlands surrounding rural communities, and there are strong traditions of informal rights of local people to this source of fuel. As deforestation progresses, more and more people find themselves without wood or with the prospect of spending several days a week gathering wood to meet their basic needs. In 1980, more than one hundred million people did not have enough fuelwood to meet even basic needs, and the situation now is even worse. The result of such acute fuelwood scarcity can be starvation and declining health.

People do not switch to other fuels because they cannot afford to do so. The monetary cost of changing to kerosene, electricity, or other energy sources is prohibitive for most rural inhabitants. Their only hope is to find other, preferably free, combustible materials in their locality. So, they turn to burning dung, crop residues, and grasses, all materials that should be going back into the fields or used as animal fodder.

This chapter suggests two complementary approaches to solve the food crisis. One involves increasing the production of fuelwood. The other involves improving fuelwood conservation and conversion efficiency.

Effective social forestry strategies to increase on-farm production of fuelwood are more complex than initially envisaged. Indeed, many efforts have failed to secure local support because project promoters and implementers did not take the time to understand the local situations. They focused on a single output: fuelwood. In many cases, local populations did not perceive any impending fuelwood scarcity; they did not realize that they were rapidly depleting their forest capital. Rather, they perceived other scarcities, such as lack of building materials or lack of fodder, as being more important. Only when planners sought and used inputs from local communities, and when they recognized the multiple-purpose nature of trees in farming systems and incorporated this into project planning, did they achieve significant progress in fuelwood-oriented programs.

With regard to improved cooking stoves (ICSs), the question remains how best to manage ICS programs so they can be widely developed. The key elements for success are available, based on recent experiences that have led to greater understanding of the technical principles involved in ICS design; real fuelwood and charcoal savings; and better and more standardized evaluation of field projects.

ICS programs can be one of the more important components of fuelwood demand management. The challenge is to concentrate efforts on the most promising ICS models and promotion opportunities and to increase local and international support for them.

5

SOCIAL FORESTRY, EMPLOYMENT, INCOME, AND INVESTMENT RETURNS

With their focus on meeting such essential needs as fuel, food, shade, and shelter, most forestry for local community development programs give little attention to the potential for generating employment and income. However, this can be one of the most important contributions of the forest sector to the rural economy (Arnold 1986, p. 179).

Subsistence, noncommercial forestry activity becomes commercial when wood or forest products become so scarce that people have to pay for what they formerly gathered free or grew themselves. The transition tends to be gradual. Some individuals start to specialize and sell or trade the product commercially. In each case, investment of local resources occurs, employment is created, and income is generated.

Experts generally consider the effects of commercialization on income as positive in a development context, however, some caution must be exercised in planning social forestry programs that promote commercial activity. For example, when forest or tree output moves from the free or subsistence category to the market or commercial category, users who do not produce it have to pay a price, either in money or in kind. This can result in hardship for the poor if they are not the producers. A prime example is commercialization of fuelwood, which in some parts of the world results in families having to pay as much as a third of their income to meet their essential fuelwood needs.

Indications suggest that some market-oriented farm forestry programs may detract from social forestry's basic objective of helping to meet the needs of the poorest rural people. Criticism has been leveled against several otherwise successful programs because they mainly helped better-off farmers and actually hurt landless laborers by taking away previous sources of employment (see Shiva et al. 1982). Policymakers must consider carefully and plan in advance policies associated with employment creation and commercialization of social forestry outputs. An example is removal of shade trees in coffee plantations, currently a trend in many tropical American countries. Agriculturists often recommend this action because commercial coffee yields may be increased whenever adequate quantities of fertilizers and carefully applied pesticides are used. However, the capital and technology demands put this approach beyond most smallholders. Thus, removal of trees may be appropriate for well-to-do coffee growers, but not for those smallholders who cannot afford fertilizer. Without fertilizer, their yields would be better with trees present.

In some cases, employment in, and income from, processing tree outputs necessarily become a major focus of programs, given that opportunities to expand employment in other areas, such as agriculture, may not be great due to already existing underemployment. Thus, for example, Singh et al. (1984) argue that expanded off-farm employment must be an essential ingredient of any development plan in the middle Himalayas.

As indicated in the summary paper by Arnold and Falconer (1987a), social forestry, income and employment, and food security can be closely linked. Thus, gathering and processing forest products, such as fuelwood, fruits, resins, nuts, rattan, bamboo, and various fibers, can provide income that can in turn be used to purchase food. Often, the opportunities are seasonal and fit in during slack times in agriculture.

Finally, in an investment framework, trees can be looked at as a form of investment that creates savings in some cases. As Chambers and Leach (1987) put it, for the poor, trees are like bank deposits; the initial deposits are low, but the rates of appreciation are high.

Employment Impacts

Social forestry can give rise to significant employment opportunities for farm families and the landless. These income-earning opportunities are not only in seedling production and in planting, tending, and harvesting trees, but also in complementary activities, such as processing and selling wood and other parts of the tree (fruits, bark, resin, branches, leaves) and other forest products grown among trees (fodder, berries, roots, mushrooms, and tubers). These activities, in turn, can stimulate service employment, such as in transportation and maintenance. In situations of chronic high unemployment, this aspect of social forestry can be critical in a strategy for sustainable development (FAO 1987).

In some rural areas, a major portion of off-farm employment is in forest-related activities, such as producing handmade furniture, tool handles, and carts, often using wood produced by local farmers or local communities. Small-scale investment opportunities in these activities and in farm forestry itself can be quite attractive for rural families in terms of generating employment, income, and savings.

In many parts of the world, off-farm employment in traditional, small-scale enterprises (TSEs) in the forest-based sector is significant. For example, in two countries that have been studied in some detail, Sierra Leone and Jamaica, forest-based TSEs account for more than one-fifth and one-third, respectively, of total employment in the nonagricultural, small-scale enterprise sector, which is by far the major employer of rural labor (FAO 1985c). The typical forest-based TSE is quite small: the mean number of employees per firm in each country is two. Enterprises employing one person (the owner) range from 36 percent in Thailand to 68 percent in Egypt. Some studies indicate that the numbers of people employed in the TSE sector, often defined as an "informal" sector, are much greater than indicated in official statistics. For example, in selected areas of Bangladesh, Sierra Leone, and Honduras, official censuses underestimated employment in TSEs by 59, 44, and 20 percent, respectively (FAO 1985c).

Wood-based TSEs undertake diverse, and often quite labor-intensive activities. At the same time, these TSEs generally appear to be as efficient in the use of capital as their more modern, larger-scale counterparts (FAO 1985c). Activities range from oak and pine mushroom production and marketing by village forestry associations in Korea, to collecting of rattan for furniture production in the Philippines and Indonesia; from women's groups producing seedlings for sale in Senegal and Costa Rica, to making wooden handicrafts in Ecuador and handsawing lumber and selling it in Colombia.

A study by Khattak and Amjad (1981) reveals that Pakistan has about 98,000 village carpenters. This figure excludes furniture producers (another 41,000) and carpenters employed in the urban building industry. The village carpenters use about 249,000 cubic meters of wood a year in addition to the estimated 506,000 cubic meters used in building construction. Village carpentry is the largest single category of employment and represents about one-third of a total employment of 320,000 in the forest-based sector.

Page (1978) analyzed employment in small industries in selected African countries. He found that carpentry/furniture making was the second largest sector after clothing, employing between 8 and 20 percent of the labor force in the intermediate sector of the countries studied.

Few estimates exist of total employment in TSEs associated with forest-based activities for most countries. Recognizing this, the FAO financed and organized a number of studies of small-scale industry in Sierra Leone, Jamaica, and parts of Honduras, Egypt, and Bangladesh (FAO 1985c, 1987). The TSEs in these areas produce a wide variety of outputs for both local and export markets. Table 5.1 shows the general categories and the percentages of TSEs in each category.

TSEs generally get their wood from nearby natural forests or from farmers or other private sources. The FAO studies found that, in many parts of the world, competition for wood is mounting and TSEs are running into severe wood supply problems. Shortages and large price increases have a critical impact, since the cost of raw materials represents a significant portion of total costs in many forest-based TSEs.

Table 5.1 Types and Numbers of Traditional Small-Scale Enterprises Using Forest-Based Products
(percentage of total number of enterprises)

Activity	*Bangladesh*	*Egypt*	*Honduras*	*Jamaica*	*Sierra Leone*	*Zambia*
Saw-milling/ pitsawing	0.9	—	3.2	0.8	0.1	5.6
Carpentry/furniture	27.2	23.8	71.4	23.1	66.8	14.3
Wood carving/ bamboo/cane	11.6	—	0.2	12.5	5.9	11.9
Basket/mat/ hat making	32.4	70.4	10.6	63.5	23.8	60.3
Others	27.9	5.8	14.6	0.1	3.4	7.9
Total	100.0	100.0	100.0	100.0	100.0	100.0

— = none

Notes: 1. The "Others" category includes activities such as making brooms in Honduras, collecting fuelwood in Zambia, making agricultural tools in Egypt, and making containers and agricultural tools in Bangladesh.
2. Many TSEs do not specialize in the production of one item; so classification sometimes depends on the most dominant or important activity.

Source: Fişseha (1987).

Social forestry's links with wood supply concerns and TSE activity go beyond the above-mentioned enterprises that produce wood-based products. In many parts of the world, enterprises that produce such items as tobacco, pottery, coffee, bread, and salt are major consumers of wood for energy. On the one hand, these enterprises are in direct competition with villagers seeking wood for their own use. On the other hand, they create markets for smallholder-grown wood and employment for local people in wood harvesting and transport.

Many TSEs could not operate without a ready source of relatively inexpensive fuelwood. Thus, in wood-poor areas, growing trees to increase the supply of wood can help save jobs. Planners of social forestry projects must take this into account when considering projects that have commercial components, particularly in areas where industrial and urban fuelwood use is growing and unemployment is high.

A significant proportion of proprietors and workers in the forest-based TSEs have other sources of income, for example, 23 percent in Jamaica, 63 percent in Honduras, and 83 percent in Sierra Leone. Much of this other income is from farming, but the studies do not reveal whether such farming activity includes tree growing. Thus, the forest-based TSE sector has close economic ties to agriculture, as does social forestry.

Employment in forestry activities can be significant in the economies of many villages. Local groups in Costa Rica, Kenya, Korea, and a number of other countries have established hundreds of small nurseries that sell seedlings to local farmers and village groups. Often, these have become good sources of income and employment, in addition to providing a ready source of seedlings for social forestry activities. In Korea, village forestry activities also include collecting, preparing, and selling kudzu fiber (used primarily in wallpaper), producing oak and pine mushrooms, and collecting of stones for sale, all of which add to local income. In Central America, farmers collect and sell ornamental plants from the forest. Charcoal production and collection of nuts, fuelwood, bark, and medicinal plants from the forest provide employment and income for many thousands of rural people worldwide.

An economic advantage of social forestry projects in natural forest areas is that because the wood and other products are already there, productive jobs can start to generate income for local people almost immediately. This is the case, for example, in Honduras, where the Integrated Forestry Development for Social Benefit Project was started in 1982 within Honduras' social forestry system. The project's objective is to get rural people involved in forestry activities that generate local income and jobs, while at the same time involving them in managing and protecting the natural forest (box 5.1).

Box 5.1 Social Forestry in Natural Forests Creates Immediate Jobs and Income: Honduras

The Integrated Forestry Development for Social Benefit Project in Honduras involves both profitable activities (farmers earning income through the sale of products), and nonprofitable activities (forest protection and road maintenance) that the government pays for. The project is currently working in eight communities, and includes some 2,500 people and 21,000 hectares. A forest technician lives in each community and initiates project activities in consultation with the community council.

Of utmost importance in this project was a regulation that states that the state controls all trees, regardless of who owns the land. In the project areas, the government and the community councils signed agreements that give the communities the right to cut and sell the trees on lands falling under their jurisdiction. After they sell the trees, the communities pay the government the usual stumpage fee. The significance of this change is that now the farmers and not outside contractors benefit from using the forest, while the government benefits by having local farmers protect the forest, thus reducing the need for expensive government protection activities.

Planned project activities include a component called Forest Industry, Energy, and Social Systems, which aims to expand charcoal production and establish small cottage industries that produce simple wooden products such as boxes, pallets, and tables. The idea is that the industries use wood waste for energy and provide off-farm employment to local citizens.

It is too early to assess the success of the project. However, the indications are that local incomes can be increased substantially. For example, a socioeconomic survey carried out in three of the project communities in 1983 showed an average gross income of US$312 per family. Incomes have doubled through participation in project activities, although some of the income increase was government pay for carrying out various infrastructure and protection activities.

From Mulder (1986).

Investment Returns and Income Flows

When considering investment returns and income flows, two main questions are of interest. First, can commercial farm or village forestry activity be profitable to the participants? Second, what is the nature of the cash flow involved and how do farmers' cash flow patterns change as tree growing is expanded?

These questions have no general answers because investments in farm or village forestry, and the results of those investments, vary widely from situation to situation. Reports from India indicate that a social forestry program in Gujarat, involving farmers planting eucalyptus for sale in cities, produced extremely high rates of return for individual farmers in the early days of the program, which is probably the main reason that farmer participation expanded so rapidly. In some other parts of the world, rates of return are very low or negative because of slow tree growth, poor markets, or the need for expensive inputs.

Between these extremes, many projects provide reasonable and acceptable rates of return to farmers. For example, evaluation of tree-farming projects financed by the World Bank indicates financial rates of return to farmers ranging from 15 to 27 percent (see table 5.2). More intensive types of farm forestry can produce even higher rates of return: ones that often exceed significantly those from any other use of the land. Thus, Srivastava and Pant (1979) provide data for a farm forestry project at Vatava, Ahmedabad, in Gujarat State in India that produced an 89 percent rate of return to farmers. They also summarize two other cases with similar rates of return based on Rowe's (1980) work (table 5.3). In the case of roadside plantings and village plantations in India, the financial rates of return they calculated varied widely, from 7 percent for several village plantations on poorer soils to 32 percent for a roadside planting in Haryana State, where seedlings were well tended (protected and watered).

Table 5.2 Financial Rates of Return for Selected Tree-Farming Projects Financed by the World Bank

Country	*Average farm size (ha)*	*Species grown*	*Rotation (years)*	*End product*	*Initial investment cost per hectare (US$)*[a]	*Financial rate of return to the farmer (percent)*
Brazil	20	*Eucalyptus* spp.	22	Pulpwood, fence posts, and fuelwood at 5 and 15 years plus some sawlogs at 22 years	350	18
Colombia	2	*Eucalyptus* spp.	10	Fuelwood	150	16
Philippines	10	*Albizzia falcata*	5	Pulpwood at 7 years	180	22[b]
Philippines	5	*Leucaena glauca*	5	Fuelwood and charcoal	300	27
Republic of Korea	11	*Robinia pseudacacia* *Alnus firma* *Lespediza* spp., etc.	5	Fuelwood	250	18
Sudan	25	*Acacia senegal* (gum arabic)	5	Gum arabic	30	15[c]

a. Costs of establishment (including farm labor costs) during first three years in 1977 prices.
b. *A. falcata* is being grown as an integral part of a crop rotation on farms of 10 ha of which 2 ha are devoted to foodcrops and livestock production and 3 ha to trees. Pulpwood sales account for more than 75 percent of total net farm income.
c. Gum arabic is being grown as an integral part of a crop rotation that includes millet and groundnuts as the principal crops. It accounts for about 20 percent of total cropped area and about 25 percent of net farm income. The rate of return would drop to approximately 10 percent if the gum arabic component were excluded.

Source: Spears (1978).

Other analyses for Madhya Pradesh State in India indicate similar rates of return for village plantations when outputs not intended for sale were valued using existing market prices. Thus, Bromley (1983, p. 284) states:

> The economic feasibility of social forestry of the scale envisioned by the Indian government seems beyond question. Even the least profitable plantation model (V - pure fuelwood) has a (financial) internal rate of return of 13 percent. The one with 20 percent fruit (II) has an internal rate of return of 33 percent. The more probable plantation models are in the neighborhood of 20 percent internal rate of return.

Researchers have estimated the likely rates of return for both farmers and the overall project for the Haiti Agroforestry Outreach Project, which so far has involved some 110,000 farmers. Their results suggest that the US$8.7 million already spent by USAID and other donors will generate a total of US$34.4 million of additional net income to the tree planters during the next 20 years. In addition, US$12 million or so of rural income is expected from the harvesting and transformation activities associated with the tree growing (USAID/Haiti 1986). Adjusting these values for when they occur over time, the economic rate of return for the project is estimated at around 15 percent. Total project cost per *surviving* seedling is about US$0.70, with survival rates estimated at 40 to 60 percent, depending on planting location (Grosenick 1986).

Table 5.3 Financial Rates of Returns for Two Tree Plantations: India

Type of plantation	*Net present value at 12 percent (Rs)*	*Benefit cost ratio at 12 percent*	*Financial rate of return (percent)*	*Direct employment (total man-days)*
Sughad Village, private farm: eucalyptus hybrid planted at 3 meters by 1 meter on five-year rotation; hybrid castor raised between the *Eucalyptus* rows; irrigated and fertilized.	11,123	3.18	17	1,781
Lodra Village, private farm: eucalyptus hybrid planted at 4 meters by 1 meter; worked on a five-year rotation; intercropping: year 1, cotton; year 2, *Bajra* and wheat; year 3, jowar and tobacco; year 4, napier grass; irrigated and fertilized.	9,567	1.85	75	4,752

Source: Srivastava and Pant (1979).

Researchers calculated the financial rates of return to Haitian farmers using a farm model approach. For example, for the southern region of Haiti, for a tree crop, maize, sorghum, and bean crop association, they expect farmers' rate of return to be 38 percent, allowing for an estimated increase in real wood prices of 4 percent a year based on past experience. Trees and food crops are intercropped during the first two years of each tree cycle. Wood outputs include poles and charcoal. Crop productivity without the tree planting is assumed to decline an average of 2 percent a year during the 16-year project period due to declining soil productivity without trees.

Table 5.4 shows the cash flow for an average 10-hectare farm on the island of Mindanao in the Philippines, where 8 of the 10 hectares were planted with *Albizzia falcataria* for pulpwood, at a rate of 2 hectares a year. A government agency provided financing to cover most of the farmer's cash costs at an annual interest rate of 12 percent. The financial rate of return, without considering credit, was 30 percent. Note that with the financing arrangement, the annual cash flow for the farmer was only slightly less favorable with tree planting than it would have been without tree planting up to year 8, at which time the returns from tree harvesting should increase positive cash flow significantly. Once the smallholder achieves a regular pattern of planting and harvesting, cash flow problems due to tree growing should disappear. In the case of the Haiti example, interplanting crops for the first two years of tree growth helped to ease the situation, but the cash flow was disrupted nevertheless.

Table 5.4 Farm Forestry Financial Investment Analysis for a 10-Hectare Farm: Mindanao, The Philippines
(pesos)

	Without project	Years: 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Inflows																					
Forestry	0	0	0	0	0	0	0	0	5,523	6,174	6,174	6,810	6,810	7,434	7,434	8,046	6,714	6,714	6,714	6,174	6,174
Crops	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
Residual value[a]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		34,569[a]
Total	*2,500*	*2,500*	*2,500*	*2,500*	*2,500*	*2,500*	*2,500*	*2,500*	*8,023*	*8,674*	*8,674*	*9,310*	*9,310*	*9,934*	*9,934*	*10,546*	*8,674*	*8,674*	*8,674*	*8,674*	*43,243*
Outflows[b]																					
Investment (forestry)	0	1,436	1,559	1,559	1,599	122	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Forestry operating expenses	0	0	0	0	0	0	0	0	208	352	352	352	352	352	352	352	352	352	352	352	352
Farm operating expenses	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Total	*100*	*1,536*	*1,659*	*1,659*	*1,659*	*222*	*100*	*100*	*308*	*452*	*452*	*452*	*452*	*452*	*452*	*452*	*452*	*452*	*452*	*452*	*452*
Net benefit before financing	2,400	964	841	841	841	2,278	2,400	2,400	7,715	8,222	8,222	8,858	8,858	9,482	9,842	10,094	8,222	8,222	8,222	8,222	42,791
Incremental net benefit before financing	0	(1,436)	(1,559)	(1,559)	(1,559)	(122)	0	0	5,315	5,822	5,822	6,458	6,458	7,082	7,082	7,694	5,822	5,822	5,822	5,822	40,391
Financing																					
Loan receipts (80 percent loan)	0	1,250	1,250	1,250	1,250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Debt service (principal and interest)	0	0	0	0	0	0	0	0	3,466	3,466	3,466	3,466	0	0	0	0	0	0	0	0	0
Total	0	*1,250*	*1,250*	*1,250*	0	0	0	0	*(3,466)*	*(3,466)*	*(3,466)*	*(3,466)*	0	0	0	0	0	0	0	0	0
Net benefit after financing	2,400	2,214	2,091	2,091	2,091	2,278	2,400	2,400	4,249	4,756	4,756	5,392	8,858	9,482	9,482	10,094	8,222	8,222	8,222	8,222	42,791
Incremental net benefit after financing	0	(186)	(309)	(309)	(309)	122	0	0	1,849	2,356	2,356	2,992	6,458	7,082	7,082	7,694	5,822	5,822	5,822	5,822	40,391

Internal rate of return before financing = 30 percent   Internal rate of return after financing = 47 percent

a. Assume trees can be cut three times (to year 32). Present value at 12 percent from year 22-32 (11 years) is 5,822 x 5.937699 = 34,569.
b. In this case study, incremental working capital would not be necessary until year 9 for harvest. It was decided unnecessary in this example on the grounds that (1) the figures are not large and (2) as the costs are associated with a harvest, the financial burden on the farmer would likely be very quickly removed if payment is received promptly.

Source: Gregersen and Elz (1983).

Spears (1987) points out how agroforestry investment can increase farmers' overall rates of return when soil conservation and shelterbelt benefits are taken into account. As indicated in table 5.5, the rate of return increases from 7.4 percent to 16.9 percent when agroforestry/soil conservation benefits are considered, and from 4.7 to 21.8 percent when the analysis is expanded from considering wood benefits alone to include soil conservation and food crop benefits as well as the wood benefits.

Table 5.5 Appraisal of Economic Benefits of an Agroforestry/Shelterbelt/Soil Conservation Project: Northern Nigeria
(percent)

Component	Internal rate of return
Agroforestry	
Wood/fruit benefit alone	7.4
Wood/fruit benefits plus positive impact of trees on conservation of soil and crop yield	16.9
Shelterbelt	
Wood benefits alone (poles/fuelwood)	4.7
Wood benefits plus positive impact of shelterbelt on soil conservation and crop yield	21.8

Note: The original analysis includes a broad range of rates of return related to different assumptions about the phasing of benefits, level of crop yields, and other variables.

Source: Spears (1987) based on Anderson (1987).

Increasingly, agriculturists are becoming aware that income generation, in addition to food production for their own use, has a prominent place in farmers' production objectives. This is also the case for the very poor farmers. Often, land-use strategies involving tree growing fit in with the income-generation objective and with the high cost of capital and high opportunity cost for labor when a person does not own enough land to make a living from it. Thus, when the size of holding is very small, the farmer is forced to find outside employment, and thus shifts to land uses that involve less labor than agricultural crops. Many agroforestry practices fit this need and at the same time can provide attractive income opportunities (Arnold 1986, 1987b; World Bank 1986b).

Different social forestry models can have quite different returns to investment (capital), land, and labor, as indicated in the illustration from Malawi shown in table 5.6. The discount rates of 25 and 50 percent reflect what farmers actually perceive to be the discounting of future earnings. Obviously, with such great differences in returns, farmers' perceptions of relative input scarcities are very important. Farmers with more land than their families can handle by themselves would have to hire labor; thus labor productivity would be of concern. For the small farmer, labor might or might not be considered a scarce resource, depending upon whether off-farm employment is in the picture or not. If not, then fuelwood collecting might seem the rational choice of activity, since labor is abundant and capital and land scarce.

Arnold (1987b, p. 179) provides an example from Kenya and sums up several points about farmer investment decisions in relation to perceptions of relative factor scarcities and risk.

Tree growing tends to be practised by poor farmers who are unable to meet their basic food needs, and for whom it is a principal source of farm income. In Vihiga location in Kakamega District of Kenya, for example, average farm size is about 0.6 ha, of which some 25 percent is under eucalyptus woodlots (Gelder and Kerkhof 1984). Gross income per hectare in this area is considerably lower from tree growing than from other agricultural crops. Dewees (World Bank 1986 [b]) suggests that farmer preference for tree crops in these circumstances is conditioned by availability of capital and labour, and by attitudes to risk management. Alternative crops often require investments at levels beyond small farmers' access to capital. Trees, by contrast, require very little expenditure. Tree growing is also attractive to farmers in an area where there is a shortage of labour because of widespread out-migration of male members of the farm households to seek off-farm employment. Where markets for tree products are good, returns to labour from pole production have been estimated to be some 50 percent greater than from maize production (World Bank 1986 [b]). Consequently tree growing is a rational use of resources for poor farmers needing to devote a substantial part of their labour to non-farm employment.

[The] decision to grow trees has been influenced by two main factors. One is the high cost of labour and capital, and the advantages tree cultivation offers in this respect because of its low input requirements. The other is the prominent part that income generation, as distinct from food production, plays in the farmers' production objectives.

Table 5.6 Model Comparisons: Malawi Forestry Study

Activity	*Returns to investment (internal rate of return) (percent)*	*Returns to land (net present value, MK per ha)*		*Returns to labor (net present value MK per discounted labor day)*	
		Discounted at 25%	*Discounted at 50%*	*Discounted at 25%*	*Discounted at 50%*
Growing poles	185	858	256	8.9	4.0
Growing fuelwood	65	84[a]	13	1.0	0.2
Collecting fuelwood	Over 1,000	Does not require farmers' land		0.3	0.3
Improved maize + fertilizer[b]	240	198	146	1.4	1.0
Local maize - fertilizer[c]	Over 3,000	69	57	0.7	0.5

Note: At the time of the study, MK 1 = US$0.75.

a. If a full harvesting of the wood was undertaken in year 4 and thereafter at four-year intervals as with poles this returns to land figure would increase somewhat to a NPV of 104 at the 25 percent discount rate.

b. From Malawi Smallholder Fertilizer Project Maize Model Table T-8.

c. From same report Table T-7.

Source: World Bank (1984b).

Table 5.7, based on an analysis by Arnold (1987b), summarizes farmer production/investment responses to changes in factor constraints and outlines the economic contributions of agroforestry in each case.

Issues Related to Commercialization

A number of issues arise with regard to the expanding commercialization of previously subsistence forest- and tree-related products. The process of commercialization takes place as increasing scarcity forces consumers to pay for previously free forest or tree outputs. The formation of prices and their rise in response to scarcity results in persons devoting their capital and time to activities associated with producing, transporting, and marketing these tree-based products. The outputs become commercialized—sold and traded—products.

Anticipating wood scarcity

In some cases, wood becomes scarce rapidly and an adequate investment response—either by government or the private sector—is not forthcoming fast enough. Growing wood takes time. Thus, investment and expanded tree growing need to anticipate scarcities, commercialization, and rising prices.

The rise in prices for some products such as fuelwood can be rapid. For example, an exhaustive USAID (1983) study in Pakistan revealed that prices for fuelwood more than doubled in real terms between 1972 and 1982. Other examples also indicate rapid price increases: statistics from Costa Rica indicate fuelwood prices almost tripled in one market during 1980 to 1984. They also increased from US$4 to US$17 per stere (0.65 cubic meters) during 1974 to 1984 in Guatemala, and from US$2.50 to US$17.10 during 1974 to 1983 in Nicaragua (Reiche 1985).

Table 5.7 Selected Situations with Agroforestry Components in Changing Farm Systems

Agroforestry component	*Constraints/opportunities*	*Farmer response*	*Contribution of agroforestry*
Homegardens, Java	• Declining land-holding size, minimal or no rice paddy, minimal capital	Increase food and income output from homegardens	Highest returns to land from increasing labor inputs, flexibility of outputs in face of changing needs and opportunities
	• Further fall in land-holding size below level able to meet basic food needs	Transfer labor to off-farm employment	Most productive and stable use of land with reduced labor, inputs
Compound farms, Nigeria	• Declining land-holding size and site productivity, minimal capital	Concentrate resources in compound area, raise income-producing component and off-farm employment	Improves productivity, highest returns to labor, flexibility
Homegardens, Kerala	• Declining land-holding size, minimal capital	Bring fallow land into use, intensify homegarden management	Multipurpose trees maintain site productivity and contribute to food and income
	• Capital inputs substantially increased	Transfer land use to high-value cash crops, substitute fertilizer and herbicide for mulch and shade	Trees removed unless high-value cash crop producers
Farm woodlots, Kenya	Farm size below basic-needs level, minimal capital, growing labor shortage	Low-input low-management pole cash crops, off-farm employment	Lower capital input than alternative crops and higher returns to labor
Farm woodlots, Philippines	Abundant land, limited labor	Put land under pulpwood crop	Expands area under cultivation, increases returns to family labor

Source: Arnold (1987b). Reproduced with permission from ICRAF.

If early investment does not take place, the problem can be more than rising prices: periods of no supply can occur, and—as experience has shown—local shortages of wood can cause loss of employment, hardship, and environmental degradation (box 5.2). This situation is developing in many places. The key policy question is how to help people anticipate future shortages and take action to avoid them. In most cases, governmental or outside, NGO and incentive programs will be needed to stimulate action and investment at an early enough stage. Commercial activity will become more important; governments must anticipate this.

In some cases, the market provides the regulatory mechanisms that keep commercial prices in check. For example, one study found little evidence of rising fuelwood prices in large cities in South Asia, principally due to interfuel substitution and to fuelwood usage and prices being sensitive to the prices of alternative fuels (Leach 1986, as cited in Arnold 1987b).

Box 5.2 Wood Scarcity and Loss of Employment: India and Africa

India: Nirmal, 200 kilometers from Hyderabad in Andhra Pradesh, is known for its handcrafted wooden toys, which are exported in substantial quantities. The art is believed to go back a thousand years and is based on a light wood called "ponki," purchased from local or nearby forest sales depots. Local fisherfolk use ponki for their catamarans, and the toy makers even borrow from them when supplies run short. Ponki is today in short supply. In 1967, one unit cost Rs 0.25; it now costs Rs 17.50. In a desperate bid to survive, the toy makers' cooperative is trying to get 40 hectares reserved for a ponki plantation.

Africa: A Lobi potter reported that her husband had left home in search of work as his blacksmith trade had become uneconomical because of the scarcity of fuel. She herself had given up making large pots and was wondering how much longer she would be able to support her family as a potter because getting fuelwood to fire even the smaller pots was becoming difficult. Many women in developing countries depend upon woodfuel not only to cook for their families, but also to earn money by processing foods such as the snacks sold in the markets. Many work in small industries that depend on fuelwood, for example, smoking fish.

From Centre for Science and Environment (1985)—India
Hoskins (1979a)—Africa

Organizing small producers to ensure adequate returns

As discussed, some types of commercial tree-growing activity undertaken by farmers can provide attractive returns. Much depends on the market situation and the transportation infrastructure available to get wood or other tree products to market. The rate of return to the farmer can erode rapidly if the farmer has to depend on middlemen who hold strong bargaining positions (box 5.3).

Citing work done for the World Bank (Baah-Dwomoh 1983), Arnold (1987b) points out that in two instances in West Africa, the price of standing wood was only 1 to 1.5 percent of the retail price of the wood in the market. Even if the wood were cut and stacked at farm gate, the cost would only be between 11 and 13 percent of retail market price. Clearly, a lot of the profit was going to those who transported and marketed the wood. Low returns cause farmers to lose interest in tree growing as a commercial venture. If rural people develop some form of organization that can influence pricing and can provide distribution services, then their returns can be increased.

The Korean village forestry associations are well organized and linked locally, regionally, and nationally. A strong central marketing unit obtains good prices for the associations in export markets. Even back in the 1970s, they were earning over $100 million annually from the sale of such forest products as oak and pine mushrooms, kudzu fiber, stones, and carvings (Gregersen 1982).

The cooperative approach is very sensitive to the cultural and economic environments within which it must operate. Cooperatives in forestry have failed as miserably in some countries as they have thrived in others (Gregersen and McGaughey 1985). Therefore, each case should be considered on its own. In developing any program to encourage commercialization of wood or other forest- and tree-related products, planners must consider markets and organization explicitly and seriously. Failures or disappointment hit hard in poor, rural communities; getting a community involved in new ventures will take a long time if failure is still fresh in people's minds.

Box 5.3 Bargaining Power Needed to Ensure a Fair Share of Returns: Tanzania

In Dodoma, Tanzania, some villagers carry bags of their home-produced charcoal to sell in towns up to 15 kilometers away. Observations reveal that the buyers (normally merchants who resell the charcoal) make between 120 to 300 percent return or profit. Rural charcoal producers usually have no alternative: they have to sell their merchandise quickly to get home in time to do other tasks. One way to circumvent this difficulty is to encourage the charcoal producers to form informal groups so as to increase their bargaining powers. They should also use their village organizations to help them get regular customers, once they themselves are organized.

From Mnzava (1983).

Social forestry benefits lost through commercialization

In many instances, the adoption of an intensely commercial attitude has resulted in the loss of broader social forestry benefits, particularly to the poorer members of a community. Pursuing opportunities to develop and expand commercial markets is often a central theme of development. This is indeed appropriate in many cases. What is at issue is a matter of objectives and priorities. Over time, a strong, economically healthy, commercial agricultural sector is a necessity for development, including development for the landless and the poorest in communities. It is by taxing the profits of strong sectors and producers that resources are raised to support programs for the poor who cannot escape the cycle of poverty without help. However, combining commercially oriented development plans and socially oriented programs is often possible. For example, India's social forestry program, in addition to emphasizing commercialized farm forestry, includes such objectives as allocating degraded forest and agricultural wasteland to landless families, who will be helped to become cash crop tree farmers.

One program that has received particularly widespread attention is the farm forestry program in the Indian state of Gujarat. In response to strong markets, the rate of planting increased four-fold between 1975 and 1979, from 12 million to 48 million trees per year. The rate doubled again, to 100 million, by 1981 and yet again, to 195 million, by 1983 (FAO 1985c). Some people have expressed concern about this program. First, they argue that growing eucalyptus instead of food crops decreases the availability of food, thus causing increases in food prices and hardship for the rural poor. Second, they argue that employment is reduced from what it would be if traditional agricultural crops were still being grown (Kirchhofer and Mercer 1984). As discussed in chapter 3, these concerns relate directly to the question of income distribution and the plight of the landless and very poor in any region. Whenever commercial market opportunities develop, some groups benefit and others do not.

In the case of a smallholder tree-growing program associated with the Paper Industries Corporation of the Philippines (PICOP), most farmers adopted a straightforward plantation production approach (see box 5.4). Most did not adopt a more labor-intensive, employment-generating, agroforestry approach, because this approach would have resulted in added labor cost and loss in returns to the landowner/tree grower.

Both of these cases, Gujarat and PICOP, are examples of outstanding projects that raise incomes and speed up development for local farmers. If one looks at these programs in this context, they were successful. However, when looked at in the broader, social context of forestry for local community development, they—initially, at least—missed opportunities to do more for the poorest people in the communities involved.

Box 5.4 Expansion of a Smallholder Tree-Farming Project: The Philippines

The Paper Industries Corporation of the Philippines (PICOP) chose as initial targets of its tree-farming campaign local leaders such as town mayors and *barrio* officials. Twenty-two municipal and *barrio* officials were chosen to be demonstration farmers.

In 1968, only one tree farm was established. Five years later, the total area put to tree farming was 1,002 hectares, and the number of participating farmers had reached more than 1,000. A marked increase in tree farming occurred in 1972, after the Development Bank of the Philippines approved the allocation of a P 7.2 million loan to tree farmers. A streamlining of the loan scheme in 1974, coupled with the demonstration effect of the first tree farm harvest, further increased the number of hectares planted to pulpwood species.

As of October 1977, 3,129 tree farmers had a total farm area of 14,567 hectares. Translated into labor requirements, the PICOP agroforestry project needed a total of 1,602,337 man-days during one rotation of eight years. By the end of 1981, 22,607 hectares of land were producing trees and additional income for some 4,500 farmers.

From Mindajao (1978); Picornell (1983).

Some people also assert that the conventional commercial tree-growing model, with its emphasis on products for sale, does not consider a number of significant, on-farm benefits that can be achieved with the broader social forestry model. An illustration of the differences between the two models, using the commercial planting of *Eucalyptus* as an example, is provided in figure 5.1. While this example may be overdramatized, it does illustrate a general point: different philosophies can be involved in planting trees strictly for commercial sale and in planting trees as part of a farm system to supply local needs, which only incidentally may provide commercial products for sale.

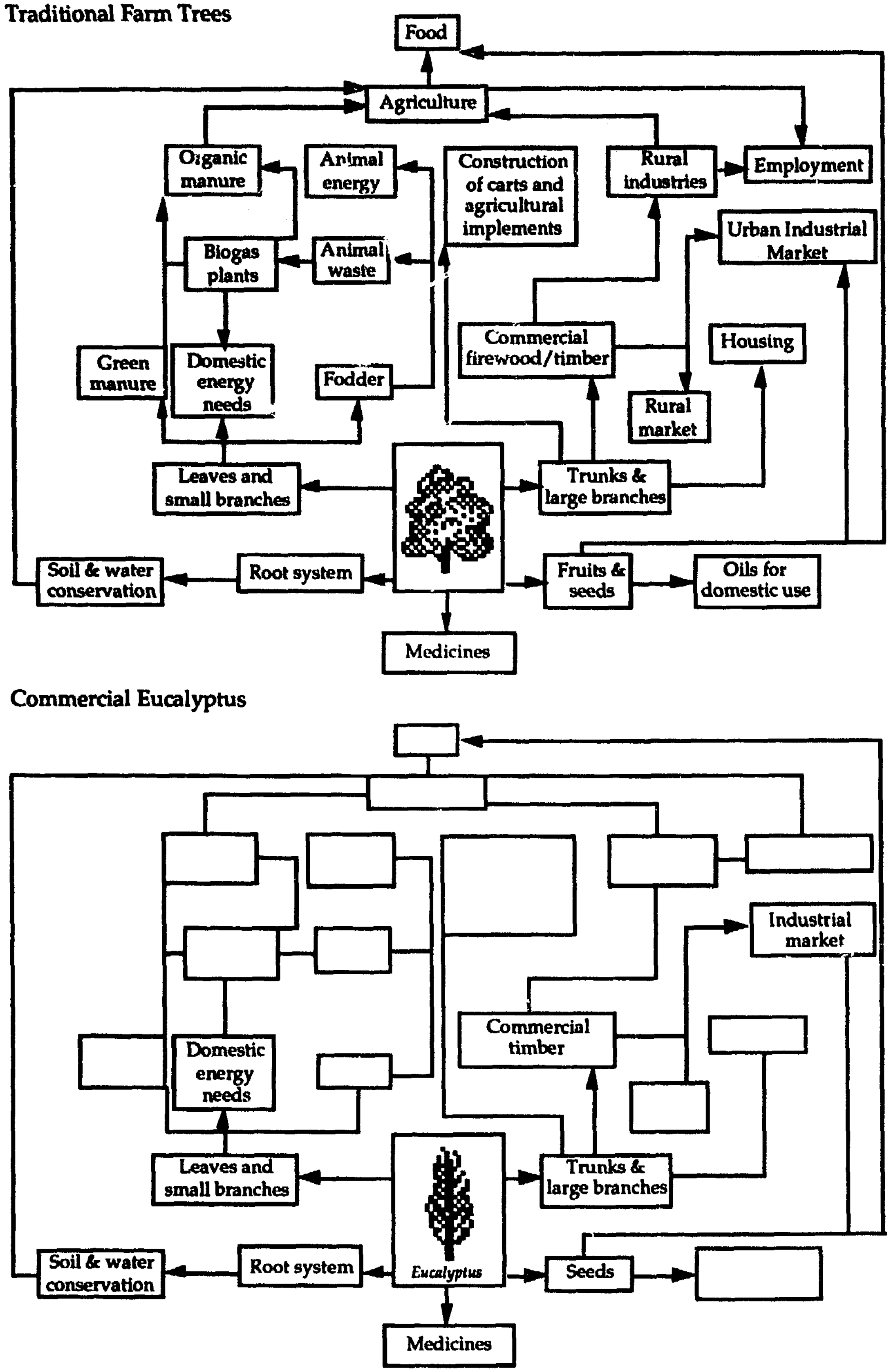
The various issues associated with commercialization in social forestry must be addressed and not suppressed as the process of commercializing previously subsistence tree crop outputs such as fuelwood continues to reach further into rural areas. As Arnold (1986, p. 182) states: "The growing of trees in response to market forces is becoming an increasingly important component of forestry for local community development programs." Thus, market development and commercialization should be encouraged, but they should also be given increasingly critical attention in planning efforts and in project implementation.

Summing Up

This chapter has shown that social forestry can transfer subsistence production into commercial activity to provide significant employment and income-generation opportunities. Particularly in situations of high unemployment and increasing population pressure on the land, it is important that complementary income-earning opportunities be considered, for example, through commercialization of forest products produced by local farmers or communities and through the establishment of small-scale processing facilities to produce wood- or tree-based products. Whole new fields of small-scale enterprise activity based on locally grown tree products wait to be developed in most countries.

Data reveal that tree-based, off-farm employment is significant in many countries, but that trees to support such activity are becoming scarce in many of these countries, and that returns

Figure 5.1 Comparative Contributions of Traditional Farm Trees and Commercial Eucalyptus



Source: Shiva et al. (1983).

from investment in tree growing can be attractive for the smallholder. Rates of return in the 15 to 25 percent range are not uncommon, although rates of return are generally lower in arid or semi-arid regions.

Commercialization of social forestry activity is essential in many instances to create gainful employment. Some of the greatest successes in getting widespread participation in local tree growing have been projects in areas where the market incentive has been strong. Project and program organizers and planners should recognize this and build on the strength of market incentives, but they should also be aware that commercialization can have some negative impacts, particularly if the impacts are not anticipated and moderated with effective measures. Among other things, they must consider the effects of commercialization on the poorest members of the community and on the landless. Furthermore, farmers must be made aware of the benefits that are foregone when they focus exclusively on growing trees for the market. In some cases, adjustments can be made that will permit them to obtain both the income from sales and the on-farm benefits that are so important in social forestry.

PART II

PLANNING AND IMPLEMENTING SOCIAL FORESTRY PROJECTS

The same basic process is used to plan social forestry projects as is used to plan industrial forestry and most other types of projects: planners specify objectives, set targets, design and appraise alternatives, and make choices. However, the details and substance of the approach to planning and implementing social forestry projects are quite different from those used for industrial forestry projects.

Part II deals with social forestry project planning and implementation issues. Chapter 6 summarizes a basic planning framework and comments on the process of applying the framework in practice. The chapter also highlights substantive issues of particular concern in social forestry project planning and implementation and shows how they are related. Chapter 7 through 14 discuss specific issues in detail. The topics covered are listed below:

Learning about local communities and their institutions (chapter 7). Social forestry projects are participatory in nature and require widespread, preferably voluntary, involvement of local people and potential beneficiaries from the earliest stages of planning. This means that early in the planning process, planners must make a significant effort to understand the needs, wants, and potentials of local communities and to understand their institutions.

Deciding on the social units of organization with which to work (chapter 8). A major focus of community appraisals is to develop an understanding of the social and economic units of organization that exist in the community, that is, farm families, associations, cooperatives, school groups, women's groups, church groups, and so forth. Once planners establish the needs, aspirations, and motivations of the various groups, they can develop a strategy for involving selected groups—or the community as a whole—in planning and implementing social forestry project.

Developing incentives to motivate local participation (chapter 9). Project planners need to consider which market and nonmarket incentives are appropriate and most effective for motivating widespread local participation in the activities included within a social forestry project plan.

Dealing with land constraints and needs (chapter 10). The regions most in need of social forestry activity tend to be the areas with heavy and growing population pressures on a fixed land base. One of the most critical challenges facing planners is to find sufficient idle or underutilized land that they can use for social forestry activities. Project planners also have to develop innovative ways to involve communal lands in projects and deal with the landless.

Administering and coordinating projects (chapter 11). The implementation of social forestry projects tends to be much more complex and involved than the implementation of traditional public forest administration, industrial plantations, or natural forest management projects. Appropriate governmental and nongovernmental organizations must be mobilized to organize, administer, and implement projects and programs. A particularly critical concern of project planners and administrators is what form of delivery mechanisms to use in extending social forestry technologies and institutional innovations to communities and farmers.

Monitoring and evaluating social forestry activity (chapter 12). As an organized area of activity, social forestry is relatively young. Projects should be flexible, and planners need data on which to base recommendations for changes in ongoing programs and on which to base the design of new programs. Thus, establishing strong monitoring and evaluation functions within projects and programs is important.

Education for social forestry (chapter 13). Planning and implementation concerns must go beyond the immediate concerns associated with given projects. Thus, careful consideration needs to be given to the basic training and education of those who will be involved in planning and implementing programs and in developing national policy on social forestry.

Research: development of technologies to support social forestry (chapter 14). Expansion of sustainable social forestry systems over time depends on the use of appropriate technologies that can increase productivity and expand the use of marginal or degraded lands. The availability of such technologies depends to a great extent on the amount and quality of research that is taking place. Thus, this chapter provides a detailed discussion of technical research needs and priorities related to social forestry. It is meant mainly for technical personnel who deal with social forestry development, although project planners and administrators will also find it useful.

Finally, chapter 15 provides a review and a checklist of topics and ideas that project planners and administrators might consider when planning and implementing social forestry projects. The suggestions presented should not be considered as rules to follow. Rather, they should be considered only as guides or indications based on experience to date and as ideas that might usefully be considered in the development of future projects. Social forestry can be very complex, and enough evidence has not yet been accumulated to be able to recommend with confidence a particular set of actions for a given social forestry situation.

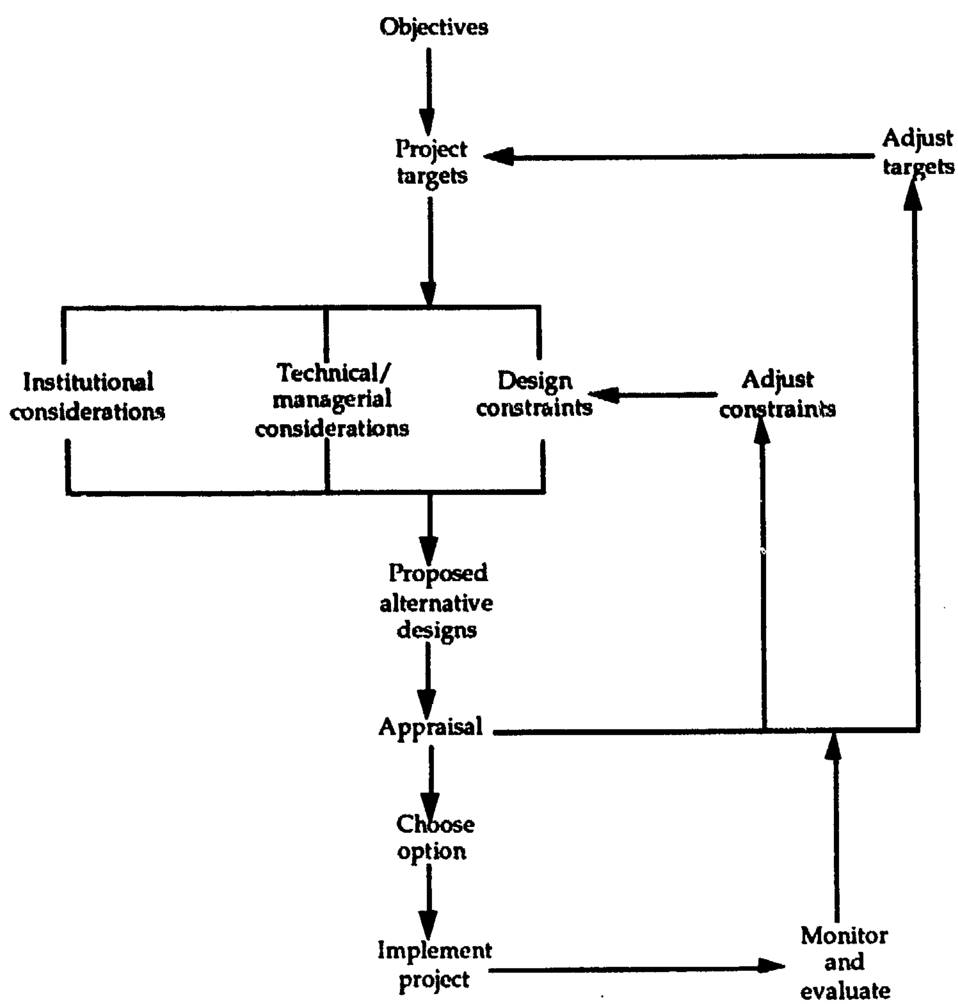
6

PROJECT PLANNING ISSUES

Planning a social forestry project is an iterative process that starts with a project idea and a set of stated objectives and finishes with a decision on a specific plan of activities and institutional arrangements. In most cases, the final set of objectives and targets will be modified during the planning process for various reasons. These reasons may relate to political constraints; resource scarcities; environmental conditions; and limitations on technical, financial, and institutional capacities that decisionmakers did not recognize when the process started.

For exposition purposes, the social forestry planning process is treated here as an orderly one that roughly follows the steps indicated in figure 6.1. In reality, however, project planning is less neat and generally requires circling through the process a number of times as the planning team moves toward the compromise that will eventually become a politically and socially acceptable, technically feasible, interconnected set of activities and institutions that will be "the project." The following paragraphs discuss the elements in figure 6.1, with a focus on issues of particular concern in social forestry planning.

Figure 6.1 Planning Social Forestry Projects



Understanding Objectives and Setting Targets

A primary objective for social forestry projects is to increase the sustainable net income or the welfare of rural people by increasing the availability of tree-related goods and services in the project area. Planners must identify the kinds of goods and services the project should produce, since different outputs require different technical designs. For example, species selection, spacing, and harvesting regimes are fundamentally different for a project aimed at fuelwood biomass rather than at timber production. In addition to production and efficiency objectives, social forestry projects may have objectives related to benefit distribution, employment generation, environmental improvement, tribal development, improved watershed management, and so forth.

Project beneficiaries—farmers and other community members—should be involved in the process of setting objectives. Getting them involved can be a frustrating task, as, for example, in highly democratic communal or tribal situations where all families in a region have to vote on a proposal. Nevertheless, local participation at this early stage of the planning process is essential, and so is a good understanding of local communities and their social and economic groupings (see chapters 7 and 8).

Normally, a project is prepared within a given budget constraint and often as part of a longer-term program. Initial boundaries on budget and time provide useful benchmarks for planners. Furthermore, they often reveal the administrator's or politician's view of the project's objectives and importance. During the iterative project design process, these initial boundaries are usually revised to conform to technical, social, commercial, and financial realities that come to light, and to the absorptive capacity of the target groups and implementing agencies.

The planner's initial task is to formulate project objectives in a concrete, operational form. A useful approach is to translate general objectives into specific targets and constraints within the boundaries of which the planner can design the project. In a commercial or public plantation project, the planner proceeds to set targets in terms of a certain number of hectares of plantations to be established, based on consideration of costs, intended outputs, demand for output, and how the project will fit within a broader wood supply program. The setting of preliminary targets is generally more difficult in social forestry projects, since it will involve specifying numbers of farmers and communities that will be involved and what they are expected to achieve. Hectares planted is a meaningless measure when people are planting trees along roads, in combination with agricultural crops, around their houses, or in small parcels here and there.

Number of trees planted is often used as a measure, but this measure also has its dangers. Trees planted is not synonymous with trees surviving. Most projects that involve planting by unskilled farmers cannot be expected to show survival rates much above 50 percent, and often survival rates are much lower. Furthermore, social forestry involves more than the direct benefits from the trees planted. Trees may be planted in combination with food crops or instead of food crops. Windbreaks may provide fuelwood, crop protection, shade and fodder for animals, and so forth. Output measures must reflect the multiple uses of trees and not just the total number of trees planted or cubic meters of wood produced.

Design Constraints

In addition to the initial size and time boundaries, the design of a social forestry project is guided by a number of specific constraints that relate mainly to limitations on financial, natural, or human resources or to political and institutional considerations. A major part of the planner's task is to define these constraints, recognizing that they might change during the planning process to take account of (a) better knowledge of the problem being tackled, (b) changes in the constraints themselves due to deliberate action to reduce them, or (c) both (see feedback loop in figure 6.1). Appendix 6.1 shows the types of data needed to define project constraints.

Public financial resources

Normally, administrators and public officials determine the public sector budget allocation before project planning starts. The amount initially allocated for a project will have a significant impact on the scale of the project. Often the exact level of the project budget will be subject to adjustment during the planning process; however, many administrators are reluctant to accept provisions for inflationary increases of project cost over time. This could result in the actual size of the project being smaller than initially envisaged, particularly in highly inflationary economies.

Land and labor

Participants in social forestry projects, such as local communities, NGOs, or individual farmers, contribute part of the resources used. The availability of such resources has substantial implications in terms of developing strategies to meet project targets. For example, in parts of India and in Haiti, most of the trees planted under social forestry projects are planted by farmers on their own land, while the government provides seedlings and technical assistance. Farmers' resources will be forthcoming only if they think that their contributions, mostly in the form of land and labor, will give them commensurate returns. If market conditions change for the worse during project implementation, the availability of local resources can decrease substantially. Therefore, a careful assessment of market conditions, demand expectations, and participant response is required to establish the likely availability of participant resources during the project's life.

The availability of land that is suitable for forestry, free of other claims, and to which intended beneficiaries have access is a major constraint in social forestry development (see chapter 10). Generally, planners will find that available public or common land suitable for social forestry is limited, often because of political reasons. Official records of availability often do not reflect the actual use of such land for various legal and illegal purposes. Private land available for social forestry is also limited for a variety of reasons.

Local labor is usually available, and employment generation is actually an objective in most social forestry projects. However, in some cases, labor availability can be a constraint, particularly during certain seasons. So planners must consider carefully the availability of labor during critical periods (for example, planting time, which in some climates and conditions can be a very short period) that may overlap with periods of heavy labor requirements for agriculture. Labor may be scarce in a number of other situations, for example, in projects where planners have determined that women will do much of the planting and tending of trees, given their other duties, women may not have the free time available.

Technical staff

A lack of technical staff can be a severe constraint in social forestry projects. Existing staff from public forestry agencies can be asked to perform additional tasks, but ultimately the volume of work that can be performed without adding more staff is limited. Planners, however, often overlook the lack of technically competent people in the planning stage. This can result in project proposals with ambitious staff recruitment programs that never materialize, which means that targets may not be met and/or that the quality of work suffers due to the shortage of staff. If a staff training program is required, this might delay project start-up.

Supply and demand conditions for project outputs

Project planners must determine the requirements and demands for products (goods and services) that could be produced under the project. This includes both market demand and nonmarket requirements. Planners must also establish what the production of such commodities would be without the project. In this context, the term production should mean production on a sustained-yield basis. Planners should also note that wood consumption normally goes up with increased availability, lower prices, or lower cost of access to it. Planners should establish which commodities are in shortest supply and in which areas. Using this information, scarce resources can be allocated to areas where they are most needed and where, therefore, the local response is likely to be most favorable.

In making demand forecasts for various outputs associated with a project, planners must consider both the breadth of the market (that is, the variety of social forestry outputs that are consumed in the relevant market area) and the depth of the market (namely, the extent of consumption of individual products). Market depth is often difficult to estimate, particularly in situations where the market is currently nonexistent or poorly developed. One strategy in such cases is to plan for multipurpose species that have a variety of uses. This was the approach taken in Korea's fuelwood program. While the main objective was fuelwood production, planners recognized that the demand might be overestimated, given the rapid rate of electrification and development in rural areas. This turned out to be the case in many areas, so plantation wood was diverted to other purposes.

Environmental protection

Afforestation or improvement of existing forests can serve a dual purpose: environmental improvement and production of forest commodities. In social forestry, trees are seldom planted for environmental purposes alone. However, in areas where existing vegetation must be protected to ensure its regeneration or in areas that contain unique flora and fauna, a relevant criterion could be that tree felling should be controlled or prohibited. Another important consideration is that some tree species that retain their leaves in the dry season consume substantial amounts of water and, therefore, should not be planted where the objective is to stimulate groundwater recharge. In such cases, either planting should be avoided or appropriate species with a low water demand should be selected. If, however, rising water tables and salinization is a problem, planners should suggest technical solutions that employ trees that use a lot of water. This will allow both environmental improvement and wood or fodder production.

An often neglected consideration is that livestock grazing can have a profound, negative effect on the regeneration of existing forests and survival of newly planted trees. These problems can be partly offset if social forestry projects produce substantial amounts of grass and tree fodder for the stall-feeding of livestock. A relevant design consideration would be to prescribe that, in all new plantations with adequate soil and moisture conditions, the grasses between the trees should be improved and that a certain percentage of planting should be with locally recognized fodder trees (see chapter 3).

Benefit distribution

A feature social forestry projects have in common with agricultural projects is that they are based on land, which is a limited resource to which the poorest people normally do not have access. Therefore, already at the onset a forestry project will inevitably be aimed at those who have land. However, several design considerations can increase the utility of the project to the poorer of the intended beneficiaries. Potentially, the most important is to provide employment opportunities in rural areas. The project could focus on areas with underemployment, and attempt to create work opportunities in those areas, for example, in small-scale harvesting and processing activities. Another consideration is to ensure that more well-to-do people do not use poorer people as free labor in self-help schemes that end up providing benefits mainly for the former. In other cases, the landless can be given access to public lands for the purpose of tree growing.

Cultural and social constraints

All projects must be planned so that they are in harmony with local customs, attitudes, habits, behavioral patterns, and incentive structures in order to secure active involvement of the people concerned (see chapters 7, 8, and 9). A project out of harmony with local customs and attitudes is not likely to succeed. For example, if local people feed their cattle with tree fodder that they cut and carry, planners should consider species suitable for that purpose. If, however, uncontrolled grazing is prevalent, nonbrowsable species might be preferable to protect them. If poor people traditionally have had little say in local decisionmaking, the project's design might ensure that benefits automatically go to the less advantaged. For example, certain *Acacia* species can produce much biomass, but not be suitable for commercial timber sale and, therefore, not attractive to commercial loggers.

Technical and Managerial Considerations

The choice of technical implementation models involves two considerations. Given social forestry's focus on benefits for local people, the first step is to define the tree-growing models that the project will employ. Models are defined on the basis of who will do the planting and tending, where it will be done, and who will have access to the benefits. The next step is to choose the technical packages (the species, planting methods, other inputs needed, and so on) that will fit best. This choice depends very much on physical and biological conditions—soils, climate, and so on—and on institutional and social considerations (see chapters 8, 9, and 10).

Tree management models

There are five basic tree management models for social forestry, four of which involve tree planting, plus a fifth model for improved management of existing woodlands.

1. **Community woodlots**—planting by the community (self-help) or by an outside agency (governmental or NGO) on land the community owns, with benefits being shared by the community group.
2. **Farm forestry**—planting by farmers on their own land in strips on farm boundaries, in blocks, or as individual trees around the house or elsewhere (for example, agroforestry systems as discussed in chapter 3).
3. **Tree tenure forestry**—planting by individuals on land allocated to them for the specific purpose of tree growing. (This normally means that the landless or farmers are being allocated a piece of public land. The land would still belong to the government, but the holders have the right to cultivate it and they can dispose of the products at their discretion, as long as they keep the land under tree production.)
4. **Departmental forestry**—planting by a governmental department on land belonging to the government. (This includes land along roads, railroads, and canals—strip plantations—and reserved forest land—[block plantations]. The department then sells the outputs or gives them to certain individuals or groups within a community.)
5. **Joint management of existing communal or public woodlands**—controlled management of selected areas of natural forest or woodlands, jointly implemented by a forest department and designated local participants, with the latter receiving defined quantities of products (grazing, fodder, wood, and so on) for free or at agreed prices.

After determining broadly how much land might be available for each of these models, the planner needs to consider the technical packages that would fit the models. This involves consideration of species choice, spacing, planting patterns, protection activities, and so forth.

A first, but sometimes neglected, step in the process of choosing options is to consider the management of existing vegetation (model 5). The existing vegetation might be degraded trees, but could also be bush vegetation or rangelands that could be managed to yield useful biomass in the form of fodder and fuel at less cost than producing biomass in plantations. The technical considerations for this model are, of course, quite different than for models involving the planting of trees.

Choice of species

Selecting the most suitable species for the project's location and objectives is of crucial importance. Unfortunately, no tree will serve every purpose, although a number of species perform well in many latitudes and under a wide range of climatic and soil conditions (see Panday 1982; Weber and Stoney 1986). The width of the band of tolerance (or adaptability to ecological conditions) varies considerably; some species are very sensitive to changes in soil and climate, while others have a much wider range of tolerances. Many lists and references on species selection exist (see Burley 1980b; National Academy of Sciences 1980a, 1983b; Carlowitz 1984; Huxley 1984b; Nair et al. 1984). Box 6.1 provides an indicative list of species for three different rainfall zones in Africa. Planners should seek local sources of information to the extent possible.

Box 6.1 Common African and Introduced Trees Species by Water Requirement

Dry sites: 200 to 500 mm mean annual precipitation

Acacia albida	*Conocarpus lancifolius*
Acacia radiana	*Dobera glabra*
Acacia senegal	*Euphorbia balsamifera*
Annona senegalensis	*Maerva crassifolia*
Balanites aegyptiaca	*Parkinsonia aculeata*
Boscia salicifolia	*Prosopis juliflora*
Commiphora africana	*Ziziphus spp.*

Medium sites: 500 to 900 mm mean annual precipitation

Adansonia digitata	*Ficus sycomorus*
Anacardium occidentale	*Haxoxylon persicum*
Azadirachta indica	*Parkia biglobosa*
Bauhinia spp.	*Salvadora persica*
Cassia siamea	*Sclerocarya birrea*
Combretum spp.	*Tamarix articulata*
Eucalyptus camaldulensis	*Terminalia spp.*

Moist sites: 900 to 1,200 mm mean annual precipitation

Albizia lebbeck	*Cordia abyssinica*
Anoegeissus leiocarpus	*Dalbergia melanoxylon*
Borassus aethiopum	*Erythrina abyssinica*
Butyrospermum parkii	*Markhamia spp.*
Casuarina equisetifolia	*Tamarindus indica*

From Weber and Stoney (1986). Reprinted with permission from Volunteers in Technical Assistance

In addition to climate, soil, and water, environmental factors may affect the choice of species (Weber and Stoney 1986), namely:

- Elevation—some species will thrive only above or below a certain altitude.
- Slope—some species are especially useful for erosion control on steep slopes and unstable soils because they have lateral root systems (*Acacia* spp., *Balanites aegyptiaca, Anacardium occidentale*).

- Topography—rough, broken terrain may vary a great deal in microsite conditions, thus species that can tolerate a wide range of site conditions are needed.
- Fire history of the area—are fires rare or frequent? Some trees are more fire-resistant than others.
- Pests—certain pests affects some trees more than others, therefore a planting site that has several kinds of trees is less likely to be destroyed by insects or disease, because a pest that attacks one species of tree may not be attracted to another species.
- Animals—do the livestock in the area prefer the leaves and bark of certain trees more than those of the other species under consideration?

Planners must also take social factors into account. Farmers will tend to favor those trees with which they are familiar. Many programs have fallen short of their goals because the species offered to farmers did not appeal to them. This emphasizes the importance of giving the fullest consideration to the preferences of local participants. Farmers use trees that are compatible with their other farming practices. Therefore, they may select tree types whose volume production may be inefficient or that do not produce high quality wood, but that, nonetheless, satisfy their other selection criteria (for example, relatively small with slender crowns that do not cast too much shade, deep-rooting and thus do not fill the topsoil with roots, with foliage that is valuable as fodder, are nontoxic to other plants, and so on). Thus, an overriding concern in species selection is the desires and perceptions of the project beneficiaries and of those on whose behavior the success of the planting depends. Thus, species selection becomes very much a matter of local judgment and choice (see box 6.2).

Planners should choose species based on the intended output, both in terms of production (fodder, fuel, or timber, for example) and in terms of other aspects such as shelter, soil improvement, and environmental protection. Many species are multipurpose by nature, and other species can be managed to serve several purposes by proper silvicultural treatment. Still other species have a more narrow usage; a feature that planners can use to ensure that intended objectives will not be modified during the period that the tree is growing to maturity.

Species used for field boundary plantations require special consideration. If free-grazing cattle have access to the area, the species must be nonbrowsable or farmers must produce sufficient fodder from grass and trees to ensure that the cattle can be stall-fed. The cost for fencing or providing guards for such plantations is normally prohibitive. A further consideration is that trees selected for field boundaries should not compete for scarce natural resources required for other crops. The effect of the species on soil fertility, availability of light, and protection from strong winds must also be considered.

Box 6.2 Factors Affecting Species Choice: Senegal

The cashew tree *(Anacardium occidentale)* is technically a good multipurpose tree that tolerates a wide range of soil types, elevations, and rainfall variations. It is valuable for soil reclamation and protection and it produces cashews that can be consumed locally or sold as a cash crop. In addition, it provides fuelwood, tanins, dyes, and medicines. But, in parts of Senegal, local people believe this tree attracts ghosts (Hoskins 1979a), while in other countries, people think that the cashew apple is poisonous if eaten with dairy products. In some areas, cashew nuts are not even harvested because an oil in the nutshell irritates the skin.

From Weber and Stoney (1986).

Planting pattern

Three planting patterns are commonly used: strips, blocks, and individual trees. The selection is determined by the availability of land and the specific project objectives.

- Strip plantations often use land that cannot be used for other purposes. Strips can produce the benefits of shelterbelts, as discussed in chapter 3. They are, however, more expensive to establish and protect than blocks. Strip plantations are most common in farm forestry as field boundary plantations and in departmental or tree tenure forestry alongside roads, railroads, and canals.
- Block plantations are cheaper to establish, easier to protect and manage, and produce better quality poles and timber.
- Finally, individual trees are sometimes planted around the homestead or in gardens and fields, often among annual crops or perennial food crops, such as in traditional homegardens or in agroforestry systems.

Spacing of trees

In plantations, the spacing of trees is an important technical consideration. High quality plantations (for timber) can be established either by wide spacing, or by dense spacing that is later widened by thinning. Since the cost of establishment rises with the number of seedlings planted, selecting the best spacing to optimize growth of the trees is important. A further consideration is that thinning and other silvicultural treatments could be costly, however, they could yield intermediate benefits, such as employment.

If the project's objectives are not primarily wood production, planners must consider other implications of spacing in addition to those already discussed. Grass and treefodder production is an important consideration if livestock production is part of the land-use system. This requires less dense spacing than if the only objective were wood production. Intercropping with commercial or subsistence agricultural crops between the trees during the years of establishment is a common practice that also has a bearing on spacing. Under certain site and other conditions, an agroforestry model may best meet project objectives. The spacing between the trees must be increased when intercropping is to take place during the full tree rotation. Planners must weigh the advantages and disadvantages of different spacings for each situation.

Protection

Protection problems are common to all models, but are more pronounced for strip plantations and for all types of plantings in areas with high human and/or livestock population pressure. If people are against a plantation project, they will always find a way to graze their livestock in the area or otherwise destroy the seedlings. If, however, they are in favor of the plantation, they can nearly always manage to keep their livestock out of the area, just as they do with their crops.

Social forestry plantations should be protected through the active participation of local people right from the beginning. If fencing is required, various plants and tree species can be used for living fences, thereby reducing the costs and increasing the production of useful biomass.

Considering "best practices"

When designing a project, planners should always consider the best techniques ("best practices") local farmers are currently using to grow trees. Farmers who are using best-practice techniques may be obtaining significantly higher yields and incomes than those who are not, even though both groups are growing the same species. In this case, the first step is to see what can be done to achieve wider adoption of the best-practice techniques. The barrier to adoption may be difficulty in obtaining planting material, lack of knowledge of improved cultural practices, insecurity of tenure, shortage of labor at planting time, or lack of some other input (box 6.3). In the case of planting material, for example, in the tropics many trees will not survive after planting if their roots have been exposed to direct sunshine for more than 15 to 20 minutes. Hence, many seedlings that have been planted with dried-out roots have failed, resulting in a consequent loss of enthusiasm on the part of those who planted the trees.

Box 6.3 Constraints on Tree Planting: Tanzania

Both the government owned and village nurseries are not raising enough seedlings at the right time, though the main reason seems to be inadequate resources; locally available materials are not being used. A good illustration is the use of polythene seedling pots: their production is low. Only two plants, both in Dar es Salaam, produce polythene rolls from which the pots are made. Yet foresters sit and wait for these rolls for several months or longer. No wonder 70 to 90 percent of all late tree planting between 1970-80 was attributed to the late arrival of polythene rolls. Other options are available. Villagers have been using banana peelings to make coffee seedling pots for ages. Of course, banana plants are not available throughout the country, yet even in those areas rich in bananas, villagers insist on using polythene pots. Another alternative is earth balls (a ball-like pot made from clay and other types of soil), which give reasonable tree survival and are cheap: only about a third of the cost of polythene rolls.

From Mnzava (1983).

Project planners should systematically assess current practices to determine the range of techniques used, and establish the proportion of farmers using best-practice techniques. This will indicate whether or not interventions based on existing local knowledge are likely to increase production and income. This approach has the advantage of building on technology that is already proven under local conditions, and thus should reduce the risk of failure (see chapter 7).

The next step is to compare the advantages and costs of any proposed new techniques over the existing best-practice techniques. If the planners think that advantages exist, then they must judge the pace at which these techniques should be tested and introduced to ensure that they are technically sound and acceptable for adoption by local farmers.

Tree growing and harvesting technology

The management system for farm-grown trees will usually differ from that used in commercial forest plantations. For example, the main objective in commercial plantations is likely to be the production of stem volume suitable for sawn wood or plywood production, whereas farmers may be growing trees for small poles, firewood, and fodder, in which case branchwood and leaves are the most important outputs. Many species of trees are well suited to this latter type of production when farmers coppice, pollard, or prune the trees.

Coppicing, as explained earlier, is the practice of cutting trees close to the ground, leaving a stump from which new shoots grow. Only certain species provide this option, since many species do not sprout from the stump. With coppicing species, the shoots are thinned to the desired number, usually one to three, and these then grow into the second rotation crop. Coppicing can be repeated over a number of rotations from the original root system. For example, three to four rotations of five to six years each is common for eucalyptus species in the tropics. Some species can be coppiced for much longer periods. For producing small-diameter stakes, once-a-year coppicing is commonly practiced, and for fodder production, some fast-growing species can be coppiced several times a year. *Leucaena leucocephala* can be coppiced annually for 30 years or more in humid regions (Weber and Stoney 1986).

Pollarding is similar to coppicing except that the tree stem is topped some distance from the ground, usually 2 to 2.5 meters, and the new shoots grow from the top of the bole. This system prevents damage to young shoots by browsing domestic and wild animals, and also enables the bole to grow to a large diameter suitable for sawn timber.

Pruning and lopping are the periodic removal of branches or parts of branches. In commercial forestry, trees are pruned to get rid of unwanted branchwood and channel the vigor of the tree into stem growth. In farm forestry, farmers usually prune to obtain intermittent supplies of fuelwood or fodder, relying upon regrowth of the branches to replenish the supply. Farmers may use a different pruning technique called "lopping," in which the branch is cut some distance from the stem to stimulate regrowth. Since farmers often obtain a very significant proportion of their tree products from branchwood, this difference in approach is important to remember when estimating individual tree production of farm trees. Farmers generally use a combination of coppicing, pollarding, and lopping to regulate the size and spread of the crowns of trees so that they do not interfere unduly with other crops.

Tree yields in farm forestry

Planners must be cautious when using conventional forestry data to estimate yields of open-grown trees, that is, trees grown away from other trees, thus having no competition from others on farms. Foresters customarily measure tree yields by calculating the annual metric volume growth of merchantable timber (stems of trees over a certain diameter or size) on a per hectare basis; they then express this as growth of so many cubic meters (m3) per hectare per year. For example, growth rates of 1 to 2 m3 mean annual increment (mai) per hectare are common for slow-growing natural forests, and 10 to 20 m3 mai are not unusual for plantations of coniferous trees, while 30-40 m3 mai can be found for well-managed eucalyptus plantations. In other words, foresters do not measure the annual growth of individual trees, but rather the mean commercial volume growth per hectare.

This measure is not useful for estimating the yields of scattered or single-row trees planted on farms for two reasons. First, foresters customarily measure the growth of the stem only and do not include small branchwood, the salvage wood left after logging, and the small, young trees that are removed during the early stages of the plantation and not sold. Second, in commercial plantations, trees are grown in competition with each other to produce tall, straight trunks with a minimum of branches for high quality timber. This constricts crown formation and depresses the total growth of individual trees. This is why the trees in the outside rows of a plantation are usually larger in diameter than those inside (the edge effect).

Farmers are likely to grow the same species of tree as in plantations for its entire biomass production, not just the merchantable lumber volume, and will probably not grow the trees in such severe competition, although they may be surrounded by grass or crop plants. Therefore, the per tree, effective annual yields of farm trees are likely to be higher than those indicated by forestry data based on plantations and stem volume only.

Institutional Considerations

The success of any social forestry project depends on active, positive support by the people in the project area. No technical solution is so good that it can work regardless of people's support. Therefore, as already emphasized, the intended beneficiaries have to be involved right from the beginning, whichever technical model is used. During project preparation, planners must acquire an understanding of the people affected by the project. With this knowledge, they can formulate an institutional framework that takes account of the local social and economic circumstances. Establishing the procedures for ensuring active involvement are more important than the detailed project design itself.

Incentive mechanisms

Market and nonmarket incentive mechanisms will be the driving forces behind getting and sustaining widespread local participation. Experience to date indicates that market incentives are particularly effective. In some cases, however, planners will have to introduce nonmarket incentives, such as subsidized inputs, credit, and tools; and provide free extension and other technology transfer services. In all such cases, planners must be aware of the potential problems of creating long-term local dependence on outside resources and of reducing local initiative.

Note that most farmers can draw on a whole set of incentives and subsidies related to their agricultural activities. In most countries, farmers receive free extension advice and sometimes subsidized inputs and credits as well. In addition, the final farm product may be subject to price regulation designed to ensure attractive output values. Planners designing incentive mechanisms for social forestry programs should be able to rely on experience in the agricultural sector.

Distribution of benefits

A general objective in social forestry is to generate tree-based benefits for the poorer members of society. In practice, this is often difficult to achieve since the poor are not normally in control of the land to be used for tree production. Also, the production and distribution of forest products on communal lands is beset with fundamental problems. Even if project planners can convince a community to establish plantations, some individuals will likely cut a tree or two for themselves before the plantation is mature. The "law of the commons" will ensure that others will follow suit to protect their "rights" before all the trees are gone.

There are several ways to overcome these problems. In the simplest distributional model, production is under the control of the individual, as in the case of farm and tree tenure forestry. The drawback, however, is that this system gives the benefits to those who already have access to land and who, therefore, are usually not the poorest members of a community. Moreover, larger farmers stand to gain more than smaller farmers. During project design, planners can minimize this problem by stipulating that poorer people have preferential access to extension services and material support.

With respect to communal forestry, experience has shown that the distributional model most likely to succeed is that which allocates the same nominal benefit (amount of wood or other product) to each member of the community. An equally important consideration is that all the members of the community should understand the project's methods and purpose, both to prevent abuse and to ensure active local interest in protecting the plantation.

In the departmental forestry and natural forest management models, benefits might be distributed differently. The most important principle is that those individuals or communities who were using the land previously or those who could help protect it after establishment must receive some of the benefits. In highly populated areas, this could mean that all production would be allocated accordingly. In isolated areas, some or all of the production could be allocated to those who do not have access to forest products, cannot afford to buy them, and cannot benefit from other social forestry schemes. This distributional model would only apply when tree tenure forestry is not feasible.

Products from road-, railroad-, or canal-side plantings could be distributed to neighboring communities or to individuals as in the tree tenure schemes. In some cases, however, the identification of suitable beneficiaries might be so complicated or random that distribution to deprived people outside the area might be more appropriate. In any case, planners must consider distribution rules and channels at the early stages of planning, since the results will be of great interest and importance to the local population.

Project organization

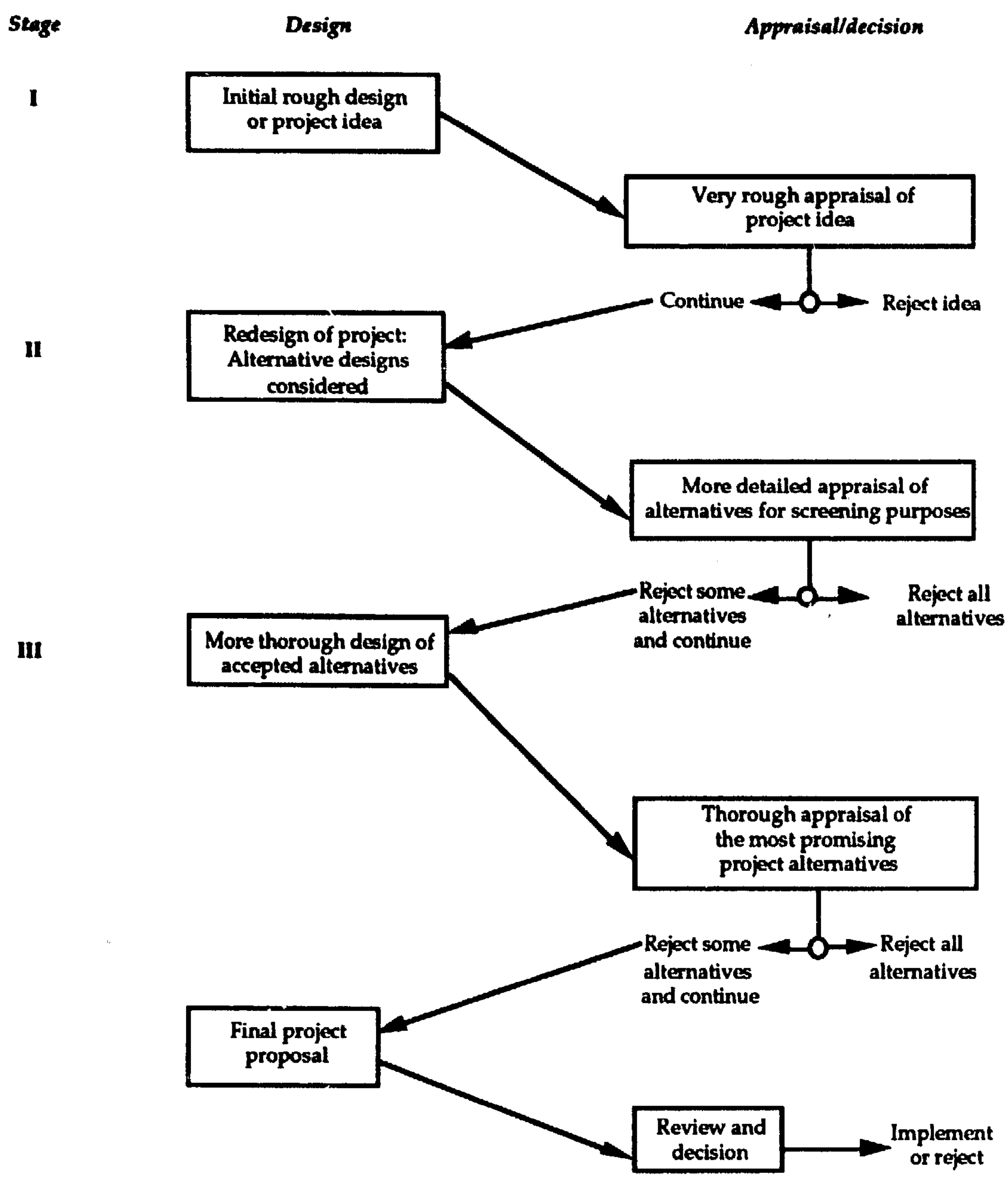
So far the discussion on project planning has been limited to management of the different planting models, but has not covered the linkage between these models and the government.

This linkage between individuals and communities on the one hand and governmental departments on the other can be direct, or indirect by means of NGOs. The organizational structure should ensure that the intended beneficiaries can communicate their ideas and opinions to the government, and that the government can extend funding and technical support to the communities and people involved in the project.

Project Appraisal

During the planning process, a parallel appraisal process is going on to guide design efforts systematically toward options that are effective and economically efficient, and that meet certain conditions related to social equity and environmental stability goals. This iterative and interactive process of design and appraisal is illustrated in figure 6.2.

Figure 6.2 Stages in the Project Planning and Appraisal Process



Source: OECD (1986). Reprinted with permission from the OECD.

The process generally culminates in a formal appraisal when the design is fairly clearly defined. This appraisal estimates the project's likely economic, social, and environmental impacts. It contains information that is vital for decisionmakers when choosing among project alternatives and deciding whether or not to undertake a given project. The OECD (1986) discusses the basic elements involved in appraisal of forestry projects. Specific guides to the economic analysis of projects are provided in Gregersen and Contreras (1979) for forestry; by Gregersen et al. (1987) for watershed management; by Gittinger (1982) for agriculture; and by Hansen (1978) for projects in general. The following paragraphs summarize some key considerations for appraising social forestry projects.

The nature of project effects or impacts

A social forestry project can have a great many impacts, both locally and nationally, over time (table 6.1). Thus the first step in the appraisal is to identify and define the project's probable impacts. To do this, the appraiser should make a projection of what is likely to happen with the project and compare that with a projection of what would be likely to happen in the absence of the project (the without project condition). The difference provides an indication of the nature and level of project impacts.

Table 6.1 Common Effects of Social Forestry Projects

Economic and financial effects

- Regional and national level of production
- Allocation of resources
- Regional and national income
- National balance of payments
- Stability of income over time
- Distribution of income (both interpersonal and intertemporal)
- Public budgets

Environmental effects

- Ecological diversity
- Watershed stability
- Wildlife protection
- Soil protection
- Landscape aesthetics
- Natural resource conservation
- National patrimony

Social effects

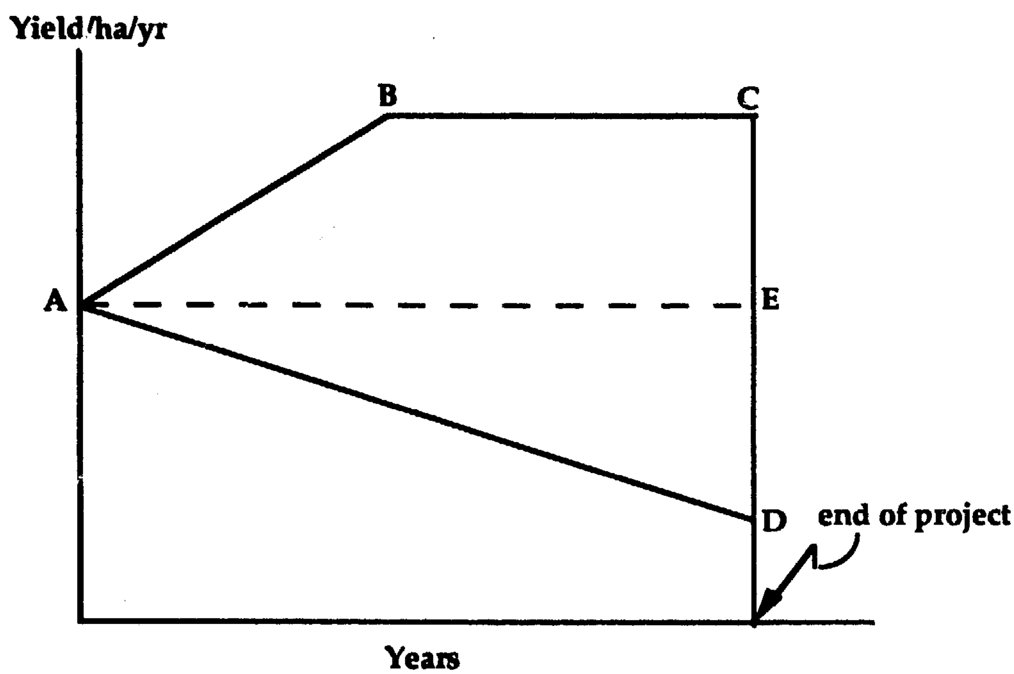
- Regional employment
- Working conditions
- Public participation
- Migration flows
- Cultural traditions
- National vulnerability
- Political stability

Note: Despite the division into three categories of effects, substantial overlap occurs.

Source: OECD (1986). Reprinted with permission from the OECD.

Note that in social forestry projects that, for example, involve soil conservation elements, the without project situation will not be the same as the before project situation. Where soil conservation measures are introduced, a dynamic process is involved where productivity is steadily declining over time as the land continues to be misused. Thus, figure 6.3 shows that the estimate of benefits with the soil conservation practices should be the area ABCD, and not area ABCE, which would only define the benefits under the assumption of no further decline in land productivity without the project. In reality, productivity would usually decline steadily as indicated by line AD. The point here is that losses avoided (area AED) are just as important a benefit as productivity increases gained. In social forestry projects, many of the benefits will be losses avoided, which may be difficult for untrained appraisers to estimate. For example, many agroforestry practices merely help to maintain crop productivity or reduce its decline and do not result in any measurable increases in crop production. This loss of productivity avoided is a legitimate benefit that must be included and will be if the appraiser compares the with project and without project situation and uses the results to identify impacts or benefits and costs.

Figure 6.3 Estimating Project Impacts



Source: Gregersen and Contreras (1979).

Organizing project appraisal work

As mentioned, project appraisal—albeit of a partial nature—should be included in the early stages of the project planning process, culminating in a final appraisal that will be presented to decisionmakers. While some organizations require elaborate, formal, and often expensive project appraisals, in most situations the appraisal process will be organized more informally and will involve fairly low levels of input. In many cases, this is because the resources to carry out more elaborate appraisals are simply not available.

Table 6.2 summarizes the three stages of an appraisal. The number of stages given here is arbitrary and only illustrates the progression of work as planners go from initial ideas to final project proposals. In some cases, the appraisal may not go beyond stage I, if the decisionmakers believe that they have enough information on which to base their decision. In other cases, as mentioned above, formal agency rules require going through the systematic and detailed process of stage III appraisal.

Table 6.2 The Stages of Project Appraisal

Stage I. Rough appraisal

- make tentative calculation of the economic effects of the "most obvious" project alternative and the "without" alternative
- make quick assessment of financial, administrative, and political feasibility
- attempt to detect adverse environmental effects (i.e., long-term and system effects), social effects, and effects on different groups concerned (i.e., distributional effects)
- consider means to mitigate negative effects

Outcome: recommendation on whether or not to continue with project idea

Performed by: project initiator, using existing available information

Stage II. More detailed appraisal for screening purposes

Using the results of stage I, the appraisers

- design several project alternatives that seem relevant in light of existing objectives and of the major problems arising in the environmental and social fields, as identified in stage I
- acquire economic, financial, environmental, and social expertise for the appraisal
- make calculations of the economic and financial effects of the alternatives, possibly improving upon existing forecasts and shadow prices
- identify and describe the major social effects, possibly with the help of a representative discussion group
- identify and describe the major environmental effects, particularly indirect and long-term effects
- sample public opinion on the project alternatives
- exlude alternatives that are not feasible for administrative or political reasons
- rank the remaining alternatives, possibly using the representative discussion group

Outcome: identification of several promising project alternatives, elimination of alternatives with obvious flaws, decision on whether to continue the project

Performed by: appraisal team in collaboration with external expertise and possibly a representative discussion group

Stage III. Thorough appraisal of the most promising project alternatives

Given the results of stage II, the appraisers

- redesign the project alternatives in the light of results obtained in stages I and II
- complete the detailed analyses of economic/financial, environmental, and social effects, collecting new data where necessary and using the insights of a representative discussion group (level of detail depends on the time and budget available, on the purpose of the appraisal, and the nature of the project)
- complete an appraisal report on the most promising alternatives, in the form of a scenario of likely developments over time for each alternative, including the "without" alternative
- rank the most promising alternatives as seen by various groups, in collaboration with the representative discussion group, and possibly with input from local hearings
- prepare summary presentations of the scenarios and the ranking results for the decisionmakers, public group, financial institutions, and other authorities

Outcome: the necessary basis for choosing between project alternatives or terminating the project

Performed by: appraisal team, in collaboration with the discussion group and whatever expertise is available given budgetary and time constraints

Source: OECD (1986). Reprinted with permission from the OECD.

Those organizing appraisals for social forestry, need to keep the following points in mind:

Involving local people. Local people (intended participants) should be involved in project decisions. Therefore, appraisers should include them in the appraisal process, and the appraisal should address their concerns and interests. This also means that the appraisal should examine costs and benefits from the viewpoints of the various groups of intended project participants in addition to looking at them from the financing and/or administrating agency's point of view.

Establishing economic and financial impacts. Five economic/financial questions are generally of concern to decisionmakers when looking at the impacts of social forestry and related projects.

- *Economic efficiency.* From society's point of view, do the benefits outweigh the costs when both are appropriately adjusted for the times when they occur? This answers the question of whether or not the project is expected to increase the aggregate economic benefits (goods and services) available to society derived from the use of the nation's limited or scarce resources.
- *Distribution of impacts.* Here interest focuses on which groups will gain from the project and which groups will lose (or have to pay the costs). In most social forestry situations, the focus is on how the poorer members of society can benefit from the project. Often the focus is also on benefits and costs for specific regions.
- *Economic stability.* This relates, for example, to questions of how the project might affect the stability of economic activity seasonally and over the long run in the project area, or how the project might affect the balance of payments. The question is tied up with the whole issue of sustainability and the introduction of activities that help to avoid nonsustainable uses of natural resources and disruption of local communities.
- *How will local people fare financially?* In other words, does the project involve local activity that will be financially attractive to each of the private entities that will have to be involved to make the project succeed? If not, then incentive mechanisms will have to be considered. Chapter 5 addressed the question of the financial profitability of various tree-growing models to farmers and other land users, and indicated that rates of return vary widely, but can be quite attractive. Incentive mechanisms—both market and nonmarket ones—are addressed in chapter 9.
- *Budgets and financing.* Does the project exceed reasonable budget limitations? What about recurring cost issues? How will the various components be financed (through beneficiary repayment, through regular public budget allocations, through special grants, with foreign donor or lender funding, and so forth)? Obviously, the resolution of budget issues is critical for project implementation and success.

In analyzing all these questions, appraisers must keep the project's dynamics—or its time-related effects—clearly in mind. This is particularly important, for example, when looking at expected demand for social forestry project outputs over time.

In answering the above questions and others, appraisers should remember that the purpose of the appraisal is to provide information needed to make practical decisions. It should not be a highly technical document that obscures relevant issues by applying sophisticated analytical techniques. In this regard, social forestry projects generally involve a number of nonmarket costs and benefits that are not amenable to quantitative economic or social analysis. This is no excuse to ignore them. Further, there are acceptable ways to deal with values for a number of outputs and inputs not traded in the market and, therefore, that do not have market prices attached to them (see Gregersen and Contreras 1979; Sinden and Worrell 1979; Hufschmidt et al. 1983; Peterson and Randall 1984; and references cited therein). Box 6.4 provides an example. If appraisers cannot quantify the effects of a project (costs, benefits, social or environmental impacts), they should at least describe them explicitly so that the decisionmakers have as much information as possible on which to base decisions.

Finally, project planners must use practical judgment in deciding how efforts will be spent in appraisal work. If economic rates of return are irrelevant to the decisionmakers—as they are in some countries—then spending time calculating them makes little sense. Similarly, if farmers/participants are concerned about financial rates of return, then that is a relevant measure, and should be calculated.

Box 6.4 Estimating the Value of Fuelwood Based on Replacement of Dung: Nepal

Appraisers calculated the economic value of fuelwood in terms of the cattle dung that the fuelwood would likely replace. They used the following coefficients:

- 1 kg of air-dry fuelwood contains	4,700 kcal
- 1 kg of dry cow dung contains	2,400 kcal
- 1 m3 of air-dry fuelwood weighs	725 kg
- The dung equivalent of 1 m3 of fuelwood is thus (725 x 4,700)/2,400 =	1,420 kg
- 1,420 kg of dung yields four times that quantity of manure, i.e.:	5,680 kg
- Farmers use on the average 8 tons/ha of manure on maize fields, which increases yield per ha by about 15 percent of 1,500 kg/ha or 225 kg	
- 5,680 kg/ha of manure thus increases maize yield per ha by about (5,680/8) x 225 =	160 kg
- 160 kg of maize has an economic value of	NRs 520
- The economic value of 1 m3 of fuelwood is therefore about	NRs 520

Note: NRs = Nepal rupees

From World Bank (1986a).

However, even if financial and economic rates of return are not considered, this does not mean that socioeconomic and environmental impacts are irrelevant in the broader context of the project and the public agency's decision to undertake it. This is where the distinction between economic rates of return and financial rates of return enters the picture. From the point of view of individual investors or farmers, the only items of concern may be the monetary costs incurred and the monetary returns received. However, from society's point of view, the broader socioeconomic impacts also matter. How will the project affect people downstream? How will the activities of one farmer affect the neighbors' welfare? What will be the nonmarket impacts of the project, for example, on environmental stability and cultural values? Table 6.3 indicates some of the differences between financial and economic analyses.

Handling uncertainty. Social forestry projects should be planned on the basis of best estimates of the various relationships between inputs and outputs and how they will change over time. All involved in making decisions need to be aware of the nature of the uncertainty surrounding alternative uses of resources or alternative approaches to achieving project objectives. In most cases, quantifying the elements of risk in projects is not practical; and, by definition, quantifying the probabilities of events in situations of uncertainty is not possible. Thus, in most cases, decisionmakers must make judgments: they weigh all the information available on a given element of uncertainty and make an intuitive judgment. The appraisal process can sometimes provide useful information that will help make such judgments, but it cannot eliminate them. Thus, a sensitivity analysis can be developed that looks at the sensitivity of the relevant estimated measures of project performance (rates of return and so forth) to changes in assumptions about input and output variables in the project. For example, the financial rate of return might be examined under several alternative assumptions about the value of fuelwood in the future; or changing wage rates; or varying growth rates for trees, losses due to insects, disease, illegal harvest; and so forth.

Table 6.3 A Comparison of Financial and Economic Analyses

Item	*Financial analysis*	*Economic analysis*
Focus	Net returns to equity capital or to the private group or individual.	Net returns to society.
Purpose	Indication of incentive to adopt or implement.	Determines if government investment is justified on economic efficiency basis.
Prices	Prices received or paid either from the market or administered.	May require "shadow prices," e.g., monopoly in markets, external effects, unemployed or underemployed factors, overvalued currency.
Taxes	Cost of production.	Transfer of payments and not an economic cost.
Subsidies	Source of revenue.	Transfer of payments and not an economic cost.
Interest and loan repayment	A financial cost; decreases capital resources available.	A transfer payment and not an economic cost.*
Discount rate	Marginal cost of money; market borrowing rate; opportunity cost of funds to individual or firms.	Opportunity cost of capital; social time preference rate.
Income distribution	Can be measured based on net returns to individual factors of production, such as land, labor and capital, but not included in financial analysis.	Is not considered in economic efficiency analysis. Can be done as separate analysis or as weighted efficiency analysis with multiple objectives.

* Unless external loan.

Source: Gregersen et al. (1987), as adapted from Hitzhusen, (1982).

Flexibility in Project Design

In social forestry projects, the iterative process of project planning (figure 6.1) does not end when project preparation is complete. This is because when the project begins, there is often a degree of uncertainty as to what proportion of project resources will actually be absorbed by the various models that make up the project. For example, once a project is under way, perhaps many more farmers than anticipated wish to participate in farm forestry, while community forestry falls short of expectations because of unforeseen disputes about land issues. At the same time, early successes in instituting improved management of existing woodlands may indicate that a sizeable increase in the scale of natural woodland management should take place. Thus, the final project design should include explicit provision for flexibility to move project resources from one activity (model) to another in the light of progress made and understanding reached with the local community and the financing agency. To guide implementation and ensure that appropriate changes are being made to meet objectives, a monitoring and evaluation system is an integral part of project management design (see chapter 12).

Summing Up

This chapter provided an overview of the project planning and design issues commonly encountered in social forestry projects. The planning and design process is an iterative one involving successive approximations of the various relationships considered essential to achieve the project's objectives. The first and most critical step is to understand the exact nature of the objectives sought. This process of identification must involve the project area's population as well as government policymakers. At the same time, design constraints should be defined.

Once project planners have clearly established objectives and initial design constraints, an important next step is to lay out the potential technical models that they could use. Five models are relevant to social forestry: community forestry, farm forestry, tree tenure forestry, departmental (public) plantation forestry, and management of existing natural forests and woodlands for the benefit of local people. These models can employ three general planting patterns: strips, blocks, or individual trees. Choice of species is a critical consideration, and one that planners must base on consideration of local preferences as well as on technical factors. Similarly, planners should consider existing successful practices in the project area to see if at least part of the project can be based on achieving wider adoption of best practices being used by the local population.

Institutional factors are also important in terms of alternatives and their feasibility in given project situations. Institutional considerations include units of social organization, incentives, forms of distribution of benefits and costs of projects, and so forth. An important institutional consideration is the organization of the project itself, for example, where the main responsibility will be in terms of government structure, whether NGOs will participate, and how the project will be linked or integrated with other activities such as agriculture.

Once planners have the technical and institutional models in hand, they can appraise alternative project designs for other impacts and recommend a consolidated design, bearing in mind the importance of flexibility as the project progresses.

Appendix 6.1 Checklist for Preparing Social Forestry Programs and Projects

Data required	Probable sources of information: Country, state, district	Probable sources of information: Project area	Comments
Extent, topography, and climate of project area			
• General description		x	Should include brief description of the area including slope, soil fertility, erosion intensity, communications systems, lakes and rivers, in sufficient detail to permit conclusions on agricultural and forestry potential and constraints.
• Altitude		x	
• Slope		x	
• Soil types		x	
• Nutritional status		x	
• Soil depth		x	
• Geomorphy		x	
• Rainfall		x	
• Rainfall distribution		x	
• Rainfall intensity		x	
• Temperature		x	
• Temperature distribution		x	
• Water resources		x	
• Groundwater level		x	
Demographic data			
• Population	x	x	
• Sex ratio		x	
• Population growth rate	x	x	
• Ethnic configuration		x	
• Income distribution	x		
• Land distribution		x	
• Sociological survey		x	Specific information relating to the habits and attitudes of people likely to affect the planning and implementation of the proposed program or project.
• Surveyed number of farmers interested in farm forestry		x	Availability and cost of labor depends on the nature of work opportunities. A record of their variations is important, since forestry work typically coincides with the agricultural cropping season and therefore often results in seasonal labor storage.
• Labor availability		x	
• Labor profile		x	
Environmental status			
• Areas of special interest		x	Much of the information under this heading would have to be qualitative rather than quantitative. Rather than burden the planning document with extensive texts, reference can be made to annexes or relevant supporting documents.
• Existing reserves:	x		
area		x	
main purpose		x	
present status		x	
• Flood conditions	x		
• Desert encroachment	x		
• Air pollution condition	x		
• Present use of pesticides		x	
• Status of biological cover on the land		x	
• Status of pollution in lakes and rivers	x		
Land use and production data on agriculture			
• Area of land under different crops	x	x	The level of detail for information on agricultural activities will depend on the degree of interdependence with the forestry crops. In a project where the technical solution of the
• Farm sizes		x	
• Land tenure		x	

Appendix 6.1 (continued)

Data required	*Probable sources of information* — *Country, state, district*	*Probable sources of information* — *Project area*	*Comments*
• Degree on dependence of population on land-based income of subsistence		x	land-use problem is likely to be a highly integrated system, such as in hill watershed, desert encroachment, and marginal land development schemes, this type of information must be provided in sufficient detail. In other cases, e.g., projects limited to wood energy production, a general description of the country, state, or district might suffice.
• Production and productivity of different crops		x	
• Livestock			
- Number of cows		x	From existing livestock census or if required from census carried out specially for the planning.
- Bullocks		x	
- Sheep		x	
- Camels, etc.		x	
- Consumption per livestock unit of grass		x	
- Tree fodder		x	
- Other		x	
- Availability of animal health		x	
Data on forest production			
• Forest types	x		General description avoiding too much detail and Latin names, but concentrating on the state of the forest and its potential. Caution is needed to define the different categories clearly and meaningfully. Private land must be included as well as government land.
Area of forest			
- natural	x	x	
- planted	x	x	
- broadleaved	x	x	
- conifers	x	x	
• Species distribution	x	x	
• Yield in m^3/ha/yr for natural and planted forest by species and type of land	x	x	
• Densities of natural and planted forest			Some of this information could be provided through remote sensing; either aerial survey or satellite pictures.
• Age distribution of natural and planted forests			
Total standing volume	x	x	These figures are not always readily available, but are vitally important. Therefore, if not available, assumptions for estimations should be given.
• lumber size			
• small lumber size			
• other			
Total annual increment			Data on governmental forests are sometimes available, but the production estimates are often based on old forest management systems rather than on actual production. Production on private land is even more difficult to assess. Estimates based on remote sensing is one possibility; another way is to survey number and/or area of private trees combined with an assessment through random sampling of standing volume and annual yield.
• m^3 or ton/yr			
	x	x	
	x		
	x		
Consumption of forest products			
• Fuelwood of which is from:	x	x	Avoid obvious survey mistakes, such as estimating consumption for one specific season only or accepting quantification by the surveyed persons without control.
- stemwood	x	x	
- branches			
- twigs			

Appendix 6.1 (continued)

Data required	Probable sources of information: Country, state, district	Probable sources of information: Project area	Comments
• Fuelwood as share of total household energy	x	x	
• Pulpwood	x	x	
• Small timber	x	x	
• Poies	x	x	
• Timber	x	x	
• Total wood consumption in M ton or Mm3	x		
• Wood-using industries	x		
• Number in different categories	x		
• Capacities in different categories	x		
• Output in different categories	x		
Wood production/ consumption balance	x	x	This information would be used to detemine investment requirements to meet demand for products. Balance figures could be used to identify priority areas, i.e., where the gap between production and consumption is the greatest and therefore where the need for development is the greatest and at the same time the response from the local population is likely to be the greatest.
Earlier forestry experience			
• Data on survival			Summarize information available from monitoring and evaluation of ongoing or completed projects. Attach any special studies on subjects such as yields and developmental impact.
• Spacing			
• Production			
• Area covered			
• Labor requirement			
• Costs			
• Environmental impact			
Costs and Prices			
Unit costs			
• Labor			
• Equipment	x		This information could be provided as part of the cost tables.
• Land	x		
• Buildings	x		
Unit prices			
• Fuelwood	x		
• Poles	x		
• Small timber	x		
• Pulpwood	x		
• Timber	x		
• Sawn timber	x		
Institutional arrangements			
• Organization chart of implementing agency	x	x	
• Job description	x	x	Refer to existing documentation.

Appendix 6.1 (continued)

Data required	Probable sources of information: Country, state, district	Probable sources of information: Project area	Comments
• Staff list with number, level, and salaries			
• Links between the implementing agency and other agencies responsible for related activities (irrigation, animal husbandry, tribal welfare, NGOs, etc.)			

7

Learning About Local Communities

As mentioned in chapter 6, planners should consider the constraints and opportunities that exist in the communities that are to participate in a project early on in project planning. Thus, before planning and initiating social forestry activity in a community, planners need to determine the extent to which the prerequisites—resources, knowledge, incentives, institutions—for action exist within the intended project or program area.

Planners will also need information from prospective participants to define objectives and targets properly. Initial village surveys attempt to determine the actual situation: where scarcities and needs exist, what local residents' priorities are, and what resources they have available to move toward achieving those priorities. This information helps planners determine the best mix of support to ensure that local participation is widespread.

This chapter deals with the means of generating the information needed. Planners can use the baseline surveys, carried out systematically and in detail. They can also use more informal, quicker means, depending upon the resources available and other circumstances surrounding the intended program.

Making Use of Existing Local Knowledge and Practices

In most cases, a substantial local knowledge base exists on which to build, which results from the widespread involvement that local people already have in planting trees and producing seedlings (table 7.1). Local people often have quite a thorough understanding of how different tree species meet their needs (see Hoskins 1979a; Brokensha, Warren, and Werner 1983; Jamieson 1984). Too often, project planners ignore this knowledge and experience.

Table 7.1 Local Knowledge about Deforestation and Involvement in Tree Planting in Six Countries, Various Years
(percentage of people studied)

Item	*Costa Rica*	*Kenya*	*Malawi*	*Senegal*	*Sudan*	*Tanzania*[a]
Recognized problems of increasing deforestation	87	n.a.[b]	77	n.a.	95	71
Producing own seedlings	n.a.	38	53	n.a.	65	n.a.
Have already planted trees	<50	76	40	48	22	59[c]

n.a. = not available

a. This study compared villages that had started woodlots with those that had not. Figures shown are for those villages that had started woodlots.
b. Definitely high, given the number of trees already planted.
c. Percentage of population participating in the village woodlot plantings. Comparable percentage for individuals who planted privately is 87 percent.

Sources: Costa Rica, Thropp (1981); Kenya, Van Gelder and Kirkhof (1984); Malawi, Mnzava (1983); Senegal, Gueye (1985), World Bank (1984c); Tanzania, Skutsch (1983).

Planners are in danger of reaching erroneous conclusions about local practices, interests, and motivations, if they have not thoroughly investigated and considered the overall strategies and actions of local land users. Thus, the investigation of strategies should include the entire production/consumption system (box 7.1). Considering local knowledge and present production systems can pay off by saving time and preventing a waste of resources in project development and implementation. For example, in the case of a program in Nepal, thorough discussions with villagers revealed that users of forests needed to be defined by specific products or uses in addition to defining them by area of forest (box 7.2). Recognition of such differences in program design helped to ensure increased acceptance and participation.

The point to note is that project planners and managers from the outside need to be aware of the indigenous knowledge of different local groups and to learn from them. This will often involve more time than planners have devoted to such understanding in the past.

Box 7.1 The Importance of Understanding Local Resource Strategies: The Philippines

Farmers of the Ilcos region of the Philippines favor Gliricidia *(Gliricidia sepium)* for planting because of its ease of propagation and management and its excellent fuelwood characteristics. They like the fuelwood of this species better than that of the native ipil-ipil *(Leucaena)* and consider the less dense wood of the giant varieties of ipil-ipil even more inferior (Wiersum 1982). Many farmers did not want to change to the latter which are used in all official fuelwood projects, not only because of their inferior fuelwood characteristics, but also because farmers replacement of Gliricidia with these trees would involve uprooting the existing Kakawati rootstock, as newly interplanted Leucaena cannot withstand its competition. Thus, replacement would involve discontinuity of the present production system.

Although farmers were found to be very active fuelwood producers, the existence of these woodlots has largely gone unrecorded by foresters and fuelwood planners, and no data about areas and production capacity are available. Because foresters were unfamiliar with both species and management systems, they assumed production in these woodlots was low, but some preliminary measurements indicated that the fuelwood yield of yearly coppiced Gliricidia on deep soils may well reach 40 cubic meters per hectare a year, decreasing to 23 cubic meters per hectare a year on sloping lands with shallow soils (Wiersum 1982).

These indigenous forms of tree growing are but one aspect of farmers' strategies in respect to resource use. As the evaluator of a tree farming project in this area (Hyman 1983) did not investigate such strategies, several possible reasons for nonparticipation in the tree farming project were not treated. Interesting questions, such as to what degree private lands farmers consider suitable for tree growing are already used as such and the appropriateness of a tree farming approach versus an agroforestry approach, could not be ascertained.

From Wiersum and Veer (1983).

Because the introduction of new technologies and institutions involves additional time and resources and often disrupts local communities, project planners should promote the expansion of existing, familiar practices where they are appropriate for the social forestry objectives sought. The FAO (1985d) provides a logical framework for determining the need to introduce innovations from the outside rather than to support expansion of existing, traditional practices (see fig. 7.1).

Box 7.2 Defining Project Participants by Forest Uses: Nepal

In Nepal, the national government has defined and established forest areas to be protected by local units of government (Panchayats). Because the laws governing Panchayat Protected Forest (PPF) are written in terms of Panchayats as a whole, many user groups feared that their local forest resource would be "nationalized" by the Panchayat. Therefore, reaching consensus on these forests usually required careful definition of the user group by product. In many cases, the group of people who collected specific products, such as bamboo or fuelwood, were willing to acknowledge the right to other products, such as timber for house construction, of the Panchayat as a whole as long as the products they had previously collected remained theirs. Thus, it became crucial to the success of the program to specify benefits and responsibilities by product and beneficiary. Project planners developed an "Existing Forest Management Survey" to determine existing usages in place of the earlier survey of needs to allow the project to build on traditional management systems. This survey, conducted in a group session, forced communities to make explicit a number of more or less implicit group management rules to allow them to be encoded in a legal agreement.

From Arnold and Campbell (1985).

Surveys to Learn About Communities

In most social forestry projects, outsiders such as extension agents introduce technical packages and instructions that they think will help improve some aspects of life in the local community. They base their efforts and suggestions on their perceptions of what community members know, what they need and want, and what resources are available in the community. At times, their perceptions are accurate; more often, they are only partially right. Astute observation and understanding are needed to interpret local conditions; each community can be different (box 7.3). In some cases, a simple inquiry of villagers, put together with basic social survey statistics (for example, occupation or source of income), will provide information that can be critical in project planning and in identifying a role for social forestry (box 7.4).

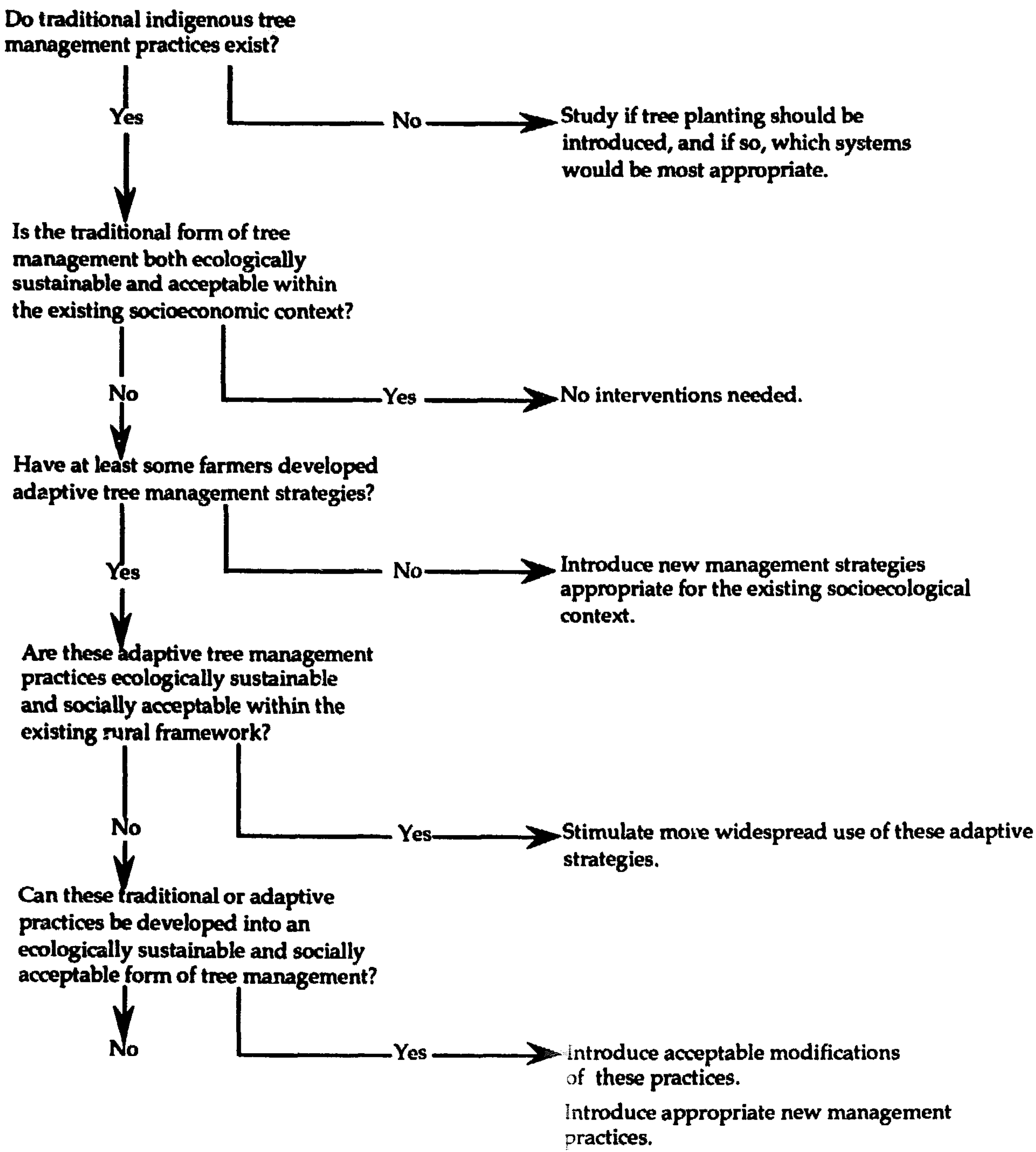
Considerable progress has been made in this type of community survey work in agricultural development and much of the work is relevant and can be applied in social forestry. For example, the International Center for Improvement of Wheat and Maize and the International Rice Research Institute, in cooperation with national agricultural research agencies, have formulated approaches for small-scale sample surveys on which to base interventions. Existing field staff can carry out these surveys, with the possible addition of social science expertise from local universities (see Collinson 1981; Roling 1984).

Increasingly, planning teams are including sociologists, anthropologists, and other social scientists to develop a basic, integrated understanding of village or community needs and opportunities (see Cernea 1985a,b). A concurrent development is the setting up of appropriate monitoring and evaluation systems (see chapter 12) that enable planners to check program outcomes against objectives and modify the programs accordingly.

Baseline surveys

Researchers have developed and tried various approaches to generate baseline social data. No one correct approach exists, although some methods of data collection are best suited to answering certain demographic and sociological questions. Common sense, consideration of project requirements, and consideration of existing social science experience and methods are fundamental ingredients in a good survey that will give project planners confidence in their interpretations of social and cultural systems and constraints.

Figure 7.1 Analyzing the Need for Introducing Changes in Tree Management Versus Retaining Traditional Practices



Source: FAO (1985d).

Box 7.3 Understanding Fuelwood Needs: Burkina Faso and Senegal

Local needs may be difficult for outside experts to identify. In one region of Burkina Faso, land ownership was such that residents could collect fuel only from land owned by their own family. Even if dead wood was on adjoining land, they could not collect it. A forestry report spoke of this area as having no fuel problem because dead wood was visible around the village, while a local woman potter discussed having to abandon her craft because of a lack of fuel. Many other villages in the area had the accepted rule that any forestry product from a "God-given" tree (one not planted by someone) was available for the taking.

Women in a Senegalese village complained of a shortage of fuel, but large wood piles were visible. In this village, women collected a year's worth of wood during a two-month period because supplies were inaccessible in the rainy season. This village had a different collection pattern from one 20 kilometers away whose supply was more accessible. Some reports from the coastal urban areas discuss "African women" preferring to cook inside without taking into consideration that this is progressively less true as one goes into drier climates, especially in rural areas.

From Hoskins (1979b).

Box 7.4 Simple Inquiries Provide Useful Information: India

Researchers studied villagers in an area where a new canal had been commissioned only a couple of years earlier. When they asked the villagers if their economic condition had improved as a result of the irrigation facilities provided, the villagers replied in one voice that they were on the verge of starvation and wanted some forest land for cultivation. Further inquiries revealed that the entire village consisted of *Harijans* whose occupation had been making *charasa* (a leather contrivance for drawing water from wells) and bamboo baskets used to lift water from *tal* and ponds. Construction of the canal meant they had lost their hereditary occupation because the demand for *charasa* and bamboo baskets had ceased to exist.

The point is not that the construction of the canal has been a mistake (it was essential), but that no one had taken into account what would happen to the *Harijans* and devised an alternative scheme to absorb them. For example, planners could have initiated a scheme to grow useful plants such as babul *(Acacia nilotica)* bamboo, mahua *(Madhuca longifolia),* and mango along the canal's banks. The villagers could have been easily employed for the first few years in planting and tending the trees and after three or four years, when plenty of leaf fodder would have become available, they could have taken to rearing goats, sheep, and milk cattle. Some of them could have been employed in making various cottage industry products from bamboo and small timber, gum, fruits, and seeds. Quite a few could have been transferred to shoemaking and other leather industries when tanning material from babul and hides from the goat, sheep, and cattle would have become available.

From Tiwari (1983).

A baseline survey for social forestry planning might include the types of information indicated in table 7.2. Specific information needs will vary from case to case. Much of this information is useful in identifying the causes of low involvement in tree growing and in finding the means to increase participation. Thus, a first step in project planning is to examine what has been done already in the way of surveys in the area, for example, for agriculture or rural development. Planners can then fashion the survey instruments for social forestry using proven successful models and at the same time identify needed information that is already available from these other surveys.

Table 7.2 Information Categories for Baseline Surveys

Demographics
- Population characteristics
- Population density; household budget, time use, energy needs
- Rates of population growth
- Migration patterns, employment

Land tenure and land-use systems
- Availability of land
- Possession of the land
- Rights of allocation and use
- Security of tenure
- Land use (agriculture, livestock, other)
- Past history of human association with trees

Social organization
- Institution regulating access
- Organization units (family, lineage, village)
- Decisionmaking
- Participatory systems
- Economic cooperation mechanisms
- Distributional mechanism
- Traditional marketing systems

Cultural attributes
- Religion
- Perceptions (of change agents, of forestry)
- Values
- Cultural practices, tradition

Incentive structures (role of)
- Economic (market)
- Social (nonmarket)

Rapid rural appraisal

Obtaining information to design and implement projects or programs costs money and takes time, both of which are often scarce. Planners should not spend more on data collection than they must to get the information needed to design and execute a good project or program. Also, information generally has to be generated in a fairly short period so as not to lose the existing momentum of support for a project or program idea and the flexibility in design that exists before commitments have been made.

These two guiding concerns have led to a set of approaches to generating information on target populations. These approaches are referred to collectively as rapid rural appraisal (RRA) (see Beebe 1985; Chambers 1985; Khon Kaen University 1987; and references cited therein). The newer thinking in RRA questions the earlier assumption that a direct relationship exists between spending more money and time and acquiring better information (better in terms of ultimate project success) for two reasons. First, in many cases, additional information on more aspects of a community does not help to design a better project. What is needed is just enough relevant information on key factors to meet the objectives and to provide a framework for design that takes into account the wishes, needs, resources, potentials, and capacities of the local population. If the information needs are properly thought out, then in many cases only a few new items of information, combined with what has already been gathered and is known, will be sufficient for planning purposes. Second, more accurate information about a given event, resource, or need will not necessarily improve the social forestry project design or decisions about it. Certain minimum levels of accuracy (which will vary from case to case) are needed to reduce uncertainty in planning, however, in many cases, such levels are far below the levels that have been generated in existing surveys or community studies.

In addition, all information about a community does not have to be collected each time a new project is planned. Planners can often draw upon a wealth of existing social science information and use it as a base for quick verification in local communities. Too often planners spend insufficient time exploring existing data sources—including those quite separate from conventional forestry sources—before undertaking a new survey.

In sum, planners often generate too much information with a level of accuracy that far exceeds that needed to make good project or program design judgments. Generally, the greater the amount of information collected and the more accurate the measurements or observations made, the greater the time and resources that have been spent on gathering information. The key is to generate just enough relevant information of sufficient quality to permit making sound judgments on the issues addressed and objectives sought. This is what Chambers (1985) refers to as following the principles of "optimal ignorance" and "appropriate imprecision."

The RRA approach was born out of the frustration of field personnel who, on the one hand, had learned about the traditional, lengthy, and costly field survey methods used in the social sciences and, on the other hand, were faced with limited budgets and a time constraint. The aim with RRA was to find some approaches that were fairly quick, low cost, and reasonably accurate in terms of avoiding the common biases and problems associated with expert visits to project sites. Of particular concern are types of antipoverty biases listed by Chambers (1985):

- **Spatial (urban, tarmac, and roadside).** The poorer people are often out of sight of the road, having sold out and moved away. They tend to be concentrated in regions remote from urban centers and to live on the fringes of villages or in small, inaccessible hamlets.
- **Project.** Outsiders link up with networks that channel them from urban centers to rural places where projects exist, where something initiated by outsiders is happening or is meant to be happening, to the neglect of nonproject areas.
- **Personal contact.** Rural development tourists tend to meet the less poor and the more powerful, men rather than women, users of services rather than nonusers, adopters rather than nonadopters, the active rather than the inactive, those who have not had to migrate, and (inevitably) those who have not died. In all cases the bias is against perceiving the extent of deprivation.
- **Dry season.** In many tropical environments the wet season is the worst time of year, especially for the poor, since it brings hard work, food shortages, high food prices, high incidence of disease, and high indebtedness. Urban-based professionals, however, usually travel in the postharvest dry season when things are better.
- **Politeness and protocol.** Courtesy and convention may deter rural development tourists from inquiring about and meeting the poorer people. The visitor is also short of time, and the poorer people stand at the end of the line.

Many of these biases can be reduced by using common sense and the type of investigator who approaches each community with an open mind and as few preconceived ideas about the community and its needs and ways as possible.

In certain circumstances, more traditional, longer-term study of communities is justified and desirable, as in cases where past activity is being studied on an *expost* basis to gain general background information for future social forestry activity. Thus, RRA is not appropriate for every situation. Indeed, it can produce spurious and confusing results if not used with caution and understanding. However, RRA provides a starting point and a way of thinking that planners of social forestry projects can apply in the typical case in which they face resource and time limitations in trying to understand what is going on in project communities and to learn which of the four major constraints on local involvement—knowledge, resources, incentives, institutions—constitute the major barriers to planning and executing a successful social forestry activity or project.

Agroforestry diagnosis and design approach

ICRAF has developed and tested a useful system for understanding specific aspects of local communities. The agroforestry diagnosis and design (D&D) system is a methodology for diagnosing land management problems and designing agroforestry solutions (Raintree 1986). As indicated in table 7.3, the D&D approach provides a logical framework for looking at the technical, social, and managerial aspects of local community land use, with a focus on agroforestry solutions to problems. In this sense, it is a more focused version of the "land evaluation" framework developed back in the 1970s (FAO 1976). Young (1986) has compared the two systems and suggests a way to incorporate useful features of land evaluation into the D&D process and vice versa. Figure 7.2 provides an overview of the land evaluation approach modified to include elements from the D&D approach.

Both approaches focus on assessing local community issues in terms of land-use patterns, problems, and opportunities. As such, these approaches, or a variation on one or both of them, can be quite useful in learning about local communities for the purpose of designing a social forestry program or project.

Techniques for collecting needed information

Social scientists, working with agriculturalists and other biological scientists, have developed a number of techniques for obtaining rapid rural appraisal information. Based on the work of Carruthers and Chambers (1981), Honadle (1982), Chambers (1985), and others, the following list of possibilities emerges:

- **Examination of written records.** This is a commonly used method, however, planners too often overlook written records in their haste to get into the field, particularly when government records are not readily available.
- **Informal delphi technique.** Honadle (1982) describes this approach as a group discussion approach to consensus-building that engages informed persons in a dialogue that exposes variations in the interpretation of events, policies, or objectives. This technique aims to reach some degree of agreement in interpreting events through group discussion and is commonly used in many types of rural development projects.
- **Confidential interviews.** To the extent possible, the results of confidential interviews should be cross-checked and verified through several interviews or other sources. Often, confidentiality is difficult to secure, particularly in small villages.
- **Key informants.** This is a variation on the interview approach, in which one key individual is used as a filter of information; in a sense, the key informant is a local counterpart for the RRA team.
- **Formal workshops.** In this common method, groups of villagers, trainers, or other persons that have key information are brought together in groups to work on issues or problems; in the process, they provide the needed information for project planning or implementation.
- **Direct observation of behavior.** This approach is widely used to gather information, but can easily lead to erroneous conclusions if the observer is not adequately trained (box 7.3).

Table 7.3 Basic Principles and Procedures of Agroforestry Diagnosis and Design

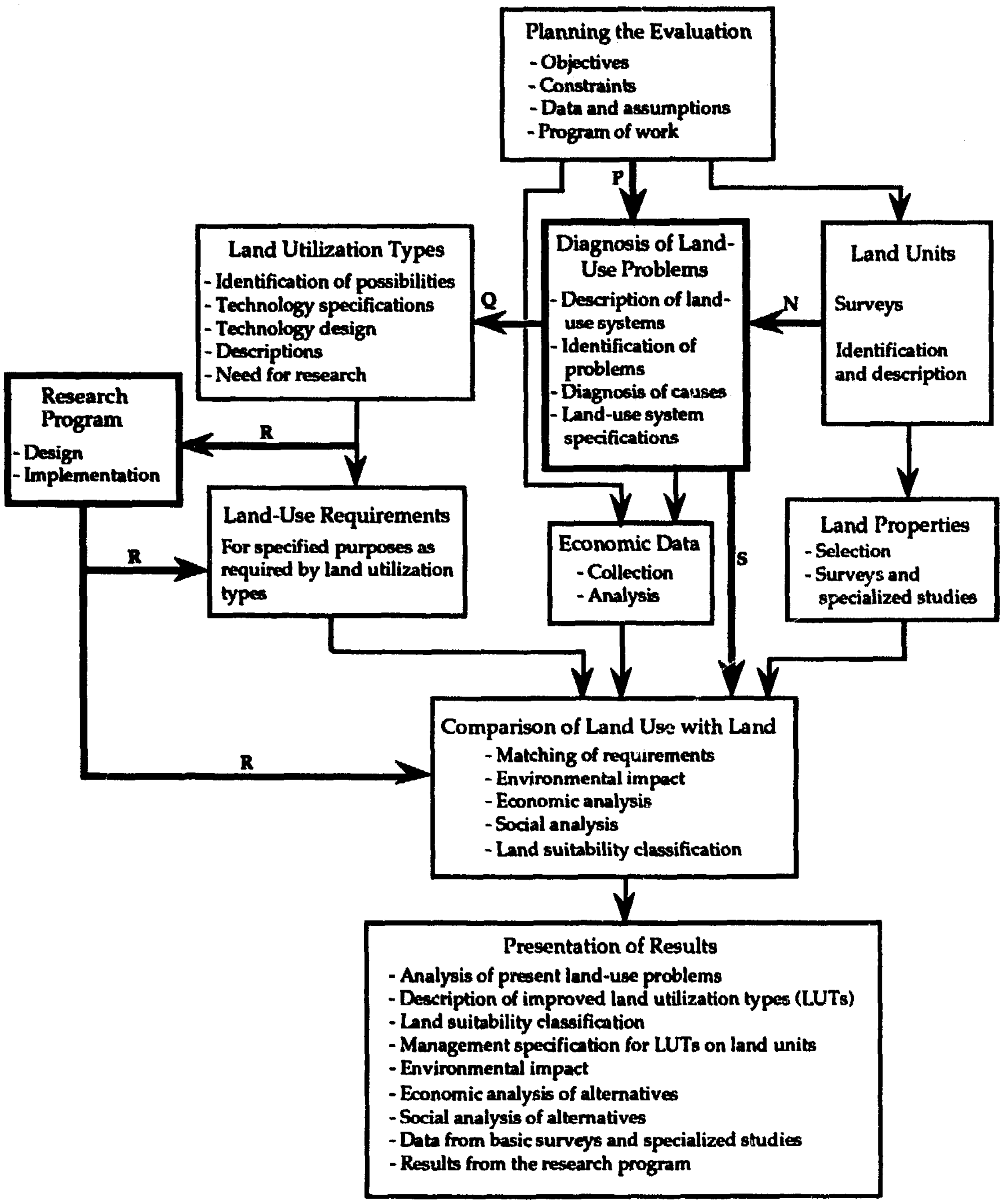
D&D stages	*Basic questions to answer*	*Key factors to consider*	*Mode of inquiry*
Prediagnostic	Definition of the land-use system and site selection (Which system to focus on?)	Distinctive combinations of resources, technology, and land user objectives	Seeing and comparing the different land-use systems
	How does the system work? (How is it organized, how does it function to achieve its objectives?)	Production objectives and strategies, arrangement of components	Analyzing and describing the system
Diagnostic	How well does the system work? (What are its problems, limiting constraints, problem-generating syndromes, and intervention points?)	Problems in meeting system objectives (production shortfalls, sustainability problems)	Diagnostic interviews and direct field observations
		Causal factors, constraints, and intervention points	Troubleshooting the problem subsystems
Design and evaluation	How to improve the system? (What is needed to improve system performance?)	Specifications for problem solving or performance-enhancing interventions	Iterative design and evaluation of alternatives
Planning	What to do to develop and disseminate the improved system?	Research and development needs, extension needs	Research design, project planning
Implementation	How to adjust to new information?	Feedback from on-station research, on-farm trials, and special studies	Rediagnosis and redesign in the light of new information

Source: Raintree (1986).

- **Ground observation of physical conditions.** A most important part of rapid reconnaissance is the reporter's ability to observe key indications: condition of crops, type of crops, condition of soils, housing standards, general health conditions.
- **Aerial surveys or inspections.** This variation on direct observation can be extremely useful if appropriate proxy measures exist that can be identified from the air or from aerial photos.
- **Village sample surveys.** Persons are picked at random or systematically and then interviewed.

In most cases, project planners use a combination of these approaches. For example, direct observation should always be part of a RRA no matter what other approaches are used. The advantages and disadvantages of most of these techniques are indicated in table 7.4.

Figure 7.2 Land Evaluation Procedures Modified to Incorporate Features of Agroforestry Diagnosis and Design (added activities and flows of information are emphasized)



Note: This figure is a modification of land evaluation procedures to include elements derived from diagnosis and design. New activities and paths of information flow are marked for emphasis. Path P, leading to the box "diagnosis of land-use problems," should be taken where it is known that existing land-use systems in an area are facing problems (e.g., declining soil fertility, overgrazing, fuelwood shortage), and where one of the objectives of the evaluation is to assist in solving these. There is an input of information on land units (Path N). The diagnosis then becomes one of the major stages in evaluation. This has the effect of collecting the information needed for social analysis (Path S), so that the additional economic and social data needed are mainly economic. Using information derived from the diagnostic analysis (Path Q), procedures derived from the design stage of diagnosis and design may then be used as one means for the formulation of improved land utilization types. This need not be confined to agroforestry; the same sequence of design can be applied to land utilization types based on other major kinds of land use. Path R may be called the research loop. A subactivity is added at the end of the description of land utilization types, "need for research," that is, assessment of the state of knowledge about the proposed land utilization types in the area.

Source: Young (1986).

Table 7.4 Data Collection by Rapid Reconnaissance

Data collection approach	*Advantages*	*Disadvantages*
Record examination	Language barrier is lessened. Documents can be reviewed at convenience of interviewer; does not disrupt staff activities.	Records are often inaccurate or inappropriate. Difficult to estimate sample bias. Limited range of variables covered can be very time consuming.
Informal delphi	Facilitates participation and exposes interpersonal dynamics. Increases accuracy of meanings imputed by researchers. Increases sample representativeness. Generates data beyond interview design. Low cost. Can begin dialogue among participants.	Minimizes extremes and range of perspectives by inducing consensus. Emotionally taxing. May require interpreter. Exposes view of informers. Susceptible to domination by a strong personality. Disrupts staff activity.
Confidential interview	Protects informer. Allows access to examples of actual dynamics. Increases extremes and range of perspectives.	Usually highly biased. Emotionally taxing. Requires leads from other informants. If interpreter is required, protection is lost, interpreter may filter information. Sample may be limited or confidentially impossible in some settings.
Key informants	Useful in clarifying issues, testing conclusions of the investigator. Acts as filter to avoid culturally objectionable questions or data gathering techniques. Key informant linked to key decisionmakers can help prepare atmosphere for report. Involvement in process can build skills of informant.	Bias or perspective of key informants may have undue influence on results. Excessive time may be required to identify the best informants. Some informants may alienate people who are key to implementing recommendations. Rapport between key informants and evaluators is essential.
Workshop	Builds capacity as well as serving as information collection technique. Promotes interest and receptiveness results on the part of participants. Can lead directly to identification of strategies to improve situation. Communicates information to decisionmakers as part of collection process. Can produce formal commitments, recommendations, or analyses based on group effort.	Costly in terms of staff or beneficiary time and effort. Requires scarce facilitative skills for evaluators. Status difference among participants may affect attendance.
Direct observation	Provides primary data. Does not disrupt routine bias. Can expose data not anticipated by investigator. Low cost.	May be confounded by investigator's presence. Susceptible to misinterpretation by researcher. May contain seasonal bias. Lack of representativeness.

Source: Honadle (1982).

Summing Up

This chapter stressed the need to understand local communities in order to design productive social forestry programs that will involve widespread local participation.

Planners can use a number of different approaches to generate the information they need about local communities. A first step is to make use of existing indigenous knowledge. Surveys and other information gathering activities must be realistically designed in terms of time and budget constraints. A promising set of approaches, commonly put under the label of rapid rural appraisal, is outlined together with the diagnosis and design approach developed specifically for agroforestry.

Regardless of the approach chosen, planners can use many different techniques to gather data about communities. These include examination of written records, informal or formal group techniques, confidential interviews, use of key informants and workshops, direct observation of both behavior and physical conditions, aerial surveys, and sample surveys in communities. In most instances, planners will use a combination of techniques within the framework of their chosen overall approach to generate the information needed.

8

LOCAL SOCIAL AND ECONOMIC UNITS OF ORGANIZATION

Lack of participation by intended beneficiaries has resulted in social forestry programs falling short of their goals. Effective participation of the rural poor and landless has been a goal of many programs, but has often not been achieved. Instead, the wealthier farmers have been a smaller and more receptive group to work with. Similarly, many projects include the goal of establishing a stronger role for women in social forestry and building provisions for their greater participation into programs; yet progress involving women in projects has been slow.

This is not to say that a forestry program aimed at commercial production of trees by relatively well-off farmers is undesirable. Rather, planners should not assume that a social forestry project will address basic community needs and goals merely because some landowners are involved in planting and growing trees rather than the government forest administration.

The factors that motivate middle and upper class farmers are generally quite distinct from those that motivate poor farmers, unemployed workers, the landless, and other disadvantaged groups. Well-off farmers may be convinced to participate on the basis of high financial rates of return. The poor are motivated by food, warmth, jobs, and dignity. While jobs and income mean something to them, rates of return from commercial tree growing activity mean little. Thus, to stimulate interest and participation in tree growing, project planners must deal separately with the different social and economic groups and interests within a community that will need to participate and benefit if a program is to succeed. They must also anticipate the attitude and behavior changes among members of different groups that will result from program interventions.

To plan programs so they address goals effectively, planners must identify specific beneficiary groups. This chapter explores the nature of such groups.

Local Attitude and Behavior Changes

In most villages, the main determinants of involvement in, and distribution of benefits from, social forestry are structural factors: markets, class distinction, power, tenure, kinship, and gender roles. The structure of the community heavily influences local attitudes. It can also repress participation in worthwhile activities. For example, landless people may have a positive attitude toward social forestry, but that does little good if the community's land tenure and power structure of the community is such that they cannot act on that positive attitude. Thus, to achieve changes in attitudes, changes are often needed in existing institutional structures, customs, and legal systems. Stressing this point is important since some planners tend to think that if only attitudes can be changed, then social forestry progress will follow. The reality of the situation is less favorable: in many cases, difficult but necessary restructuring of a community's social and economic systems or structures will be needed before sustainable social forestry and land use can become a reality.

Quite often, securing temporary positive attitudes and local participation in social forestry is possible with the use of subsidies and other outside incentives. However, for a community to adjust its structure so that introduced social forestry practices and attitudes remain active internally in the community when outside intervention ceases is a quite a different matter. Tschinkel (1984, p. 8) argues that the most successful cases he studied of tree planting by small farmers in upland watersheds in Central America were characterized by low material incentives:

> Excessively generous subsidies tended to be abused or deviated projects toward beneficiaries who were not likely to continue planting after the subsidies ended. Judicious, sparing, and flexible use of subsidies, especially if only temporary for one to three years, helped accelerate planting. Subsidies calculated on a piece rate basis (number of hectares, number of live trees) were more successful than those related to the number of days worked.

Attitude changes need to lead to behavioral changes in people as individuals (or as individual families). However, they must also change the patterns of group behavior, since most people belong to various purposeful groups that organize and coordinate the activities of their members.

Such behavioral changes are entirely feasible, despite the difficulties that project planners must overcome to engender them, but those interested in promoting social forestry programs cannot—and should not—wait passively for these behavioral changes to occur spontaneously. On the contrary, they can stimulate, encourage, and accelerate these changes. This requires a systematic social strategy, tailored to the specific structure of a community and the technical and economic characteristics of forestry production. The social strategies must become an integral part of the wider concept of social forestry. A social strategy is a design for action: the design for a sequence of steps needed to influence the understanding of farmers and other tree growers; to help them change their behavior; to organize them into groups, associations, and so on; and to mobilize them to act.

Recognizing the need to affect and change people's behavior concerning trees is an essential first step, unfortunately, one that is too often overlooked. Forestry planners frequently assume that people will plant the trees that they want them to plant, simply because the people are the ones who will ultimately benefit. In many cases, this view is too simplistic. Such ill-informed assumptions have led to inaction and a weakening of many programs that were otherwise soundly designed in terms of their technical (silvicultural) content and their economic rationale.

Planners must understand the rationale behind individual's behavior in a broad sense, including collective action, institutional development at the grass roots, and the establishment of social groupings. Planners of social forestry programs cannot count on financial investments alone to make a program a success. They must also consider social mechanisms or institutions that support forestry programs. These include purposeful social organization for conserving natural resources or for producing new resources; land tenure systems that are conducive to the intended development; ownership rights to, and distributive arrangements for, the newly developed forest resources; authority mechanisms for collective decisionmaking and for mobilizing group (or even individual) action; social perceptions and attitudes; political power that affects the distribution of benefits; and the constructive influence of external change agents. Planners must consider all these within the context of the units of social organization that will participate in the program.

Units of Social Organization in Support of Forestry Programs

Perhaps the most important factor in designing a social strategy for a forestry program is identification of the units of social organization that are likely to participate in the program and evaluation of their ability to do so. The operational challenge is to disentangle the broad term "people" and to identify which units of social organization or groups of people can and will grow trees, in which ways, and for what purposes.

Such units of social organization can be either existing groupings—such as households, cooperatives, or schools—or groups organized specifically to plant and protect trees. Establishing a functional social group can entail much more than simply bringing together a set of individuals. It generally involves a process of selection and self-selection of the members; a willingness to associate and participate; a perception of both self-advantage and coresponsibility; and the establishment of an enduring social structure with well-defined functions, responsibilities, and rules about the sharing of benefits. This in turn will help mold members' behavior and is the essence of purposive institution building at the grass roots level. Forming units of social organization that will last is particularly important in the case of tree growing, given the production cycle for trees, which requires support for an extended period.

The appropriateness and effectiveness of various tree-related technologies will vary with the social structure and the nature of the organization that will use them. For instance, determining which of the basic types of tree-planting arrangements—block planting, linear planting, single trees, or mixed associations of trees and crops—is most appropriate in a particular case requires planners to identify the socioeconomic characteristics of the intended planters and to assess local land tenure systems and land availability. Matching the technical elements of afforestation with the social units around which an afforestation strategy can be built is at the core of social forestry planning.

A relatively broad range of social groups can be involved in forestry development projects: communities, villages, village governing bodies, farm families, groups of farmers, cooperatives, women's groups, private companies, and schools and other public institutions. The roles of some of these social groupings are examined below in terms of their characteristics that are relevant for social forestry projects.

Communities

Until recently, experts widely accepted the community woodlot as a dominant model in social forestry. Many of them thought that massive fuelwood planting could best be induced if large areas of communal lands were used. Therefore, introducing this model through the community as a natural social grouping seemed logical. Planting for social forestry was conceived, and treated operationally, as a collective activity. Social foresters emphasized establishing woodlots on communally owned land. They assumed that community leaders would influence their members to plant, would mobilize labor and promote self-help, and would collectively protect the young plantations. They also assumed that communities could ensure the equitable distribution of benefits among their numbers.

Another assumption was that successful village woodlots in China and the Republic of Korea, which had been supported authoritatively by the government, were valid models for other social contexts. However, when they were replicated in other countries, community woodlots fared much worse than expected. Azad Kashmir is one example, but results in Gujarat and other Indian states, in Niger and other African countries, and elsewhere were similarly disappointing. Actual experiences, including some World Bank-assisted projects, revealed that, in most of these failures, the village community was not effective as a social unit in tree-growing programs for several reasons.

- Communities are generally not homogeneous; they are often split and stratified, and thus not able to sustain long-term projects that require cooperative efforts today for uncertain and delayed benefits some time in the future.
- The interests of community members often differ to such an extent that unified action is impossible. The "commons" syndrome (individuals overuse the commons since they as individuals do not own it; if they do not "use" it others will) (Hardin 1968) is particularly intractable, since it runs contrary to the need for community members to cooperate in establishing woodlots, in abstaining from premature harvesting, and in protecting them from animals. What is advantageous for one subgroup is not necessarily advantageous for another, or for individuals. Community leaders often appear reluctant or not powerful enough to enforce restrictions to protect the trees.
- Community land is limited, block sites are small, and costs are high in many of the areas most in need of fuelwood.
- The tenure status of common lands is often uncertain, and which social body has jurisdiction over the allocation of communal lands is often unclear (see Horowitz 1982). Usufruct is often blurred and clear rules for distribution of benefits are rare. The long production cycle for

trees weakens the confidence of those planting today that they will get wood in the future, and they fear that the communal authorities will appropriate the wood in any case. Thus, incentive is lacking (see chapter 9).

- Elaborate distributional arrangements to ensure that produce from village woodlots is made available to those who need it most have not worked.
- Communities are not necessarily organized as joint producers in any other respect. Externally designed programs have seldom bothered to establish grass roots organizations and institutions within communities to achieve the goals of these programs. The close cooperation required by community schemes cannot be fostered by decree.

Because of such factors, poor results were obtained in many places. In the *bois de village* (village forests) in West Africa, the community system was found to be a poor vehicle for getting trees established (see chapter 2 and Thomson 1980), and researchers also questioned its adequacy in Asian countries (Rao 1984). Often, forestry departments have to take over the village woodlots to maintain them, which defeats the basic purpose of community managed woodlots.

Farmers and families

Growing awareness of the ineffectiveness of the community centered approach led to a change in thinking and strategies. Social foresters shifted the emphasis of their programs, reallocated priorities, refined social forestry strategies, and changed the sociological underpinnings of certain forestry programs.

The focus shifted to individual farmers and family units. This approach has various names—farm forestry, family woodlots, agroforestry—but the common denominator is that the family farm/household is the social nucleus around which reforestation is planned, promoted, and financed. The technological package is designed to suit the opportunities available to the individual farmer, and may differ from the one proposed for community woodlots.

Recent World Bank-assisted forestry projects in Karnataka, Kerala, Haryana, and other Indian states, as well as in Haiti, Mali, Nepal, and elsewhere, provide strong support for emphasizing tree planting on individual farms. Farm forestry is now a substantial part of the follow-up project in Azad Kashmir, and about 12 million seedlings will be distributed to farmers. In India's Jammu and Kashmir social forestry project, village woodlots will represent only a small part of the total planting program, while farm forestry will represent almost half and will involve the distribution of about 47 million seedlings to farmers.

Sociologically, the significance of the family forestry strategy is manifold. It contrasts in several ways with the community approach. Thus, it replaces joint (community) responsibility for planting with individual (family) responsibility; it replaces joint ownership of trees with individual ownership; and it vests management authority over the tree plantation in a specific person rather than in a diffuse, amorphous entity. The simplification of the distributional implications is enormous. For farmers, the correlation between their inputs (labor or cash) and the output becomes direct, understandable, proportionate, and less uncertain.

Demonstration of successful forestry actively on even one farm can, over time, result in major local involvement (see box 5.4). The importance of different factors that trigger significant local involvement in social forestry projects vary, depending on the existing levels of knowledge and understanding of the technology being introduced, the adequacy of resources, and the motivation of the potential participants. In the case of a social forestry project in Haiti, the strong demand for fuelwood, the entrepreneurial nature of the Haitian peasant, and seedlings produced and supplied with outside resources were combined to create a project strategy. Participation in the project grew from a few farmers in 1981/82 to more than 110,000 in 1986 (USAID/Haiti 1986).

As mentioned in chapter 6, trees can be grown on private land not just as small blocks (family woodlots), but also along farm boundaries, internal field borders, and watercourses. From a socioeconomic viewpoint, tree planting systems that maximize the use of interstitial locations and other marginal lands are particularly suitable for small farmers because they do not compete with existing land uses. Even farmers who cannot afford to set aside land for a tree block can establish hedgerows or can plant around their houses. Thus, opportunities for expanding tree planting are greater in farm family forestry.

Since family forestry is essentially adopted through individual decisionmaking, expanded adoption is free from the difficulties, such as factionalism, that impede the collective adoption of community forestry. Adopting family forestry does, however, imply a change in behavior, assuming that farmers did not previously plant trees systematically. In India, for instance, researchers estimated that in 1984 only a small fraction (no more than 10 percent) of all farmers planted fuelwood trees. This very low figure suggests the gigantic dimensions of the changes needed. However, more recent studies in Haiti, India, Kenya, Malawi, Zimbabwe, and other countries indicate some increase in farmers' interest in planting multipurpose trees for poles, fodder, fuelwood, and as a cash crop.

Project planners with knowledge of the local culture and value systems can develop imaginative incentive schemes. They can link farm forestry to other activities or events that stimulate the farmers' interest. For instance, in projects to regularize land tenure, large numbers of farmers who have had only customary rights to land receive legal title to it. Since titles are very important to farmers, granting them can be used as an incentive for farm forestry: farmers can be asked to plant trees along the boundaries of their land as part of the title-receiving ceremony, and seedlings can be supplied to facilitate the process. Farm forestry can also be linked to irrigation and settlement projects and to the construction of roads and other infrastructure. Tree planting can be linked to many events in the farm family's life that are imbued with positive values and thus help the successful adoption of the new behavior: the deliberate cultivation of trees. For example, in the Philippines, livestock programs (pigs, poultry, rabbits) were used initially as an incentive to get farmer participation in tree growing.

As an enduring social unit able to sustain forestry development programs, the farm family is an excellent social resource. Tapping its potential requires the deftly tailored integration of technical, sociological, and economic elements.

Small groups

The often spectacular success of family-centered forestry may obscure the fact that group-centered approaches have development potential that planners sometimes overlook because of the poor experience with the community approach. The limitations of communities as social units are due to their large size and internal stratification. Other groups of smaller, more manageable sizes can prove fully functional. A small group is likely to be less diverse and stratified, more homogeneous, and less subject to internal strife. A common interest, pursued more effectively by joint action than by individuals, links the members together. A simple rule for the distribution of benefits (for example, equal shares for all) can eliminate actual or perceived disadvantages of the group approach. A small group can also enforce rules about equal contributions by its members through peer pressure. Small groups often manage other natural resources (as in the case of a water users' association formed around a small branch of an irrigation system) and may be able to operate a woodlot without the conflicts that surround community woodlots.

One successful example is a group farm forestry scheme developed in West Bengal, India. A group of landless or very small farmers is given a block of marginal public land for tree planting. The members are not granted title to the land, but have usufruct of the land and ownership of the trees they plant and protect. Under this system, group control over any temptation to change land use or mortgage the land is tight. The area allotted and the number of trees to be planted guarantee enough wood from dead trees and branches to meet each family's domestic requirements. The stem volume is available for sale, and the total output ensures participant interest. The group can organize protection of the parcel of land and the trees. The group strategy encourages and facilitates consensual action for tasks that would be performed less effectively if carried out by individuals. The people involved in this scheme are highly dependent on the income generated by their labor and cannot be expected to work without remuneration. Thus, payments are made to help meet families' consumption requirements during the early years of the plantation, and incentive payments are given for each surviving tree to encourage maintenance efforts.

This type of group forestry is feasible only if land is available for planting close to the beneficiaries' residences. Tailoring this approach to particular sites and social strata underlines, as discussed in chapter 7, the importance of land-use surveys and data from area population surveys as base lines for targeting programs. The operational principle is to create a clear link between a well-defined, small group and a well-defined piece of land that is to be converted into a woodlot. In addition, the correlation between contributions and returns must be clear, and authority and benefits must be restricted to the members of the group, not left open to the community at large.

The advantage of such small groups is that they can supply the social structure necessary to put to productive use natural resources that would otherwise remain underutilized or idle. Several states in India envisage a considerable expansion of group farm forestry on public lands. Researchers have estimated that some 2,500 seedlings, given free to each participant, would enable the participant's family to gather its domestic fuelwood from branches, tops, and fallen wood and to sell the main stem volume for cash income. This innovation is a socially significant instance of partial "privatization" of the usufruct (not ownership) of public lands. Where surplus labor is available and private land is scarce, it offers possibilities for helping to alleviate poverty.

Associations and cooperatives

Even when individual farmers plant trees, some form of group or association may be economically and socially beneficial. For example, in several countries where family farm forestry is being implemented, the forestry departments or other facilitators have helped establish tree growers' associations or similar organizations to help farm families market the wood they produce.

One structure that could support reforestation by farmers is the forestry cooperative. With a clearly defined and not too large membership, a cooperative might be a more coherent and effective organization than the village community as a whole. In the Northwest Frontier Province of Pakistan, a pilot program to revive forestry cooperatives in the Guzara forest envisages the establishment of some 15 cooperatives, each with a minimum of about 200 hectares of forest land. Each cooperative is responsibile for managing the forests of its members in accordance with a plan approved by the forest department.

The cooperatives receive assistance in preparing the management plan and the services of field foresters, both paid for by the provincial government. No other subsidies are given, and the cooperatives bear all other forestry costs (replanting felled areas, maintenance, extraction, and so on). For this purpose, the cooperatives are authorized to retain as much as 40 percent of the revenue from the sale of trees and to receive credit, if needed.

School groups

Many traditional societies, particularly in Africa, entrust certain maintenance functions in the society to subgroups. Some of these groups are defined by age and gender and are accountable to appointed group leaders as well as to the overall authority structure. Similar groups could be used for some forest development activities.

One of the notable successes in recent years has been the involvement of school-age youths in social forestry projects (in Haiti, India, Kenya, and Malawi), particularly in establishing tree nurseries. Schoolchildren are a homogeneous age group, concentrated by virtue of their main activity—going to school—and have a built-in leadership system. Although the nature of this group limits its use for activities of long duration, it is perfectly suitable for short-term, technical processes in forestry, such as establishing nurseries and producing seedlings. Institutional arrangements in the form of a partnership between schools, communities, and government agencies (Chowdhry 1983) can effectively formalize and increase the support for social forestry.

The example of Gujarat in India is impressive. At the outset of a social forestry program in 1980, less than 20 schools had tree nurseries. The forest department decided to encourage schools and private farmers to raise seedlings rather than to expand its own nurseries. The program proved to be a big success, and in three years about 600 schools had started nurseries in which schoolchildren, with guidance from foresters and teachers, produced several million seedlings a year. The only incentive provided is a guaranteed price for the seedlings; when they are ready for transplanting, the state forest service buys them for distribution to local farmers. This economic incentive is backed up by technical advice from extension workers to help schools construct and operate small tree nurseries. In practice, the schoolchildren have taken many of the seedlings home and planted them around their homesteads. The program has thus stimulated genuine interest in planting, owning, and protecting trees (Spears 1983).

Women's groups

Experience with women's groups in forestry is limited, but positive. Since women are responsible in many cultures for collecting fuelwood, they have an incentive to become involved in producing trees close to their homes. Women often possess exceptional knowledge of the qualities of various tree species (Hoskins 1979b). Evidence from a number of social forestry programs underscores the contribution women can make (Scott 1980). Although women have been organized for different productive or household-related activities in various countries, little has been done to involve them in taking group responsibility for the cultivation of woodlots. Even in a country such as Kenya, where women's groups are widespread and effective, a sociological field study found that out of 100 women's groups active in one district (Mbere), none was directly involved with tree planting (Brokensha, Riley, and Cartro 1983). However, in other districts, women's groups have recently started to plant woodlots for their own use (Rocheleau n.d.).

Women's groups could probably perform a role more or less similar to that of other small group forestry, described above, if project planners built in adjustments for their other productive and household roles. Given the constraints on the availability of poor, rural women's time, organizing group-based fuelwood production activities may increase output without creating additional time constraints on the women (Tinker 1982, 1984).

In many places, women and children must make enormous efforts to collect wood for cooking and heating, often traveling long distances. In certain areas of Nepal, for instance, researchers estimate that women spend between 20 and 40 days a year collecting fuel. Therefore, producing the fuelwood through group activity rather than collecting it may save both time and labor.

Other groups

The alternative types of social units examined are not an exhaustive list, for example, church groups have been used in some areas. Enterprises established for the industrial exploitation of forestry plantations are also units of social organization, but with a distinctive structure and functions. In a broader sense, some NGOs can also be suitable units for mobilizing and sustaining afforestation programs under well-defined circumstances (see chapter 11).

The point is, such alternative social groupings can be conceived and organized. They are, in William Foote Whyte's words, "social inventions" (Whyte 1982) or purposive social arrangements for the performance of precise productive and distributional functions. A continuous learning effort should be an integral part of the process of organizing such groups and improving their structure and operation. In turn, such social groups should develop a strong interaction and cooperation with the formal organization involved in forestry programs (government agencies, forestry departments, and development NGOs).

No "best" social strategy exists for all development approaches in social forestry. Social strategies span a broad spectrum, and alternatives are available or can be devised. Similarly, there is no "right" form of social or economic grouping of people that will be effective in all cases. As indicated in chapter 7, project or program planners have to learn about communities, their existing structures, social groupings, and behavior, and then choose a strategy that takes advantage of opportunities and strengths and addresses needs as they appear in each situation.

Summing Up

One of the more complex aspects of social forestry that project or program planners must understand and deal with is the institutional structure that will work in a particular case. Each community has its own strengths and weaknesses, its own structure within which social forestry must be introduced. In most cases, changes in both individual and group behavior are called for within the existing structure. To effect them, a social strategy is called for that defines how the community institutions should be involved and what new institutions, if any, need to be established.

The most important factor in designing a social strategy is the accurate identification of the units of social organization that can and will organize and undertake the necessary activities to grow and use trees. Many potential "social actors" exist, but they are not equally fit for each task and approach to social forestry. The proper fit between the technical elements of afforestation and the social units around which an afforestation strategy can be built is at the core of the cooperation between forestry experts, planners, and sociologists.

A broad range of units of social organization can participate effectively in social forestry projects: communities, villages, village governing bodies, farm families, groups of farmers, cooperatives, schools, private companies, women's groups, churches, public institutions, and many others. This chapter discussed approaches and strategies for community woodlots, family forestry, small-group forestry, and forestry carried out by associations, schools, and womens' groups. The appropriate strategy for each of these groups can be quite different, as can the results. For example, the community woodlot approach has had limited success, while farm family forestry has been one of the more successful approaches used.

9

Incentives for Local Participation

Voluntary participation in tree growing is a critical factor in the success of social forestry programs. The extent of such participation depends directly on the incentives people have to grow trees. This chapter discusses the types of incentives, both market and nonmarket, that stimulate participation in social forestry. Public interventions to change or enforce incentives and to remove constraints are identified and then discussed in terms of how they can be applied in practice.

Voluntary participation in social forestry occurs if people are convinced that they will get more out of a social forestry activity than they put into it in terms of time, effort, and resources. Important in this decision to participate is the individual's perception of the relative risks involved. Risk aversion is high among poor, rural people who live from hand to mouth and for whom the margin between starvation and subsistence is narrow.

Even if expected returns are greater than costs, project planners may have to remove constraints other than risk to make participation attractive. Government regulations and laws, or inadequate definition of such, may stand in the way of action. For example, people who live in an area where property rights are poorly defined may not have adequate incentives to plant trees, thinking that once trees are established, even on their own land, they will become the property of the government, village chiefs, or the forest service. Researchers have documented this type of constraint in many countries (see Hoskins 1979a; Arnold and Campbell 1985; Gueye 1985).

Incentives fall into two categories: those associated with markets (monetary returns) and those associated with nonmarket factors, such as cultural and social traditions or public subsidies. A clear example of a market incentive is when market prices for fuelwood stimulate investment in tree growing (as has happened in Haiti, India, and other countries). A clear example of a nonmarket incentive are cold and hungry children who motivate parents to gather fuelwood for heating and cooking.

Unfortunately, both these types of motivations can result in actions that damage the environment. For example, fuelwood collection by the rural poor can reduce the stock of trees available to grow fuel for the future, and this can lead to the vicious cycle of increasing deforestation and environmental degradation. Similarly, high fuelwood prices may or may not provide an incentive for socially desirable or productive forestry; they may merely give fuelwood merchants further incentive to cut down existing natural forest. In the case of fuelwood, incentives are needed to stimulate action and investment that is compatible with protecting the existing physical environment. Such incentives should motivate people to adopt sustainable fuelwood production and land management practices.

Intervention from outside may be called for when a local community incentive system does not result in socially desirable action, for example, when the incentive system leads to a depletion of forest or soil capital. Outside intervention in social as well as in industrial forestry is common throughout the world. In both market and nonmarket situations, governments provide subsidies and other types of support to motivate socially desirable action. Essentially, the aim of all such programs is to influence local incentive systems to a point where they lead to sustainable development and improvements in welfare.

Understanding Local Incentive Systems

Without knowing what motivates local people, the inclusion of effective measures to elicit local participation in a program becomes a matter of chance. The appropriateness and expected effectiveness of incentive mechanisms depend on the type of change being encouraged and whether or not the incentive system is relevant for the segment of the community with which a project is dealing. For example, in some societies, subsidized credit will be ineffective as an incentive to action because the people have a basic aversion to being in debt, often for cultural reasons (Hyman 1983). Planners have often assumed that all poor rural and tribal people are unquestioning traditionalists and have incentive systems that reflect this conservative view of the world. This is now recognized as a myth (Vayda et al. 1980).

Cultural differences exist between communities of people, and these differences influence incentive systems and the effectiveness of different types of incentive mechanisms. Still, many groups do react similarly to certain basic stimuli and incentives. Thus, while adaptations are necessary from case to case, a review of what we know about incentives operating in various communities is useful. Project planners must ascertain and nurture local incentive systems, not prescribe them in a mechanistic fashion, if participation is to take place.

Different groups, different incentives

Effective local community participation in social forestry involves different types of activities undertaken by diverse groups within a community, as indicated in chapter 8. While involvement will vary with the knowledge and resources of these groups, it also will vary with how programs respond to the motivations and incentives of the groups and the individuals within them. Thus, knowing about differences within a community is important, as indicated in chapter 7. For example, the incentives for women may be quite different from those that would motivate men in the same community (table 9.1). Agarwal (1982) illustrates this point with an example from India. In the Himalayan district of Chamoli, men were interested in trees for cash income, for example, ones bearing fruits and nuts. Women, however, collect leaf fodder and wood for cooking and heating. Thus, they preferred fodder and fuelwood trees to reduce the time consuming task of collection. At the same time, as Fortmann and Rocheleau (1985) point out, different groups of women will be motivated by different factors. For example, wealthier women may respond quite differently to monetary incentives than will poorer women from the same community.

In the same vein, incentives that would appeal to rich, male community leaders might be quite different from those that would appeal to poorer members of the community. The incentives that appeal to the landless are often different from those that appeal to landowners, both because they face different relative scarcities of goods and services, and because they have generally differing views of, or attitudes toward, risk and uncertainty. Religion, education, and political views also influence responses to incentives.

Program designers must identify and keep in mind differences in incentive systems. Since such differences will almost certainly exist among community groups, planners should design alternative incentive packages from which local inhabitants can choose those that fit their particular incentive system and preferred social groupings. One package will seldom suit all.

Farmer incentives for tree growing

Farmers generally constitute the main group that will be involved in tree-growing programs. Thus, project planners and implementers need a particularly good understanding of their incentive systems. Basically, farmers consider the perceived net benefit involved (that is, the difference between perceived costs and benefits) and the relative security or risks involved in tree growing. They consider tree growing within the context of their total farming system. Thus, they compare expected net benefits with the benefits they could obtain from using their land, other resources, and time in the next best use in the farming system. Farmers also compare their perception of the risk of tree growing with the security or risks associated with using their land, other resources, and time for other uses.

Table 9.1 Contrast between Women's and Men's Interests in Tree, Soil, and Water Resources

Item	*Women's interests*	*Men's interests*
Primary tree products	Daily fuelwood collection near the household. Concern about availability of preferred species. Interest in access to poles for local use.	Interest in building poles and timber trees as cash crop and for local use. Interest in fuelwood mainly as cash crop.
Secondary tree products	Major involvement in collecting human food and having fodder for small animals available near home site. In certain areas where cattle are kept at the household, women are in charge of gathering fodder.	Herders apt to be involved with large animal grazing, but not limited to areas near the home site. Little interest in collecting wild food products from natural vegetation.
Tertiary tree products	Collect many products needed in the household and for barter or sale. Women's employment or extra cash income may depend on access to tertiary products as raw materials.	Some men make medicines, especially herders for their animals. Men may use tertiary products, but they often use fewer and quite different ones from those used by women of their own communities.
Soil	Use limited to areas near household. Special interest in soil quality in gardens and in fields with subsistence crops.	More choice of area for farming because men are more mobile and may have access to fertilizer. Interest generally focuses on best soils used for cash crops.
Water	Generally responsible for locating and transporting household water. Often also responsible for water delivery for introduced projects (e.g., water for poultry, newly planted trees). General concern about water for garden and field crops.	Herders generally take animals to water source so they may be more concerned with water pumping than delivery or availability close to home. Concern also about water for fields.

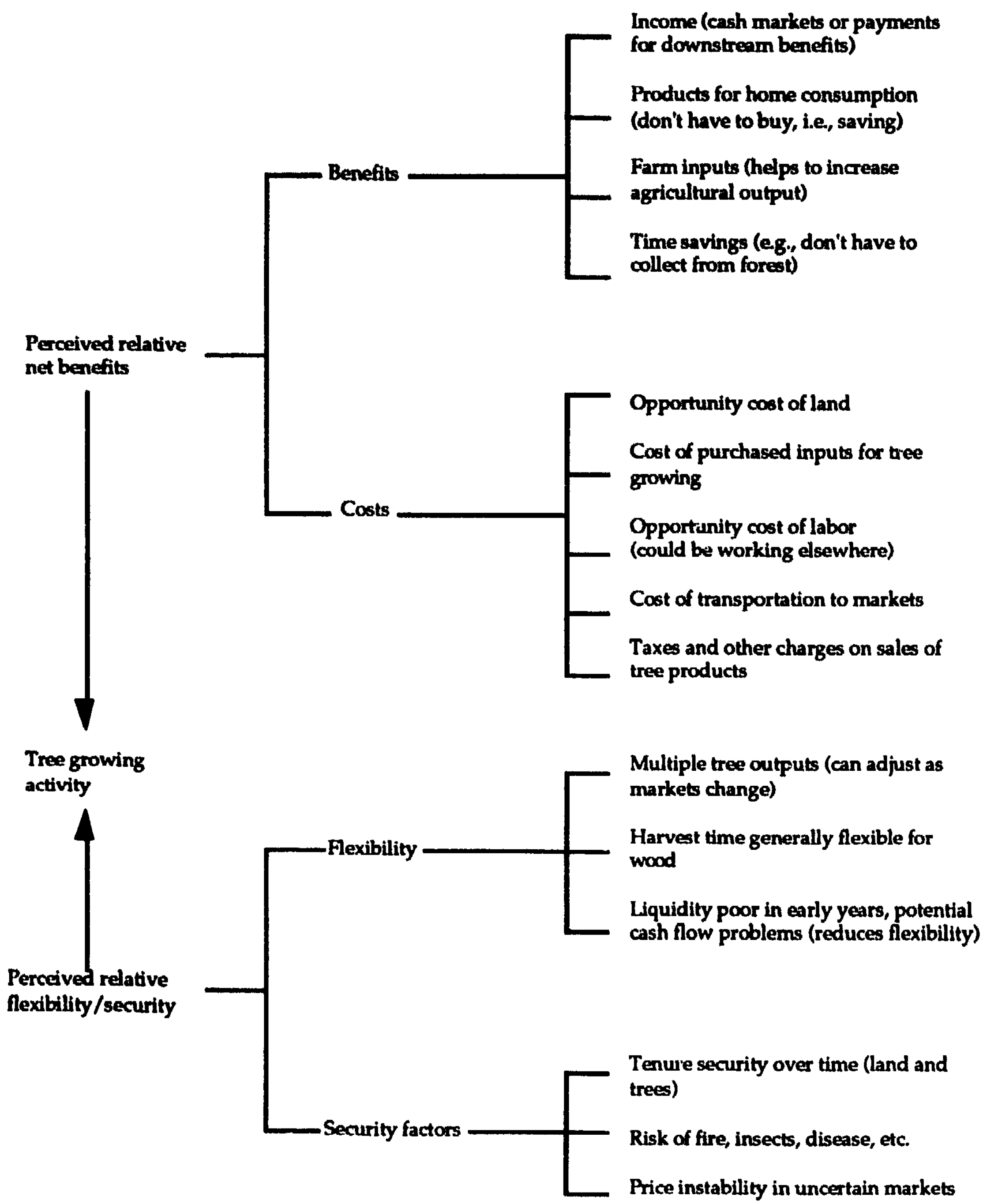
Note: These interests are general and may apply to many developing countries.

Source: Hoskins (1983b).

The main factors farmers consider in determining the relative net benefits and the relative security of tree growing in a farming system are indicated in figure 9.1. These are the factors that outside interventions intended to change incentives for tree growing can influence.

Before discussing market and nonmarket incentives related to these factors, one point needs reemphasis: the four prerequisites for successful local involvement—resources, knowledge, incentives, and institutions—interact and cannot be dealt with separately for each project or program. For example, in many cases where the aim is to get local people to plant trees for their own use, the main constraint may appear to be lack of incentive when it is actually a lack of understanding of the problems at hand and of knowledge of what to do, or lack of resources or ability to plant trees. The interaction between the prerequisites for local participation comes into play here: the apparent lack of interest in planting trees may be because constraints related to the other prerequisites—knowledge, resources, or institutions—exist (see Arnold 1987b). However, until planners understand local incentive systems, knowing which prerequisite is the most limiting and, thus, which one needs to be addressed most urgently by outside intervention, is difficult.

Figure 9.1 Factors Influencing Farmers' Incentives to Grow Trees



Market Incentives for Local Participation

> What we do in the reforms in the countryside is emancipate the productive forces and bring into play the enthusiasm of the peasants. If you want to bring the initiative of the peasants into play, you should give them the power to make money. That's why we put an end to the communes and have introduced the responsibility system in production.
> (Deng Xiaoping, interview, *Time*, November 4, 1985, p. 39).

Evidence indicates that earning income is one of the stronger incentives in eliciting widespread local participation in social forestry activity. The Haiti Agroforestry Outreach

Project is a good example of a project in which the planners and administrators built on an existing market incentive structure and the strong entrepreneurial orientation of the local population to achieve significant, widespread, local action. Other examples are found in India, Kenya, the Philippines, the Republic of Korea, and many other countries.

Social forestry programs that have multiple marketable outputs, such as the Korean Village Forestry Association program with its outputs of kudzu fiber, forest stones, oak and pine mushrooms, and chestnuts, provide multiple market opportunities and incentives for widespread local involvement. Similar variety has been built successfully into a number of projects, for example, in Senegal and several Central American programs. The multiple output approach provides a broad base of incentives for local participation. In most cases, both marketed and nonmarketed outputs are included.

Often, encouragement of social forestry activity will be related indirectly to infrastructure and market incentives. For example, lack of cheap transport may be a barrier to market involvement. Improvement of the transport situation by government or project authorities and the lowering of costs and increase in potential net returns may provide adequate incentive for local involvement in market-based activity. Market incentives or the profit motive can be an extremely powerful force, and one that project planners should search for through indirect as well as direct means (see chapter 5 for further discussion of the commercial aspects of social forestry activity).

Nonmarket Incentives for Local Participation

Many social forestry projects have little to do with market-oriented activity; they are primarily projects that aim at getting local people to produce for themselves. In these cases, the focus will be on nonmarket incentives. Planners may have to deal with religious, social, and other cultural factors in the process of building an adequate incentive system for widespread local participation. In some cases, public subsidies will be involved. Among other things, introduction of factors that reduce uncertainty or the risk of failure may be all that is needed to get local farmers to adopt various agroforestry packages.

The incentive may be provided by local leaders who plant trees. Other people, wishing to emulate the respected leaders, start planting and tending trees. Given the potential influence of a successful demonstration, the persons used in a demonstration approach have to be chosen carefully. For example, using an influential landowner's land to demonstrate agroforestry techniques can backfire if other local residents believe that the landowner is being favored or is being given something they are not given. The incentive to plant trees can actually be destroyed.

In many cases, nonmarket incentives are closely related to market incentives. For example, developing farmers' incentives to produce fuelwood for their own consumption may involve convincing them that producing the fuelwood is better than spending scarce income buying it. The incentive becomes clearly related to money and consumption, even though the relation to markets is only indirect. The motive of earning monetary returns—which is the recognized incentive in a market situation—is replaced by a savings incentive for farmers who will produce their own fuelwood and thus have money to spend on other goods or services. Both are related to consumption motives, but the two can be quite different.

Most incentives for tree growing end up being consumption-related, either through the profit motive or the savings motive, although some religious and other nonmonetary, nonconsumption-related incentives stimulate tree growing and good land use, for example, certain religious beliefs and practices. In terms of outside intervention, identifying and recognizing the existence of these nonmonetary incentives and encouraging them in building programs with widespread participation is important. The alternative to such nonmonetary incentives are subsidies that appeal to people's profit and consumption objectives.

Overcoming Lack of Incentive

In all fields of activity—agriculture, industry, education, health, and so forth—the public sector often intervenes to change or strengthen incentives when investments and actions deemed socially desirable are not taking place. In planning for such interventions, careful attention has to be given to justifying them and choosing the right incentive mechanisms for a given situation. For example, as discussed earlier, while subsidies are widely used in forestry throughout the world to change incentive structures, such subsidies may not work in some cases, and may eventually create problems as people come to rely on and expect the subsides (see Hoskins 1979a; Tschinkel 1984; Joyce and Burwell 1985). Thus, incentive mechanisms should be used with a great deal of care.

The justification for outside intervention

If the local incentive systems are leading to socially undesirable actions—for example, soil depletion or reduction of forest capital below the level that can provide outputs on a sustainable basis—then some form of outside intervention may be needed. Figure 9.2 lays out a framework for analyzing whether or not outside action is needed to redirect local incentives or create new ones for local participation in social forestry activity.

One can calculate the justifiable level of a subsidy and the level of a subsidy needed to give private landowners adequate financial or monetary incentive to plant trees. Thus, for a landowner to have the incentive to invest in an activity, the net return (NR) to the owner from the activity—that is, the total return (TR) minus the total cost (TC)—has to be positive when all costs and benefits are appropriately discounted to reflect the time when they occur and perceived risks associated with the investment. If the NR is negative, then the landowner has no financial incentive to invest. Only by making the NR positive will this incentive exist. Therefore, the minimum subsidy needed will have to make the TR at least as large as the TC (or reduce the TC to the point where it is equal to or smaller than the TR).

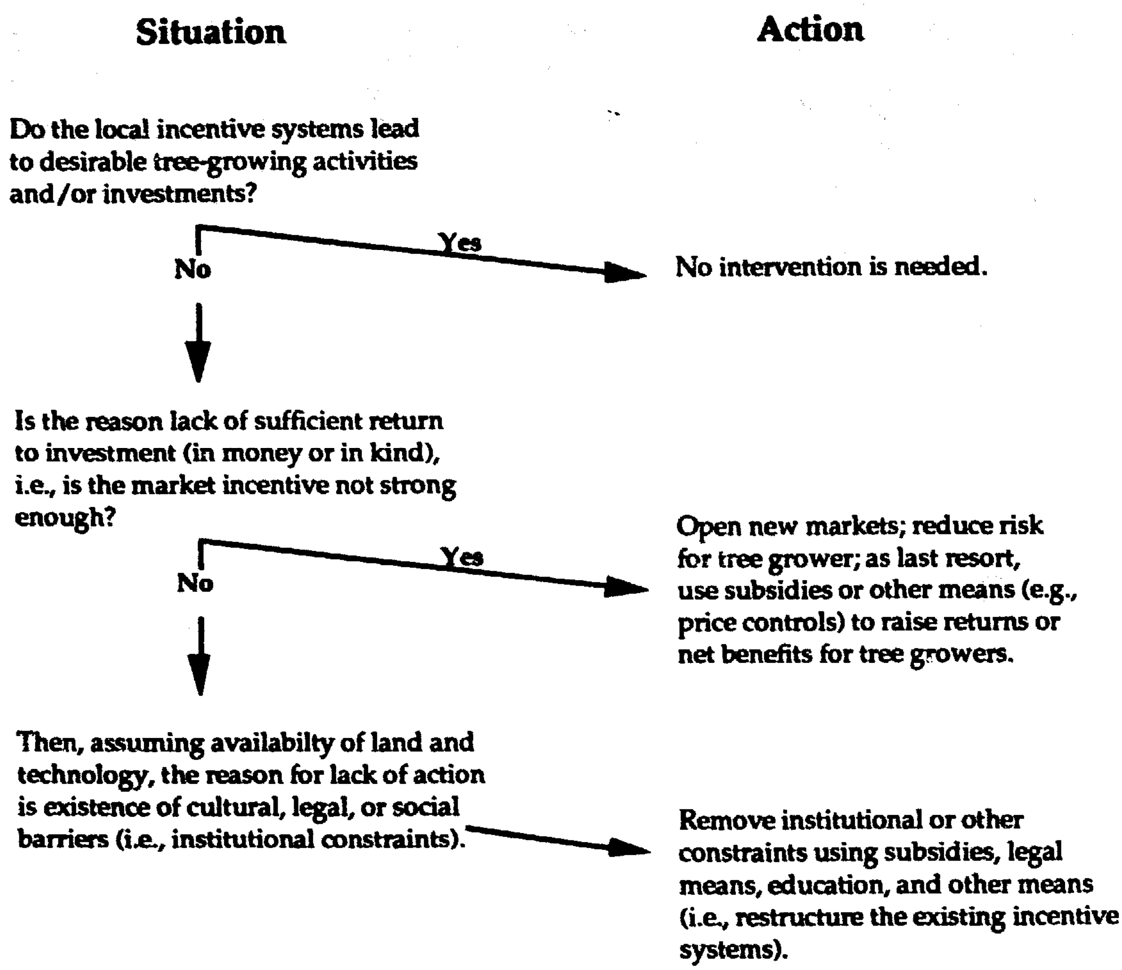
Looking at subsidies in terms of how large a subsidy can be justified by society, costs and returns to society must be considered. If, because of positive effects not considered by the private investor (for example, environmental benefits), the return to society is positive and greater than the negative private NR, everyone will gain if the public sector provides a subsidy equal to at least the negative private NR, but not higher than the social NR. In sum, the basic justification for any subsidy is that aggregate welfare is increased by an amount greater than the cost of the subsidy.

If people know how to grow trees, have the resources to do so, but do not grow trees, one might conclude that they really do not need or want them enough to invest the necessary time, effort, and resources, and thus—at first glance at least—intervention and subsidies cannot be justified. However, for several reasons this conclusion may not hold and outside intervention may be justified.

First, and perhaps most obviously, institutional or cultural constraints may be present, even though knowledge and resource constraints may not be. Project planners must judge whether or not these institutional and cultural barriers should and could be removed. Religious beliefs, social traditions, and cultural taboos are legitimate parts of a society. Great care must be exercised in trying to modify them. In some cases, introducing an institutional innovation that removes the barrier to tree growing without compromising cultural values is possible. Generally, such an innovation must be introduced from outside.

Second, trees take time to grow. From the time when the local population realizes and acts on the need for tree growing, a number of years will pass before outputs from newly planted trees become available. In the meantime, severe hardship and environmental degradation can occur. As in the case of soil depletion, people tend to draw down their forest or tree capital without realizing that they are doing so until it is too late. Deforestation by local people using wood for local uses can be a slow and largely unnoticed process; realization of the damage may come too late for them to do anything about it without significant outside intervention.

Figure 9.2 Determining Appropriate Actions to Overcome Lack of Incentive for Sustainable Social Forestry Activity



Third, outside intervention to stimulate tree growing and better land use is often justified on the basis of the "externalities" involved. That is, those people who should be growing or protecting the trees would not get all the benefits from the tree-growing activities; thus, they may lack incentive even though it may be highly desirable from society's point of view. An example of this type of situation is creation of downstream watershed management benefits as discussed in chapter 2. Outside intervention in such cases will generally involve provision of incentive payments: the government or downstream beneficiaries will compensate those who plant and tend the trees or those who change their land-use practices (Kumazaki 1982). Such compensation should be considered payment for services, not a subsidy.

Different countries have used various kinds of incentive programs to promote and stimulate conservation activities. An overview of such mechanisms and some programs in which they have been used is presented by deCamino (1987).

Types of subsidies used for social forestry

Most countries provide subsidies to stimulate social as well as industrial forestry activity. Almost all developed countries with rich endowments of forests (for example, Austria, Canada, the Federal Republic of Germany, New Zealand, Sweden, the United Kingdom, and the United

States) provide a variety of subsidies to private forestry. Table 9.2 summarizes the types of subsidies provided to forestry in 11 OECD countries. Most of the arguments for these subsidies are political and relate to environmental protection, resource sustainability, and rural stability objectives (Gregersen and McGaughey 1985).

Table 9.2 Subsidies for Forest Management Activities on Nonindustrial Private Forest Lands in 11 OECD Countries

Type of subsidy	*Harvesting*	*Reforestation*	*Afforestation*	*Forest improvement*	*Forest road construction*	*Protection (fire, insect diseases)*
Direct with landowner						
Cost-sharing						
Cash grants	N2	N8, L3	N10, L4	N9, L4	N8, L4	N8, L4
Goods/materials	---	N5, L1	N6, L3	N2, L2	N2, L2	N5, L2
Services (management, marketing, etc.)	N3, L1	N4, L1	N5, L1	N5, L1	N2, L2	N3, L1
Subsidized credit (loans)	N2, L1	N6, L1	N7, L1	N4, L1	N5, L1	N3, L1
Fiscal						
Tax rebates or exemptions	N3	N4, L1	N5, L1	N3	N3, L1	N2, L1
Special taxes (yield, property, etc.)	N3, L1	N3, L2	N3, L2	N2, L1	N2	N1
Other	N1	N1	N1	N1	N1	N1
Reduction of uncertainty						
Rental contract						
Price guarantees	---	---	---	N1	---	---
Insurance	---	N1	N1	N1	---	N2
Forest protection agreements	N1	N1	N1	N1	---	N1, L1
Land tenure security	N1	N1, L1	N1, L1	N1, L1	N1	---
Loan guarantees	N3	N2	N2	N2	N2	N1
Other	N1	N2, L1	N2, L1	N2, L1	N2, L1	N1
Indirect						
Market information/price reporting	N6, L2	N3	N4	N3	N3	N2
Extension/education	N7, L5	N7, L5	N8, L5	N8, L5	N7, L3	N10, L5
Research and analysis	N8, L3	N8, L4	N9, L4	N9, L4	N8, L3	N9, L4
General forest protection	N2	N5, L2	N4, L2	N5, L2	N4, L3	N6, L3
Infrastructure	L1	---	---	---	N1	---

— = none
N=national level; L=local level; figure following N or L indicates how many countries have national or local incentives in this category.

Source: Gregersen and Plochmann (1983).

The types of subsidies or incentive mechanisms used in social forestry programs in developing countries are shown in table 9.3. As indicated, the incentives fall into two main categories. One is direct to the landowner: direct incentives are tied to a response or action by the landowner. The other is the indirect type of incentive, which is not tied directly to any given landowner's response or action.

The incentive mechanisms listed are used not only for forestation, but also for harvesting, forest improvement, forest road construction, protection, and so forth, emphasizing that social forestry involves the whole production system, not just the planting stage. Ultimately, the consumption of the tree products and the protection provided by the trees are the benefits.

These outputs depend upon all the activities involved in forestry, from seed to final product. Incentive mechanisms should be used where they are most effective within this system.

Table 9.3 Incentive Mechanisms and Their Effects, Developing Countries

Incentive mechanisms	*Effect*
Direct with landowners (tied to performance)	
Cost-sharing: landowners are provided cash payments or subsidies in kind (e.g., free seedlings, tools, other inputs); tree planters are provided food for work; or landless are provided land for tree growing.	Reduces tree grower's cost and risk; increases returns to grower; in case of land given to landless, makes it possible for them to grow trees in the first place.
Credit: tree planters/landowners are provided credit that they normally could not obtain through the market; can be either direct from public agency or through private channels with government loan guarantees; interest can be either market rate or subsidized; terms need to fit time frame associated with tree growing.	Improves access to resources; helps reduce cash flow problems if credit terms are appropriate; reduces tree grower's costs if credit is subsidized.
Fiscal incentives: tax exemptions, rebates, reductions; tax credits (e.g., in the case of exported products).	Shifts incidence of costs, thereby reducing costs for tree grower; can reduce risks.
Reduction of uncertainty: provision of free or subsidized crop insurance; price guarantees, contracts for production, tenure security, forest protection services.	Increases security for tree grower since risks being shared or assumed by others; can reduce actual costs; can increase flexibility for tree grower.
Indirect (not tied to performance)	
Services provided free such as market information, extension, education, research; provision of public infrastructure such as roads.	Can increase tree grower's knowledge of what to do, thereby reducing uncertainty and risk as perceived by tree grower; can increase efficiency and net returns to tree grower and can reduce losses.

Source: Gregersen and McGaughey (1985).

A first step in choosing subsidy packages is to set goals and to identify target populations (that is, decide who should gain from public subsidization of social forestry activities). The question of large landowners gaining from subsidization at the expense of the landless and smallholders has been raised as an issue in some cases (box 9.1).

Coordination of interventions

Some form of coordination of policies and approaches to public intervention, including subsidies, is needed. If the relatively long period involved in tree growing results in a lack of incentive to plant, a number of mechanisms can be employed to develop adequate incentives. Actions to increase the incentive to plant might include (a) providing alternative technologies that would shorten the waiting period or provide short-term benefits; (b) reducing risk and uncertainty through insurance, loan guarantees, contracts, or changes in tenure and other laws; and (c) providing credit on suitable terms, including an adequate grace period, so that repayment can start after the first harvest.

The effectiveness of an incentive program for forestation will be improved if it involves a systems approach; that is, when everything is considered together, from seedling production to final harvest or use of the services from the mature plantation. The Korean fuelwood/social forestry program is a good example of this kind of integrated approach (Gregersen 1982). Many cost-share programs fail in terms of the continuity criterion. The program supports tree planting one year for one group and then supports a new group of landowners, ignoring the seedling survival and other problems the first group experiences. Retention rates in such cases can be very low; that is, at the time of projected maturity, very few of the original seedlings may still be alive. Thus, a key requirement is a policy that will provide for follow-through once the decision to provide support for planting has been made. If providing subsidies for planting is worthwhile, then seeing the planted seedling through to maturity should also be worthwhile, regardless of whether or not this involves subsidization. Of course, such longer-term involvement has budget implications that program designers must consider.

Box 9.1 Subsidies Going to the Larger Farmers: India

No doubt the initial spontaneous response of medium (more than 2 hectares) and large (more than 4 hectares) farmers, linked with rising wood prices, is one of the factors responsible for the spurt in farm forestry planting in India (Gujarat, Haryana, the Punjab, and Uttar Pradesh). The fact that the relatively better-off farmers have been significant beneficiaries of the subsidized program initially has led to criticism. Recent surveys have, however, revealed that the benefits of free or low-cost seedlings have reached 38.5 percent (Haryana), 42.5 percent (Gujarat), 64.7 percent (Jammu and Kashmir), and 80.8 percent (West Bengal) of the farmers with land holdings of up to 2 hectares.

From Guhathakurta (1984).

Outside interventions in market situations

Outside intervention may be justified and used in situations where the main activity is market driven or responsive to market prices. An example is when a large, urban market for fuelwood exists, with prices high enough to encourage natural forest cutting, but not high enough to induce investment in growing fuelwood for that market. The consequent depletion of the natural forest stock below the level of sustainable production of wood to meet the needs of the population can have negative social effects, such as erosion of the deforested areas and downstream damage. The local population might face other hardships as the natural forest disappears. With the dwindling supply, fuelwood prices can rise rapidly, causing hardship mainly for the poorer members of society. Other products—medicines, foods, and so forth—previously harvested in the natural forest may also be lost through deforestation, causing hardships that the market-oriented fuelwood cutters neither anticipate nor care about.

Some combination of temporary subsidies for investment in fuelwood plantations, stricter regulation, and perhaps taxing of natural forest harvesting might be justified in these cases. The subsidies would have to be large enough so that existing market prices plus the subsidy would be high enough to provide farmers with adequate incentive to invest in plantations. The subsidies may be socially justified on the basis of the environmental costs avoided (by reducing the rate of destruction of natural forest) and on the basis of the hardship and human suffering (perhaps including health problems) avoided. The subsidies should be reduced as fuelwood prices continue to rise toward levels that are sustainable in the marketplace for plantation-grown wood.

Designing effective incentive packages for social forestry

Based on a review of a number of types of incentives used in both developing and developed countries, common, important factors that should be considered in designing and implementing effective incentive packages for social forestry programs can be identified (see Gregersen and Plochmann 1983; Gregersen 1984).

SIZE OF SUBSIDY RELATIVE TO TOTAL COST. The amount or proportion of private cost covered by forestation subsidies varies widely; 50 to 75 percent is often covered in the case of cost sharing. However, several countries have used forestation incentives that end up involving subsidies of more than 100 percent of cost. This generally was not deliberate, but occurred because of a lack of information on inflation and the actual cost of tree growing.

If a subsidy covering more than 100 percent of cost is given, then an inefficient allocation of resources exits. A 100 percent subsidy means that the private entity pays nothing for the forestation, but reaps at least a portion of the benefits. This makes little sense, either from an efficiency point of view or in terms of distributional considerations. It results in an infinite rate of return for the private individual, which obviously is more than is needed to stimulate interest and investment. Better information and close monitoring can help avoid this problem and ensure that a given amount of subsidy funds reaches more people and is used on more hectares.

SUBSTITUTION OF PUBLIC FOR PRIVATE CAPITAL. From a public point of view, a program is not effective if public subsidies merely substitute for private capital, that is, if the public sector pays for activities that would have been undertaken in any event by the private sector (without the subsidy). To help avoid this problem, designers of an incentive program should closely monitor private activity to see what the private sector is doing. More careful screening of potential recipients of subsidies can also help in this regard.

EQUITABLE DISTRIBUTION OF SUBSIDIES. Equity and efficiency considerations are often in conflict when incentives to promote a social forestry program are being designed. For example, in terms of maximizing the number of trees being planted in the short term, dealing with larger landowners is sometimes more efficient. This arrangement can, among other things, reduce a program's administrative costs. However, some observers have criticized this approach because the main benefits are received mostly by the better-off farmers.

Plainly, no self-regulating mechanism will attend to equitable distribution. The mechanisms for the equitable distribution of public subsidies and for dealing with the question of land distribution are the responsibility of governments. The groups that are to receive subsidies must be clearly defined, and delivery and participation systems must be designed to reach those groups. In addition, the government should keep in mind the long-term objective of involving the majority of a community in tree growing to achieve environmental stability in an area as well as to add to the supply of tree products. Concentrating on the smaller farmers to achieve this objective may involve a slower start in terms of the scale of planting, but could well be more successful in the long run. If the government wishes to reach the poorer classes, then it should keep any incentive program very easy to explain, very easy to administer, and very easy for people to participate in.

Finally, if equity or income redistribution is a major consideration, an integrated organizational form will often be most effective. For example, in the case of the Colombian watershed program mentioned in box 2.5, the organizational structure involved downstream users (several distinct categories), upstream landowners/users, banks, extension services, a forestry agency, and the general rural development authority in the region.

Budgets, administration, and political climate

Other major factors that should influence the choice of incentive package include budget availability, administrative capacity, and political climate. In the case of budgets, different types of incentive (for example, subsidized loans versus direct cost sharing) obviously involve different funding requirements for given practices and treatment of given areas and numbers of families. Thus, with a fixed budget, there is a tradeoff between efficiency considerations, on the one hand, and the number of people and extent of area that can be reached effectively, on the other.

For a given population, different incentive mechanisms require vastly different amounts of administrative time and organization to implement. Again, there are tradeoffs to consider between numbers/area reached and effectiveness/efficiency of expected results using alternative types of incentive mechanisms.

In the case of political climate, certain types of incentives will be more favorably received than others. In some political systems, direct cost sharing by government is much less acceptable than subsidized loans, which often hide the subsidy element better. In other systems, the opposite is the case.

Tying incentives to the right outputs and actions

Too often, incentive programs are designed without enough thought being given to the recipients' attitudes and to the outputs or actions ultimately desired. Such oversight can reduce the effectiveness and the efficiency of an incentive program (box 9.2). Sometimes, the links between an incentive and the desired action can be quite indirect. For example, improvement in the water system for farms (plastic-piped, gravity-flow water supplies, improved storage tanks) can indirectly result in reduced land destruction and better survival for seedlings because if water were not available at the stalls where cattle are kept and fed, herders would have to drive the stock to water, which would lead to a resumption of uncontrolled grazing and land deterioration (Pereira 1984). This is a good example of the interrelationships discussed earlier between tree growing, watershed management, and farming and livestock systems.

Box 9.2 Cost Effectiveness of Subsidies: Senegal

SODEVA, a peanut production and marketing organization in Senegal, tried an interesting experiment. The first year, farmers who were paid to plant *Acacia albida* seedlings to improve their soil experienced well over 70 percent loss. The following year, the project did not pay farmers to plant, but after six months to a year farmers were paid 100 francs for each living tree, and 50 francs and 25 francs per living tree each of the following two years. The cost of planting and maintaining each tree until it was three years old came to 175 francs or about US$0.88. SODEVA agents report that this model yields almost 100 percent living trees. Since the goal was living trees rather than planted trees, the new reward system was more appropriate and effective.

From Hoskins (1979a).

The danger of local misinterpretation of incentive payments

It is important to guard against alienating local populations with the offer of free seedlings and planting services. Hoskins (1979a) suggests that if you pay people to plant their own fields, they might assume that you now own part or all of their crop. She also cites a USAID study that found that projects involving local support and follow through are more successful when participants consider the potential benefits important enough to commit their time or money. In various countries, the incentive to keep trees alive is encouraged through various arrangements that give farmers a personal stake in the results of the tree growing (see box 9.2).

A problem encountered in several countries is that if one village program involves payments for certain activities or actions, then neighboring villages also expect payment and will not act without it (see box 9.3). Similarly, if ongoing programs are offering incentives that are more generous than those being proposed for a new program, responses will most likely fall short of expectations. Coordinating subsidy or incentive programs and bringing them in line with each other is advisable. Tschinkel (1984) provides evidence that too large a subsidy can work against the long-term objectives of social forestry programs.

Box 9.3 Developing Overdependence on Food Aid: Lesotho, Niger

In Lesotho, many people spoke of the erosion of the self-help spirit. Food aid and community development, they say, have become synonymous. The per capita food assistance in the country is now so excessive, according to the former director of CARE, that it is becoming "harder and harder to engage people in developmental activities; they resist." After 19 years of food aid, one senior official concluded: "It is extremely difficult to get the country out of a relief mentality."

In Niger, CARE dropped food for work from its Majjia Valley Windbreak Project—where farmers were receiving food aid for planting trees on their land—because their motivation had become dependent on food aid. "We were paying farmers to help themselves in a self-help project," the CARE director said. "It just didn't make sense." When CARE announced plans to abandon the food aid, farmers began proclaiming: "No food, no work." To which CARE responded: "No work, no trees." In some villages, the director said, it took almost two years for farmers to get used to the idea of planting trees without food compensation.

From Joyce and Burwell (1985).

Summing Up

This chapter dealt with a very complex subject: the incentive systems that motivate people to plant, tend, and use trees. Two basic systems exist. One involves market incentives, of which a major one is the profit motive. The other includes the nonmarket incentives found in local communities. These evolve from religious, social, cultural, political, and other characteristics of a population. Since a community is seldom homogeneous in terms of these characteristics, the community generally has a number of different incentive systems working in it at any given time. Project planners must understand the incentive systems that are working in any given situation and for which groups, otherwise, designing effective outside interventions for social forestry becomes very difficult.

Outside intervention in local communities for the purpose of supporting social forestry activity is generally justified on the basis of the existence of externalities, and on the need to remove institutional bottlenecks that hinder local incentive systems from working properly to stimulate participation in social forestry.

A great many different incentive or subsidy mechanisms have been used in different countries. The effectiveness of any given mechanism depends very much on the circumstances surrounding its use. Effectiveness also depends on how different interventions are coordinated, how programs are administered, the extent to which subsidies merely substitute for private investment instead of expanding it, the size of the subsidy for any given activity relative to the actual costs involved in the activity, and the way in which the subsidy is distributed among different social and economic classes in a society.

In designing a social forestry program strategy, each incentive option must be considered in terms of its workability, efficiency, and consistency. Furthermore, each option must be assessed in terms of implications for recurrent costs to ensure that the program is carried through to the end.

Finally, planners and administrators must make a special effort to ensure that subsidies are tied to the right actions and outputs and that they are equitably distributed. Otherwise, from a social point of view, a subsidy can actually stimulate poorer performance than existed before the subsidy was given.

10

LAND FOR SOCIAL FORESTRY

Land is essential for expanded social forestry activity and the availability of suitable land is one of the most critical factors in social forestry projects. Usable land may be around homesteads, along roads and streams, around fields, or in blocks. What matters is that it is suitable and available for planting and maintaining trees. The three main issues related to land for social forestry programs discussed in this chapter are the availability of, and competition for, land; tenure rights and use of common property; and what to do about those who do not have land.

Sometimes, a superficial glance at the land situation indicates that very little land is available for tree growing, whereas a closer look reveals that much land is available, but not necessarily in blocks for tree plantations. Often, the difficulty with these newfound areas that might be used for tree growing is the complication of tenure. The issue of tenure rights extends beyond land, to the rights to trees and tree products as distinct from the land. The reality of tenure in most developing countries is that land is abundant for the richer, large landowners, but scarce or nonexistent for the poor, small farmers, and other, landless, disadvantaged groups. This problem is becoming worse in many countries. The latter groups may have access only to common lands; but even those lands traditionally are not available to them.

The issues surrounding land are some of the most important and politically sensitive ones encountered in social forestry. Such terms as "land reform" and "land settlement" are likely to evoke strong political arguments dealing with equality and opportunity for the poor, land redistribution, and how to create land-use systems that will benefit the poorest of the community, often at the expense of the richer members.

Physical Availability of Land

A common response given to designers of social forestry programs is: "There is not even enough land for crops and livestock; how do you expect to get land for trees?" Yet, forestry and agriculture do not always need to compete for land; in many cases, they complement each other, as pointed out in chapter 3. For example, agroforestry techniques offer ways to introduce trees and tree crops as a complement to other crops and livestock and increase total land productivity. Thus, if trees are introduced in an agroforestry approach (for example, a shelterbelt) on 10 percent of a given unit of land, and this results in a 25 percent increase in food crop yield on the remaining 90 percent of the land, then the overall increase in crop yield on the total unit of land is 12.5 percent (or 1.25 x 90 percent) for the overall unit of land. This is in addition to the benefits of avoiding a decline in yields because land would otherwise be eroding, as well as the benefits of tree products. Furthermore, agriculturists are increasingly recognizing that some land is better suited—both ecologically and economically—for tree crops than for annual agricultural crops. Some land is suitable only for tree crops or other perennials.

In many cases, the issue of land scarcity for social forestry is more apparent than real. Large areas of land considered marginal for agriculture are usable for forestry. A key issue to be addressed is scarce to whom, and using what technologies?

The main opportunities for improvement in land use are in regions that have some pressure on the land, but that also have some land that is idle, mainly because it is considered too poor for farming. These regions often include land that is in use but not producing to its fullest potential because the farmers do not have knowledge of improved technologies. In these cases, two basic challenges face social forestry planners. One challenge is how to identify and bring the marginal lands into production. The other is how to improve the use of land that is in use already; for example, how to introduce agroforestry approaches that can help to increase the productivity of farming on a sustainable basis or can expand the variety of outputs and total productivity of farming systems.

The evidence is increasing that even in countries that have extremely high population densities and intensive land use, land exists that is suitable for trees but is not being used: areas around houses; along fields, roads, canals, and railways; on village fringes; and small plots of land that are exhausted and can no longer support annual crops, mainly due to mismanagement (see box 10.1). Innovative social forestry programs can make use of such land without reducing overall farming activity. In some cases, agricultural productivity can actually be increased in a sustainable manner.

China is a good example of a country that has extremely intensive land use, high population pressure, and—until fairly recently—very little farm forestry activity. However, the government recognized the opportunities and needs, and the Chinese started a massive afforestation program that included significant social forestry elements (see box 10.2).

Other countries are at different stages in making use of their large areas of marginal land: land that could not support productive agriculture, but could be used effectively for tree growing. The Korean case is an example of an advanced program in which the major focus was on planting lands that were considered marginal because they were too steep for crops and grazing. In India, new programs are being tried to bring the landless together with idle, marginal lands to produce fuelwood and other forest products. Estimates suggest that such "wastelands" in India—presently unused but available—account for more than 15 million hectares (Tiwari 1983). The total wasteland is considered to be many times greater.

Box 10.1 Finding Land for Tree Growing: Kenya, India

A recent analysis of a watershed in a fairly densely settled farming community in the subhumid midlands of Kenya indicated that, if existing linear features of the landscape (pathways, watercourses, farm boundaries, and internal borders) were fully utilized for planting appropriate trees and shrubs, some 50 percent of the fuelwood and 40 percent of the fodder requirements of the households in the area could be supplied by these hedgerows, with very little competition with existing agricultural land uses.

In India, about 43.6 million hectares of land are estimated to be potentially productive wastelands distributed among 567,000 villages. Among others, the idle land resources consist of vacant strips of lands along roadsides (1.14 million kilometers), rail tracks (60,000 kilometers, with over 1,000 kilometers at stations), and canal banks (150,000 kilometers).

In recent years, extensive roadside and canalside plantations have been raised by the forest departments of Haryana, Punjab, and Uttar Pradesh, but much remains to be done in these and other states. To this can also be added planted areas in the compounds of schools, colleges, universities, other public places, and research and industrial establishments.

Assuming that in the rural area, not more than 50 percent of wasteland, 10 percent of other vacant lands, and 25 percent of lands along the sides of roads, canals, and rail tracks will be available for tree planting in the near future, at least 10 million hectares from these categories of land can be made available for planting under the social forestry program.

At the moment, about 7 to 8 percent of forest area is open and does not have sufficient vegetative cover. Thus, roughly a 5-million-hectare area from India's reserved forest area should be available for social forestry programs. At least 15 million hectares could be brought under tree cover through social forestry schemes by the end of the century.

From Rocheleau and van den Hoek (1984), as cited by Raintree (1985)—Kenya; Tiwari (1983)—India.

While land scarcity is sometimes a constraint, in many instances, land scarcity is more apparent than real, and improved soil and forestry management technologies and tree-growing practices can be introduced to make productive use of what are considered marginal, fragile, or unusable lands.

Box 10.2 Making Use of Marginal Lands: China

Based on a survey during 1929 to 1933 of 16,786 farms in 168 localities in China, investigors found that only 7 percent of farms had any forest and only 4 percent had any land used primarily for fuel production (grass and bushes). Furthermore, only 1 percent of the farm area was devoted to forest and 0.7 percent devoted to the production of fuel. Despite these low percentages, some 27 percent of the total area of China was considered suitable for forestry, but at the time was bare of forest and considered marginal for agriculture and thus not cropped (Buck 1956). Much of this area was on farms. (China at that time had only about 9 percent of its total area under forest).

China has taken advantage of the availability of such agriculturally marginal and idle lands and now has millions of hectares of forested land (plantations, row plantings, shelterbelts), with much higher percentages than in the 1930s being associated with forest and fuel production on farms. Things have changed. Arnold (1984, p. 52) states that:

> Even where much more intensive use is made of the land, there are often strips and pockets of unused land that could be used for trees. This system has been very effectively developed in the People's Republic of China in the so-called "four-side" or "all around" planting program. Communes are encouraged to plant trees wherever there is space—along the banks of streams and rivers, beside roads, between fields, and next to houses and villages. In Honan Province alone, 1.9 billion trees have been planted under this program.

The real issues associated with land scarcity relate to the question, scarce for whom? Lands may be available in a physical sense, but in legal or political terms, due to ownership or tenure claims, the land may only be abundant and available for certain people. Except in the most extreme cases, the question of physical availability is of less interest than the question of legal and economic availability to the poor, rural inhabitants of a country.

Land and Tree Tenure

In all countries, tenure arrangements tend to be complex and to vary in particulars. In some countries, the situation is further complicated by the existence of separate tree tenure rights. That is, one person or group may have rights to the land while others have rights to the outputs of certain trees at certain times or to the trees themselves. In some cases, it is a matter of private or individual tenure rights; in other cases, of community or common property rights. A further consideration is the informal rights established by tradition, but not supported by law. Finally, cases exist in which different groups have rights on a piece of land at different times of the year.

Bruce et al. (1985), in a recent review of documentation dealing with land tenure and tree rights, introduced the main elements of concern quite well. The following summary is adapted from their work, with permission from ICRAF.

Who has access to which parcels of land, for how long, and for which purposes are questions specific to each sociocultural environment. Land tenure, derived from the Latin *tenere* (to hold), refers to the possession or holding of the bundle of rights associated with each parcel or land. These rights can be broken up, redivided, passed on to others, and so forth. Some will be held by individuals, some by groups, and others by political entities. For any land tenure system, each of the rights in the bundle will have a number of dimensions.

- **Limits to individual rights.** No one anywhere ever owns land in some totally exclusive way. Even where individual rights are most strongly developed, society normally reserves for itself the right to take land for roads, and one cannot use one's land in such a way that it unfairly decreases the utility or value of a neighbor's land. A person whose trees are diseased can be made to destroy them if they pose a danger to the trees of others. If a social forestry plan unwittingly increases the ambiguity of people's rights over their land, then the chances of cooperation decrease in direct proportion to the insecurity created.
- **The time dimension in tenure considerations.** The longer-term aspects of tenure can complicate programs. For example, in most communities, various provisions are made for the length of time rights last and how they can be transferred. If trees are to be purposefully planted, the planters will want guarantees that their rights to those trees are secure for the time it takes for the trees to mature and produce their benefits. People have learned that what starts out to be a temporary claim to rights on trees planted on communal or other common property land can end up being permanent rights to the use of the land. For this reason, community members often jealously guard against tree growing on common property or community land unless they also are involved. This type of situation creates a special problem for the social forestry planner.
- **Spatial dimensions.** What is found in many cases is that the same space is used for different purposes by different people at different times (such as in the Nepal case cited in chapter 7 and box 7.2.). The gum arabic groves in Sudan provide another good example. Herders bring their animals into the grove to feed on the ground cover and the new seedlings and lower branches. Local farmers come to collect dead wood for firewood. Merchants purchase collection rights to the gum from the tree owners. The land itself, upon which the trees grow, is most often part of a larger social group's communal holdings. In all likelihood, all these users will seek to maintain their rights.
- **Tree tenure.** In some cultures, tenure in trees can be separate from tenure in the land on which they grow. In northern Sudan, for instance, a tree and its fruits may belong in shares to the owner of the land, the person who provided the seedling, and the owner of the waterwheel that irrigates the land. In many areas, diverse arrangements with respect to rights in trees are common and obviously of very immediate relevance to those deciding whether or not to plant trees.

Bruce et al. (1985) sum up the classifications of tenure rights as follows:

Rights in trees:

1. *Creation,* in this case, the right to plant trees.
2. *Use,* which has four constituent parts:
   a. gathering rights, that is, the right to gather or lop dead branches for fuelwood, and so on, or to gather things growing on a tree, such as fungus or insects, or to gather tree products from under the tree, such as pine needles or fallen fruit;
   b. use of the standing tree, such as hanging honey barrels in it;
   c. cutting part or all of a living tree as for building poles;
   d. harvesting produce.
3. *Disposal,* which has four constituent parts:
   a. the right to destroy: uprooting or chopping down individual trees or the right to clear a section of forest;
   b. the right to lend;
   c. the right to lease, mortgage, or pledge;
   d. the right to sell.

- **Land Tenure.** Rules for what may be done with trees may depend on what kind of land (from a tenure viewpoint) they are growing on. In general terms, the three types of land tenure are:

1. *Communal land* on which individuals may have *usufruct* or use rights on a specific portion. Some of this land may be left unused in *fallow* to allow it to rest. Some may

be held as a *commons* where everyone has use rights other than cultivation.

2. *Freehold land* over which individuals have relatively exclusive power and thus relatively greater freedom with respect to land-use decisions.
3. *State land,* which in the case of forest land may either be some sort of forest reserve or land under a taungya system, in which people are given the right to cultivate on forest land in return for planting and caring for young trees.

Various combinations of tenure and use rights exist in different situations and countries as indicated in table 10.1. Thus, generalizing is difficult and each situation must be assessed separately to determine how social forestry strategies can be fitted within the existing conditions of land and tree tenure.

Table 10.1 Forest Resource Ownership in Asian Social Forestry Projects

Project	*Land tenure*	*Tree ownership*
Taungya cultivation	State lands	State
Panchayat village forestry program, Nepal	State lands handed to community	Communal
Communal tree farming, Philippines	Individually leased state lands	Private
Dendrothermal project, Philippines	State lands leased to cooperatives	Cooperative members
Supervised village woodlots, India	Village common lands	Joint village/ forest service
Self-help village woodlots, India	Village common lands	Communal
Smallholder tree farming, Philippines, India	Private	Private

Source: Wiersum (1984).

Many studies from different parts of the world indicate how the lack of perceived security of tenure and rights to use their trees has caused local landowners' lack of interest in participation and lack of willingness to plant trees (see box 10.3). People want to know that the benefits from the trees they plant will belong to them and their families, particularly when these benefits will occur some years after planting.

Communal Lands

A major tenure issue concerns common or communal lands. Experience indicates that—with some notable exceptions (for example, China, the Republic of Korea, and Nepal)—social forestry programs focusing on village woodlot models using community or state lands have been less successful and more difficult to implement than programs that involve individual farms and other private lands, where costs and benefits are much more clearly defined (see chapter 8 and Noronha and Spears 1985).

If governments consider addressing the needs and wants of the poorer members of communities as essential, then some form of communal management of forest lands, redistribution of land, or redistribution of outputs from land will be required since the poorest families generally do not own enough land for tree growing. They are faced with a dilemma, however, in that the basic prerequisites for management and use of community or common forest lands are often not met. Arnold (1984, p. 53) has summed up some of the issues that may arise and will have to be resolved in dealing with common property needs:

> There may be no *communal* land, or no community level organization. If there is communal land, there may be divergencies of interest within the community as to how to use it or on how to distribute the benefits from a community forest. Cost and benefit impacts of tree projects are likely to be different for different income groups; for different users of the land; and between landless and landowners, and within the latter between larger and smaller farmers; for different components within the village power structure; and even within the family between men and women and between different generations (Noronha 1981; see also Faber and Stolwijk 1984). For example, proposals to use communal grazing land for trees will be perceived quite differently by those who presently use that land for grazing their livestock than by those who do not. Such conflicts may be very difficult to resolve in communities which do not have homogeneity of ethnic, economic, or social interest, or which lack social cohesion, or where there is lack of confidence in the community leadership.

Box 10.3 Tree Tenure Security and Local Incentives to Plant Trees: Sudan, India

Sudan

Under the traditional system of land tenure, the right to use the land, but not the ownership, belongs to the person who cultivates it. All noncultivated land belongs to the government. This has not encouraged farmers to make long-term investments in cultivated land by planting trees or using fertilizers to build up soil fertility. Since the 1932 forestry legislation also made owning trees impossible for individuals, farmers believed that by planting trees they would lose the right to cultivate the land. The legislation has since been changed, but even today, farmers should obtain forest department permission before they cut a tree on their land. Suspicions remain, and a considerable extension effort is still required to convince farmers of their rights to the trees they have planted.

India

Since the forest area of Haryana State was low during the year 1900, the government restricted the felling of trees on private lands to increase the tree cover on land, under Section 4 of the Land Preservation Act of the erstwhile composite Punjab State. This act stated that people could not fell trees from their land without appropriate permission. Thus, the act had an adverse effect on tree planting by private individuals. Most people wanted the provisions of this act to be amended to encourage tree planting.

From World Bank (1986d)—Sudan;
Rai (1985)—India.

The issue of internal conflicts and heterogeneity within a community is critical, and its impact is widespread (see Cernea 1985a,b; FAO 1985d). An example from the Chilalo Agricultural Development Unit in Ethiopia illustrates how large-scale landowners resist efforts to stimulate cooperative reforestation among small farmers. The common reasons why large-scale landowners and the power elite in that area resist projects involving use of community lands by the lower strata of society are as follows (West 1983, p. 48):

They may be seeking: (1) to monopolize external project aid for themselves; (2) to block and control potential competition for markets; (3) to monopolize access to key natural resources; and/or (4) to maintain the status stratification system (that is, wealthier, high-status groups often seek to block advancement of low-status groups as this threatens their dominant status position). In dealing with this vested interest and resistance to social change, Berreman (1967, p. 406) emphasizes the importance of aid strategies that will benefit both upper and lower strata, thus, buying off the one group to permit assistance to the other.

In some cases, conflicts arise between groups that have different use interests in common lands. A frequent conflict is between tree growing and grazing (see Whyte and Williams 1968; West 1983; Raintree 1985). The problems arising from use of common lands can be extremely complex and difficult to resolve, particularly because of the tenure rights often attached to trees and tree products.

Kirchhofer and Mercer (1984) give the example of village woodlots in West Africa, where individuals who plant trees on common land consider themselves the "owners" of identifiable plants. Fortmann (1984) provides other examples where individuals hold tree tenure even though the trees are planted on common or public lands. This approach to protecting trees by giving rights to them on an individual basis has also been suggested for India (box 10.4). Raintree (1985) suggests a similar approach for situations involving planting of trees on boundaries between farms, where disputes over rights can occur.

Box 10.4 Protection of Trees Planted on Common and Public Lands: India

Whereas individual owners can always protect the crops on their land, protecting trees on lands belonging to village panchayats, railways, the public works or irrigation department, and so on, is difficult, primarily because everyone's property is no one's property. Therefore, unless exclusive rights over the trees are given to individuals, such as Indian states do for lease of public land for taungya agrisilviculture, the protection of trees in all these categories of lands will always remain a problem.

One way to protect the trees, particularly on the roadside plantations, is to allot each tree to someone living close by. Those who protect the tree should also be allowed to share the benefits. In the case of fruit, flower, and seed trees, those who protect the trees should receive the annual produce free or at nominal cost. In addition, the protector should receive a share from the final felling of the trees. Advance publicity of the distribution pattern of benefits likely to accrue will foster the security of ownership so essential for the long-run protection of trees. This ownership concept will induce the owner to view each tree as a self-growing factory, needing only the protection inputs from the owner. While the question of organizing tree protection brigades *(Van rakshak Dals)*, societies of tree lovers *(Sad Vichar Samitis)*, and the appointment of honorary tree wardens may be useful in urban areas, some positive economic incentives are essential for the rural areas to ensure effective protection of trees. Analysis and modification of the land tenure systems to accommodate the needs of social forestry are also urgently needed.

From Srivastava and Pant (1979).

In some cases, the need for management strategies for common property has arisen fairly recently and fairly rapidly. As pressures on the land have increased, the number of land-use conflicts and the need for more formal tenure and management arrangements have also increased. In such cases, the need for social adaptation can be substantial. If the authorities do not handle this need appropriately, disruptions can result (box 10.5).

Box 10.5 Learning Process Involved with Changes in Tenure Arrangements: The Masai of Kenya

Under pressure from the advancing agricultural frontier, pastoralists have been the focus of programs aimed at increasing the security of their tenure over pastoral lands. But the magnitude of the social learning process necessary to institutionalize the land-use changes implicit in these schemes is easily underestimated. The Masai Group Ranch Scheme in Kenya is a case in point. Although the establishment of legal boundaries around the group ranches has succeeded in giving the Masai a measure of freedom from land-grabbing farmers and speculators, after more than a decade it is now fairly clear that the group ranches have not been able to successfully replace the traditional pastoral strategy with the social institutions necessary for common property management within the boundaries of the ranches. There is now a vigorous movement in the group ranches toward subdivision and individualization, which may have the ultimate effect of exposing individual ranchers once again to the risk of losing their land.

From Raintree (1985).

Heterogeneity of village groups has been associated with village woodlot problems in many parts of the world. Some means to reduce that heterogeneity must be found. Researchers have found that some of the problems associated with village woodlots and common forest land can be reduced by narrowing the groups involved in the various forestry activities, and by better defining the rights of different groups to harvest or obtain different products from the common forest. In India, researchers have suggested that the revenue village is an appropriate group; and in Nepal, it is the ward (Noronha and Spears 1985). This approach is being implemented in World Bank-assisted projects in the Indian states of Jammu and Kashmir, Haryana, and West Bengal.

Another alternative is to work only with those villages or groups within villages that show promise of cooperating in projects. In this regard, Noronha and Spears (1985) suggest the following:

> As a practical sociological approach at the preparation and appraisal stages of the project cycle, the populations could be classified into four groups: first, groups that have undertaken forestry activities and are willing to undertake further programs in common; second, groups that recognize the need for forestry programs and are willing to undertake one although they have never previously done so but have undertaken other works in common such as construction of village water supplies, schools, and roads; third, groups that have never undertaken forestry or other works but recognize the need for the project and would be willing to undertake forestry activities; and fourth, groups that have never undertaken any works in common and who do not recognize the need for forestry. Very few groups are likely to fall within the first class, since community forestry projects are of recent origin. A significant percentage could fall within the second group. With these, the existence of works undertaken in common indicates the capacity of the group to act as a unit; the presence of leadership could also be assumed. Similar categories are applied in Korea to screen village applications for grants, and they could be profitably extended to other countries. More detailed investigations would have to be conducted with the third and fourth groups to determine their capacity for common action.
>
> It is recommended that implementation of the community forestry component should commence with the first and second groups. Only extension services should be provided to the last two groups at the initial stages of project implementation. Convincing people to undertake community forestry is a long-term process that depends on publicity, demonstration, and proving the advantages of developing tree cover—advantages that go beyond having a sufficient supply of fuelwood and include consideration of agricultural and livestock practices and priorities.

The Landless

In many parts of the developing world, the landless poor and holders of 1 hectare or less of land account for the majority of the population, and their relative importance in the total rural population is increasing in many countries. The situation can be summarized as follows:

> The total number of agricultural households will grow very much faster than the arable land exploited in every region except Latin America. As a result, the average size of holdings will decline in Africa and the Near East, and also in Asia. Accordingly, the number of landless agricultural laborers will increase, partly because the area of land held by some individuals or families will become too small to be viable and partly because larger landholders will buy up the land of economically weak farmers (Raintree 1985, p. 7).

For the landless, use of government and community lands is one solution for meeting their everyday needs for tree products. In some cases, private lands also play a role, as in the case of the Republic of Korea, where the government obtained land for community fuelwood growing by requiring larger, often absentee, landowners to give up their generally idle land for fuelwood and multipurpose tree planting, with the landowners receiving part of the economic output. Another alternative is land reform and redistribution, whereby the landless are given tenure to land, often parts of large private holdings.

Because of difficulties encountered in projects involving the landless, many programs have ignored them and have concentrated on convincing landowners to plant trees. While social benefits may result from such programs, they will only indirectly (for example, through employment) achieve the objectives of raising the standard of living of the poorest members of the community and of meeting their essential fuelwood and other tree-related needs.

At times, governmental efforts to clarify the land ownership rights of local people can work to the detriment of the landless by reducing their traditional "rights" to collect fuelwood and other tree products on common lands or large private holdings (box 10.6). In such cases, the issue arises as to how the landless—or those who do not participate in the land allocation process—can be included in an overall scheme so their tree-related needs can be met.

Box 10.6 Land Distribution and Loss of Traditional Fuelwood Gathering Rights: Kenya

In 1970, the Government of Kenya introduced land allocation into Mbere; that is, it started giving individuals title to land. Before land allocation, firewood was a "free good" that could be gathered almost anywhere, with only a few restrictions on certain species and areas. As people received individual title to land, they started reducing the traditional rights of women and the landless to collect wood. Much litigation resulted and bitter quarrels and hard feelings developed. People started putting up fences. Although some people were still able to collect fuelwood (not cut it) if they asked the owner, the general prediction was that restrictions would increase as more owners insisted on exclusive rights over their lands and what they produced.

From Brokensha and Riley (1978).

One approach to helping the landless is to let them, in groups, use public lands and, in some cases, gain title to such lands (through settlement programs). One such program in India, the Social Security Through Forest Plantations Program, provides enough degraded forest land to landless families so they can replant the land with trees at a rate of about 2.5 hectares per family a year. During the growing period up to harvest, the families receive a salary, building materials for a house, and minor forest products coming from the operation. At harvest, they receive 20 percent of the net profit (Kirchhofer and Mercer 1984). According to World Bank supervision reports for a project of this type in West Bengal, the results to date have been quite successful. In 1982, 82 families participated. By 1983, 1,200 families were involved. The families are organized in groups and work together as a homogeneous entity (World Bank 1984c). Similar models have been tried elsewhere using leasing approaches (box 10.7).

A long-established and widely discussed approach to involving the landless in forestry activity is through the taungya system. This system—which allows landless people to grow crops between rows of newly planted trees for a few years after the trees are planted in exchange for maintaining the tree crop—may be exploitative of people, resulting only in the exchange of cheap labor for the temporary right to grow crops needed for subsistence. However, the concept of integral taungya takes a further step toward using this type of activity with more permanent and long-range improvements for the landless (box 10.8).

Box 10.7 Providing Public Lands for Smallholder Agroforestry: The Philippines

The Philippine National Communal Tree-Farm Program (CTF) was established in 1979. Under this program, low-income farmers lease small plots of public land for agroforestry purposes at no cost. The lease is renewable for an additional 25 years. The participants receive technical assistance and inputs such as seedlings. They are exempt from normal forest charges for outputs of their tree farms and are immune from prosecution as *kaingineros* (slash and burn cultivators). Each participant is required to practice tree farming on at least 80 percent of the area leased. Idle lands are used, including open and denuded areas inside timber concessions, if the licensee agrees. District foresters are in charge of screening applicants and selecting areas. Applicants' incomes must not be above a specified maximum, they should currently be living near the site, and they must demonstrate a willingness to spend at least three days a week working on the tree farm.

As of the beginning of 1981, a total of 5,046 hectares of tree farms had been developed under this program nationwide. Some 12,087 households in 176 locations were involved. More than 8 million seedlings had been produced at the CTF nurseries for planting through the program. One of the main problems is that many participants do not comply with the rule that 80 percent of area should be under trees; apparently they plant other crops that have higher value than fuelwood. (The program was justified to a large extent on the assumption that deforestation and environmental damage caused by fuelwood gathering from environmentally sensitive natural forests would be reduced when people grew their own fuelwood.)

From Hyman (1984).

Summing Up

The examples discussed in this chapter reveal clearly that a shortage or lack of land for tree growing can be more apparent than real in many cases. Quite often idle land exists, but was never thought of for any kind of use, either because it has been regarded as "unusable" or because its existence did not show up in public records.

In many cases, through appropriate use of agroforestry techniques, trees can be blended with other crops without any loss of crop output. In some cases discussed in chapter 3 (for example, shelterbelts), total food crop output from a given area of land can actually be increased, even though some land is taken out of production.

The major issues related to land for social forestry are those associated with land and tree tenure. Tenure arrangements can be very complex and, in some cases, very uncertain. Government policies sometimes make trees the property of the state, even if planted on private land. Trees can be owned separately from the land in many societies and informal rights to the use of trees for different purposes can be held by different people at different times during the year or during the life of a tree. Many people hesitate to plant trees because they are uncertain whether they will have the rights to the trees later on.

Box 10.8 Integral Taungya and the Forest Village Approach: Thailand

The concept of integral taungya is meant to invoke the idea of a land-use practice that offers a complete and culturally integrated approach to rural development, not merely the temporary use of a piece of land and a poverty-level wage for labor, but a chance to participate equitably in a diversified and sustainable agroforestry economy.

The social aims of the approach are high, and although they are nowhere yet fully realized in practice, the forest village schemes in Thailand perhaps come closest to the ideals of this concept. In some variants of this approach, to make participation in the forestry effort more attractive to traditional shifting cultivators, the Thai foresters not only encourage the participants to grow long-term perennial cash crops by widening the between-row spacing of the commercial forest species, but also allocate permanent agricultural plots to the farmers for use as they see fit. In addition, they pay decent wages for a variety of work opportunities in the forestry sector of the village economy and provide a range of extension and community development inputs, such as housing assistance, clinics, schools, and places of worship (Boonkird et al. 1984). Far from being an exploitative practice, this Thai variant of the taungya system shows promise of becoming a model example of what is meant by integral taungya, although it is not yet adequately documented in the literature.

From Raintree (1985).

The problems of social forestry projects based on common property can be complex and difficult to solve unless the society involved has very clear rules governing the use of and the penalty for abuse of such lands. In general, the community woodlot approach to meeting community wood needs has not worked as well as approaches in which farmers plant on their own lands. There are exceptions, such as in the Republic of Korea. In many cases, difficulties arise because the richer, more powerful members of the community resist the use of commons for fuelwood production, preferring to use the lands for grazing or other uses that benefit them more. Part of the problem also may stem from the development community's insufficient efforts to find workable institutional strategies and mechanisms for dealing with common property problems.

The final section of this chapter dealt with the problems of the landless. In many cases, this problem corresponds to the problem of common property land, since the main way in which the landless share in social forestry programs and meet their basic tree-related needs is through use of common property lands. Governments are trying innovative ways of getting these people into social forestry projects. One approach involves giving use rights for public lands to the landless with the stipulation that they use the lands for tree growing. Since the landless are a growing segment of the population in many countries, much more thought is needed about ways in which they can be brought into social forestry programs without putting an undue burden on public resources and without creating strife and dissention within communities. The urgency is even clearer when one realizes that the landless tend to be the poorer members of communities and, thus, those most in need of support. At the same time, project planners should not underestimate the difficulties involved.

11

PROJECT ORGANIZATION AND IMPLEMENTATION

Effective organization of social forestry programs and projects involves consideration of a number of requirements. Three major requirements are

- a project management structure that involves direct, strong linkages with community leaders and participants and vertical linkages between levels of program or project administration;
- an extension organization that addresses program needs and is attuned to community incentive and communication systems;
- an administrative structure that effectively supports NGOs that become involved in social forestry.

This chapter discusses these three requirements.

Chapters 12, 13, and 14 address three other prerequisites for effectively planning and implementing programs. They are

- the appropriate education and training for social foresters, including managers, planners, and extension agents;
- the development of a monitoring and evaluation system that can provide the kind of productive feedback needed to adjust evolving social forestry programs and to plan future programs;
- a research program that is responsive to the key information needs in social forestry.

Project Management and Project Linkages

Social forestry programs need government support. Such support will materialize only if decisionmakers are convinced that the programs are worthwhile and if appropriate organizations exist through which the necessary resources—funds and technical expertise—can be channeled. In the case of social forestry, both governmental and nongovernmental organizations have a role to play. However, even programs that NGOs initiate and manage need the administrative support of government.

A key consideration in choosing the most appropriate form of government intervention and organization is to bear in mind the long-term objective of assisting local people to develop for themselves sustainable forest management and tree-growing systems. The implication is clear: government agencies should work with local groups, helping them achieve their objectives, not dictating what they must do.

Public administrative arrangements

Government agencies can contribute a variety of services and perform a number of functions in social forestry programs. Table 11.1 provides an overview of the main forms of involvement and how they relate to community functions. Public agencies can be involved in organizing and administering projects and can have varying degrees of control over activities and the distribution of benefits from such activities. Usually public agencies provide extension services to local communities involved in social forestry projects. In some cases, they may merely provide the resources for such services, with the actual extension being carried out by NGOs or local village personnel. As discussed in chapter 9, most social forestry projects involve some provision of subsidized inputs from the public sector: seedlings, tools, and so forth. Finally, in cases where the social forestry project involves smallholder production of tree products for sale, public agencies may become involved in various ways with marketing the outputs.

Table 11.1 Potential Functions of Public Agencies

Function	*Organizational requirements and relationship to village/community*
Project planning, organization, administration, and coordination	In all projects involving public agencies, some administrative responsibility is involved. In some cases, government may control land use (generally government land), distribution of benefits, etc. Regulatory functions may also be involved; government quite often acts in a coordinating role.
Extension, training, and technology transfer	In the most common case, government provides technical and organizational skills through extension; villagers provide labor and land, either through a community program or private farm forestry activities; seedlings and other inputs may be from a village nursery or from government.
Subsidized inputs	Governments may provide free or subsidized seedlings and/or other inputs; this can require additional organizational and budget input (e.g., through nursery investment and management).
Protection services	Protecting trees against fire, theft, and so forth; government may coordinate regional or multivillage protection services; local police may patrol woodlots, etc.
Marketing of outputs	If part of the project output will be processed or sold, government may provide marketing support, either through information or through direct marketing facilities.

In some situations, a substantial change in the approach of government agencies is needed, for example, if earlier efforts followed a "top down" approach, in which local people were ordered to participate with government agencies in securing government objectives, or where the public agency involved acted as a police force protecting forests. A change in orientation is not always easy, particularly if the staff involved lacks the skills and experience of working and cooperating with rural groups, assessing local priorities, negotiating compromise solutions, and responding to local needs.

In most cases, the reorientation required will involve more than just functional and organizational changes. The attitudes and approaches of the staff of the responsible organizations may also need reorientation. Matela (1984, p. 85) suggests that "the outsider can help, but the insider (local villager or farmer) must do the work. What is needed is not relief, but release of the latent potential of the farmer-participants. They need a challenge to do good work, but with proper guidance to do so." This does not describe the typical forester working to protect public forest reserves from encroachment and working to produce wood on public lands for industrial and other commercial uses.

In the field, much of the work needed does not fit the traditional responsibilities of organizations that deal with food crops, livestock, and forestry. Thus, coordinating mechanisms are necessary to maintain the commitment of the relevant government agencies and to assure their cooperation. In some cases, different public sector agencies share responsibilities. For example, in Kenya, three ministries—Environment and Natural Resources, Agriculture and Livestock Development, and Energy and Regional Development—jointly administer independent rural forestry activities (FAO 1985d).

In many cases, simply restructuring existing government agencies will not be enough. The established norms of forest protection, exclusion of people, and the focus on commercial and industrial wood production are too strong in many traditional forestry services. Agencies get entrenched. In such cases, much time and effort can be wasted trying to reform them to focus on small-scale rural forestry. Sometimes, it is necessary—and politically acceptable—to establish a new agency or department that deals exclusively with social forestry matters.

Social foresters attribute the success of the Republic of Korea's fuelwood/social forestry program partly to the transfer of the Office of Forestry from the Ministry of Agriculture to the Ministry of Home Affairs. The latter is responsible for mobilizing local support and also controls policing functions in rural areas. Other factors that contributed to the program's success included the passage of laws to support more sustainable land use and the establishment of regulatory mechanisms to control forest exploitation, trade in fuelwood, and so forth. In India, state forest departments set up divisions to deal with social forestry. In Nepal, a division was established within the forestry organization (figure 11.1).

Coordination and cooperation

In traditional public forest department activities involving government forests and the production of wood for commercial sale, the government forestry agency generally interacts with the buyers of wood or other forest products as the seller, and with local residents as a policing entity protecting the public forest domain. In contrast, key ingredients in successful social forestry programs are cooperation and coordination with different agencies and with local inhabitants.

In addition to the issue of cooperation among different organizations or entities, there is the issue of coordination at different levels within an organization (for example, from the local to the national levels). In the case of Korea, parallel levels of responsibility existed in the Office of Forestry and in the Association of Village Forestry Associations (figure 11.2). Both horizontal cooperation at different levels and vertical coordination between levels were possible with this organizational structure.

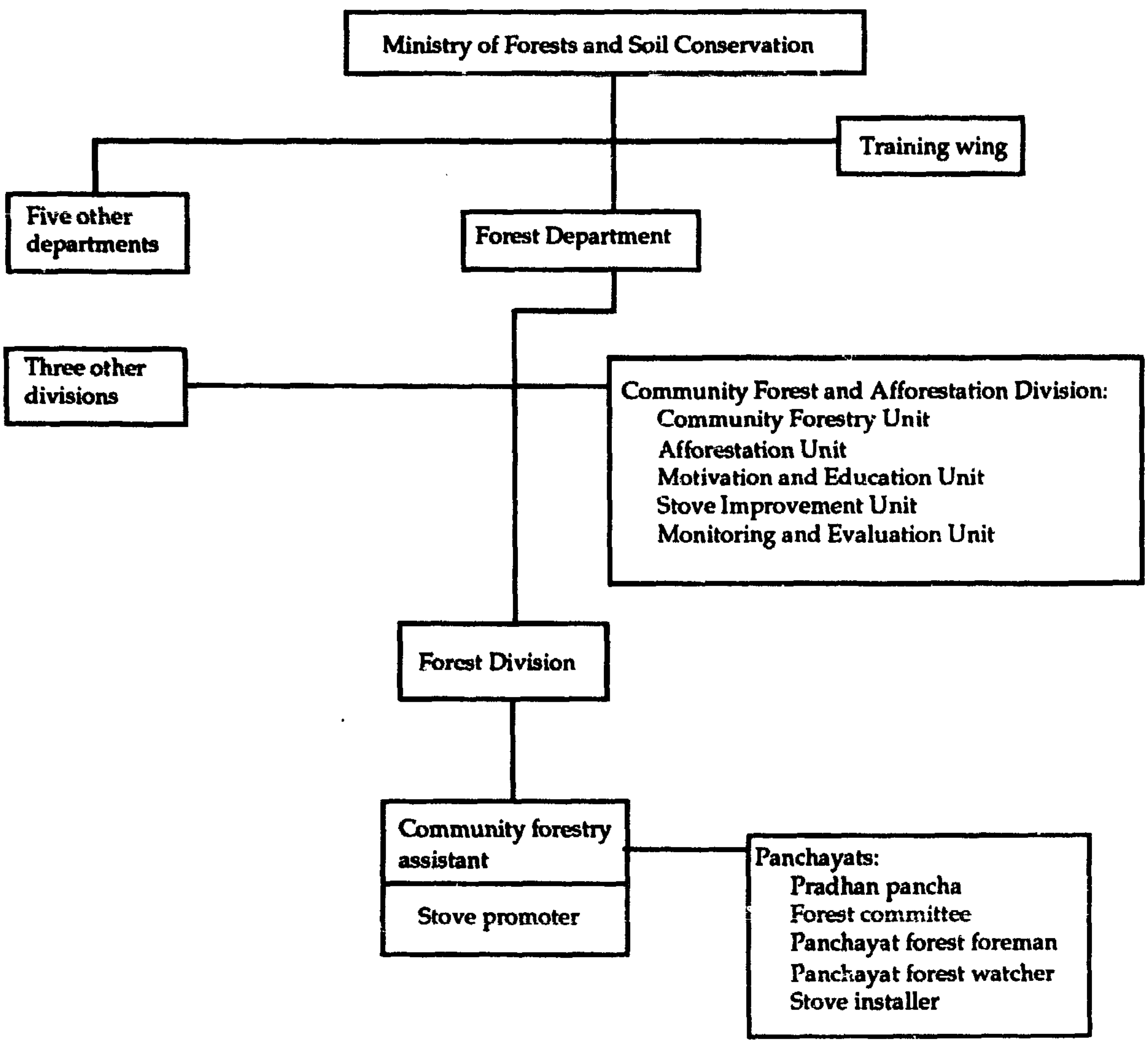
A number of social forestry models involving government, NGOs, and local villages have been used. In the most common model, the government agency (public forestry administration, department of agriculture, ministry of home affairs, or whatever) provides capital in the form of seedlings and perhaps tools, and technical, organizational, and marketing expertise through some form of extension service. In other models, regional, national, or international public organizations provide funds to development NGOs that then go into the communities with seedlings, other inputs, and technical expertise.

In other cases, government is more directly involved, either through direct participation in establishing, protecting, and managing village fuelwood plantations, or by providing public lands for villagers to use for tree growing. In these cases, technical assistance and subsidized or free seedlings also tend to be part of the total project package. In almost all cases, villagers provide the labor.

No one "right" organizational model for social forestry programs exists. Each situation will differ in terms of the strengths of established public agencies, the attitudes of their personnel, and the relationships between existing social and economic groupings in villages (see chapter 8) and existing public and private agencies.

Establishing an appropriate organizational structure for social forestry program administration and implementation may take high-level decisionmaking and the passage of complementary laws. In terms of operating programs, what matters is not so much where programs are housed, but rather how the administrative structure encourages and supports local involvement and growth (for example, through extension and the complementary use of NGOs).

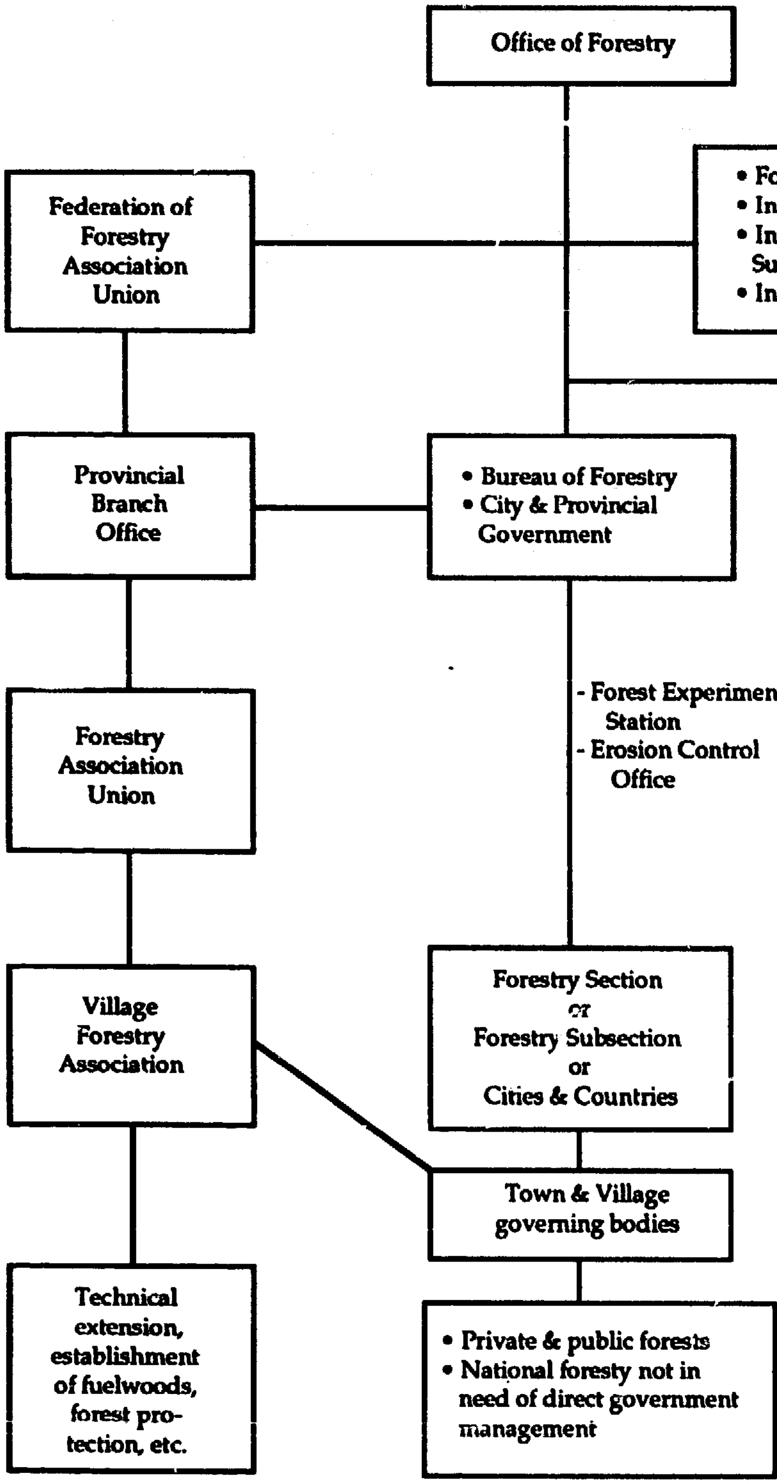
Figure 11.1 Organization of Nepal's Community Forestry Program



Note: Each forest division has six community forestry assistants each serving four panchayats.

Source: Pelinck et al. (1984c).

Figure 11.2 Links between National and Private Forestry Organizations: Republic of Korea



Source: Gregersen (1982).

Extension

The term "extension" is used here to describe the two-way transfer of knowledge and information primarily between extension agents and farmers and other land users. The agent can be, for example, a public extension agent, a NGO staffer, another farmer, or even a person selling seeds, tools, and so on. The mechanisms for extending information can be as narrowly targeted as pre-employment technical training or as general as information conveyed by newspapers and radio. An FAO publication (FAO 1986b) provides comprehensive treatment of forestry extension. Thus, this section only summarizes some specific organizational issues related to social forestry.

Basic functions and organizational models

The basic functions of an extension unit are to inform, convince, and link people, that is, to facilitate information flows by serving as a link between groups, for example, project management and villagers, researchers and farmers, village leaders and villagers, and among farmers. In social forestry, a major task is to overcome farmers' distrust of foresters. They have come to view foresters as guards trying to keep local people away from trees and as agents bringing loggers in to cut down local forests.

An important extension function in social forestry programs is understanding the views of local people. The extension agent should be close to community members and able to obtain their opinions and ideas. Generally, the extension agent is the one who can determine which local practices are the best and that should be transmitted to others through extension, and often brings back new ideas for further research. In sum, the extension agent has many, varied functions that involve a two-way flow of information (box 11.1).

Box 11.1 Suggested Functions of a Social Forestry Extension Service: India

- Working with local authorities and NGOs to gain their support and active involvement in supporting farm forestry, appropriating areas of wasteland for reforestation, providing technical advice and soil testing, and planning rural forestry programs
- Helping schools with nurseries and increasing awareness among schoolchildren of the need for, and benefits of, tree planting.
- Assisting in the review of school curricula to ensure they reflect forestry priorities, and training schoolteachers in forestry.
- Training motivators to work in villages to promote adoption of tree planting and helping communities to identify social as well as physical constraints to tree growing.
- Providing seed and other inputs, and guiding nurseries in seedling production.
- Providing forestry specialists for training village extension workers at regular extension training sessions.
- Providing a source of specialist advice on technology and management in tree farming.
- Conducting field trials of improved tree-farming practices.
- Identifying successful innovations and disseminating information about them.
- Promoting the use of tree products and village industry based on tree products.
- Demonstrating conservation-related technology (for example, improved stoves and crematoria) and helping to arrange financing for these.
- Assisting local credit institutions to establish credit facilities for tree-farming enterprises by farmers and landless peasants.
- Helping to establish marketing mechanisms for surplus wood and wood products.
- Involving industrial interests in using production from farm forestry.
- Preparing topical information for mass dissemination.

From World Bank (1983).

Appropriate activities depend on the level of extension being considered, as indicated in a recent study for the Sudan (table 11.2). The activities indicated in the table are broadly applicable in most countries. The levels or units considered range from the national headquarters extension service to the level of the individual. A successful social forestry extension program should make individual farmers informal extension agents and encourage them to pass on what they have learned and accomplished to their neighbors and friends.

Table 11.2 Extension Activities: Sudan

Level	*Target group*	*Activities*	*Cooperation*
Headquarters extension service	Staff and field staff	Educational and training programs for personnel	Ministries, private sector, donors
	General public	Publicity and awareness	Mass media
	Schools	Forestry, environment, conservation education programs	Ministry of Education
	University, technical school students	Curriculum development	Forestry education institutions
	Forestry personnel, interested users	Dissemination of results	Forestry research institutions
	Extension service	Training, monitoring, evaluating program accomplishments*	All forestry and extension staff
Regional office extension service	Staff and field workers	Educational and training programs (Extension Training Center)	
	Staff and field workers	Advice and training, canal plantings, shelterbelts	Agricultural Extension Service, agricultural schemes
	Schools	Forestry (social forestry education programs)	Ministry of Education
	Staff and field workers	Advice and assistance	Land-use departments and donors
Regional office extension service	General public	Publicity and awareness	Local media
District/ municipal/ town councils (social forestry committees)	Schools	Site plantings, shade/shelter/amenity demonstration	Ministry of Education
	General public	Seedling production, nurseries	Forests Department
	Urban population	Advice on woodlot management/ establishment, township fuel supplies	Local authorities

Table 11.2 (continued)

Level	*Target group*	*Activities*	*Cooperation*
Village community (village forestry committee)	General public schools	Advice on and technical assistance in nursery operation, village amenity plantings, school plantings, fuelwood lots, shelterbelts, demonstration plots, fruit tree plantings	Forests Department
Public	Individual (farmer)	Advice and technical assistance on fodder tree planting, shelterbelts, woodlots, livestock shelter, agroforestry	
	Individual (domestic)	Homestead plantings for firewood, poles, fruit, amenity plantings, shelter, shade, firewood conservation, improved stoves	

• Activity common at all levels.

Source: World Bank (1986d).

The FAO provides a more general matrix of the desired distribution of decisionmaking among different levels in an extension organization (table 11.3). The left-hand column provides a list of extension decisions, and the other columns indicate who should take that decision. The levels shown are merely indicative of a given situation. Each country should develop its own matrix to fit its administrative, social, and other conditions. The point is that clear understanding among all personnel of where decisions are made is essential for smooth operation.

The activities of extension personnel should also vary with the type of forestry or household activity at any given level of extension. As indicated in table 11.4, at the community level, one can identify many types of appropriate activities and target audiences depending on whether the extension agent is addressing opportunities associated with seedling production, tree planting, forest protection, or end-use improvements, for example, in cookstoves.

Appropriate extension methods

Social forestry extension can be implemented in many ways, from traditional government extension agents making their rounds with local farmers to an NGO broadcasting extension information over the radio. Extension programs and techniques can be aimed at individuals; small, homogeneous groups in a community; or the community at large. The relative strengths of each approach are indicated in table 11.5. The choice of approach or combination of approaches will depend on specific circumstances; for example, the level of existing knowledge in the community, the nature of the community structure, ease of access, and the likely pattern of the diffusion of knowledge. In general, the highest cost per contact—and often one that cannot be justified—is that made with the individual farmer or landowner. However, this approach will also result in the strongest contact and one that is necessary in a community with resistance to the activities or ideas being extended. Furthermore, if the community has a good record of diffusion of technologies through demonstration, then starting with a few selected individuals and building success stories with them may be the best approach and one that has proven itself in many cases.

Table 11.3 Matrix of Desired Distribution of Extension Organization Decisions

Decision	*Government*	*Central head-quarters*	*Regional*	*District*	*Extension officer*	*Village*
Allocation of resources to different districts		6	3	3	1	
Transfer of resources between districts		5	5	3		
Setting three year targets for districts	3	6	3	3		
Appointment of an extension officer	3	6	3	3	3	
Choice of communities to work with		2	6	4	3	3
Selection of participants for training			2	6	3	3
Choice of land to be planted				3	3	6
Organization of work in the community				3	3	6
Selection of species				5	5	5

1 = Informed after a decision is made.
2 = Informed before a decision is made.
3 = Consulted before a decision is made.
4 = Normally makes the decision subject to approval or veto from higher level.
5 = Joint decisionmaking with two or more levels agreeing on action.
6 = Normally makes the final decision.

Source: FAO (1986b).

The training and visit (T&V) system developed by the World Bank for agricultural extension (Benor and Harrison 1977) uses a variation of the individual approach. The extension worker follows a fixed schedule of visits to contact farmers who are expected to get a representative group of farmers from the village to attend the meeting with the extension worker. Farm visits are interspersed with regular in-service training and reporting days that allow a close, two-way link to be maintained between the village, the extension headquarters, and the research section. Other features of the T&V system are that the extension worker is engaged exclusively in field advisory work, with a single line of command to the agricultural department, and with each field worker concerned with a defined number of farmers, usually 16.

These 16 contact farmers represent about 200 to 1,000 farmers. This approach can be effective for diffusion of new technologies, provided that an adequate infrastructure exists to provide credit inputs and marketing support. Generally, however, social forestry extension is more concerned with changing or strengthening existing social structures and interactions within the village, and less involved with regular introductions of the latest agricultural technologies. For this reason, the T&V system's applicability to social forestry may prove to be limited.

Table 11.4 Extension Service Activities for Social Forestry: India

Type of forestry activity	*Extension activity*	*Potential main participants in extension programs*
Seedling production by private farmers, schools, and communities	Nursery location/construction/ soil mixing. Seedling production and distribution techniques. Monitoring seedling distribution. Selection of sources and organization of provenance of seed, fuelwood, and fodder species.	Forestry Department specialists/ forest extension workers, forestry motivators.
Tree planting on small farms (mainly boundary planting)	Mass media, promotional activity. Incentives, establishment techniques, choice of species, assessment of survival, fuelwood/fodder/agricultural crop, livestock interrelationships, sociological analysis of farmers' response to project design. Improved marketing.	Forestry Department mass media specialists and forestry specialists/Agriculture Department, National and Dairy Development Board, and other rural institution extension staff/village extension workers sociological research field enumerators.
Block tree planting on larger farms	Management of block plantations (tree cash crops), increasing productivity, harvesting systems. Promotional activity where smaller farmers are block planting on marginal land. Intercropping relationships/credit needs. Improved marketing.	Forestry Department forestry specialists/foresters/extension workers, Agricultural Credit Bank extension staff, forestry motivators.
Self-help village woodlots, communal, and NGO tree planting. Planting of wastelands and rehabilitation of degraded forest land by tribal or landless people.	Promotional activities. Organization of land distribution, planning inputs (seedlings), establishment techniques, fodder/ fuelwood/credit/fertilizer needs. protection of trees from grazing. Sociological analyses of community response. Help with harvesting, marketing.	Forestry Department mass media specialists/forestry specialists/foresters/forest extension workers. Sociological Research Institute field enumerators, Agriculture Credit Bank extension staff, Forest Development Corporation, marketing staff, forestry motivators.
Forest conservation, protection and management of natural forests (especially upland wastelands).	Protection of forests from fire and grazing, ecologically desirable harvesting and regeneration systems, road alignments, soil conservation, range management and fodder protection. Check dam and gully plugging techniques.	Forestry Department rangers/ foresters and forest guards; Agriculture, Livestock, and and Irrigation Department assistants; agricultural officers and village extension workers.
End-use conservation (for example, improved stoves, preservative treatment).	Appropriate stove design. Testing local reaction to stove adoption. Demonstration of pilot conservation-related activities (e.g., improved crematoria and simple preservative treatment technologies, such as for fence posts and rafters).	Sociological Research Institute enumerators, Technical Institute extension staff (for example, stove design), community-oriented home welfare extension agents/

Source: World Bank (1983).

If technical talent is scarce, which is often the case in the early years of social forestry development, a group approach is almost a necessity. Radio and other distance training approaches may be useful. Although contact is not very intense, it may be effective, particularly if a few individuals go on to develop the demonstration units necessary for wider community participation.

The group or community approach is also essential when the community has a strong tradition of collective action or cooperative effort in production and social activity. The small group approach is particularly relevant when the community is made up of many diverse types and groups of people. A fundamental principle of good extension work is that the level of the message should be consistent with the audience's level of knowledge and understanding. Thus, in a community of highly diverse types, working with small, homogeneous groups can be effective. However, using the individual or the small group approach always runs the risks of concentrating on the better-off in the community and creating—or at least aggravating—community frictions.

Regardless of which approach is used, many different forms of communication can be employed. The most common alternatives are shown in table 11.6.

Table 11.5 Comparison of Extension Methods in Communities

	Audience		
Characteristics	*Individual*	*Small groups*	*Whole community*
Strength of contact with individuals	1	2	3
Cost per contact	3	2	1
Fostering cooperative group action	3	1	2
Use of scarce technical talent	3	2	1

Key: From 1 = best to 3 = worst.

Table 11.6 Modes of Communication in Extension

Pre-employment vocational and technical training
Farmer training centers
Mobile education/training units
Field extension services
Primary education
Mobile information units
Formal distance training
Telecommunication
Broadcast technical programs
Print media: newspapers, magazines, etc.
Paraprofessional communication agents
Pamphlets, posters, cassettes
Radio
Communication through commercial channels
Traditional informal communication channels

Choosing extension agents

Some people think that the most effective approach to social forestry extension work is to train existing agricultural extension agents in social forestry. Others argue that separate extension services are needed for social forestry since the fundamental message in social forestry is different from that in general farming, which focuses more on the introduction of new technologies than on social structures and interactions.

No perfect solution exists. In some cases, a separate extension system will be best and indeed necessary, for example, if the existing agricultural extension system is inadequate. In other cases, tying in with the agricultural extension system makes sense because social forestry deals primarily with farmers, and because farmers would find dealing with two extension systems confusing, particularly when the main message of social forestry is the integration of trees within the farming system. Furthermore, separate extension systems may be impracticable if the cost is prohibitive. A general model of an integrated rural development extension service is shown in figure 11.3.

One way to effectively reduce costs—a way that has been used successfully in social forestry programs in Haiti, the Dominican Republic, the Republic of Korea, India, and Nepal—is to involve local facilitators, "animateurs," village forestry "officers," or "motivators," who come from the participating villages. An example of this approach, in which forest department extension workers trained in social forestry worked with local village-level staff in the remote mountain areas of Nepal, is given in box 11.2. This approach has the added advantages of reducing the traditional distrust of government forestry officers, of increasing the feedback to administrators from local communities, and of increasing the potential for widespread participation if the right local contact is chosen. The initial cost of training and maintaining such a wide network of local facilitators can be fairly high, but the long-term results may justify it.

When women are the main participants and beneficiaries of social forestry programs, using women as extension agents can be effective. However, using women as extension agents in male dominated societies can be a problem due to a possible lack of respect and cooperation from community decisionmakers, who tend to be men. One approach is to use both male and female extension personnel in appropriate combinations.

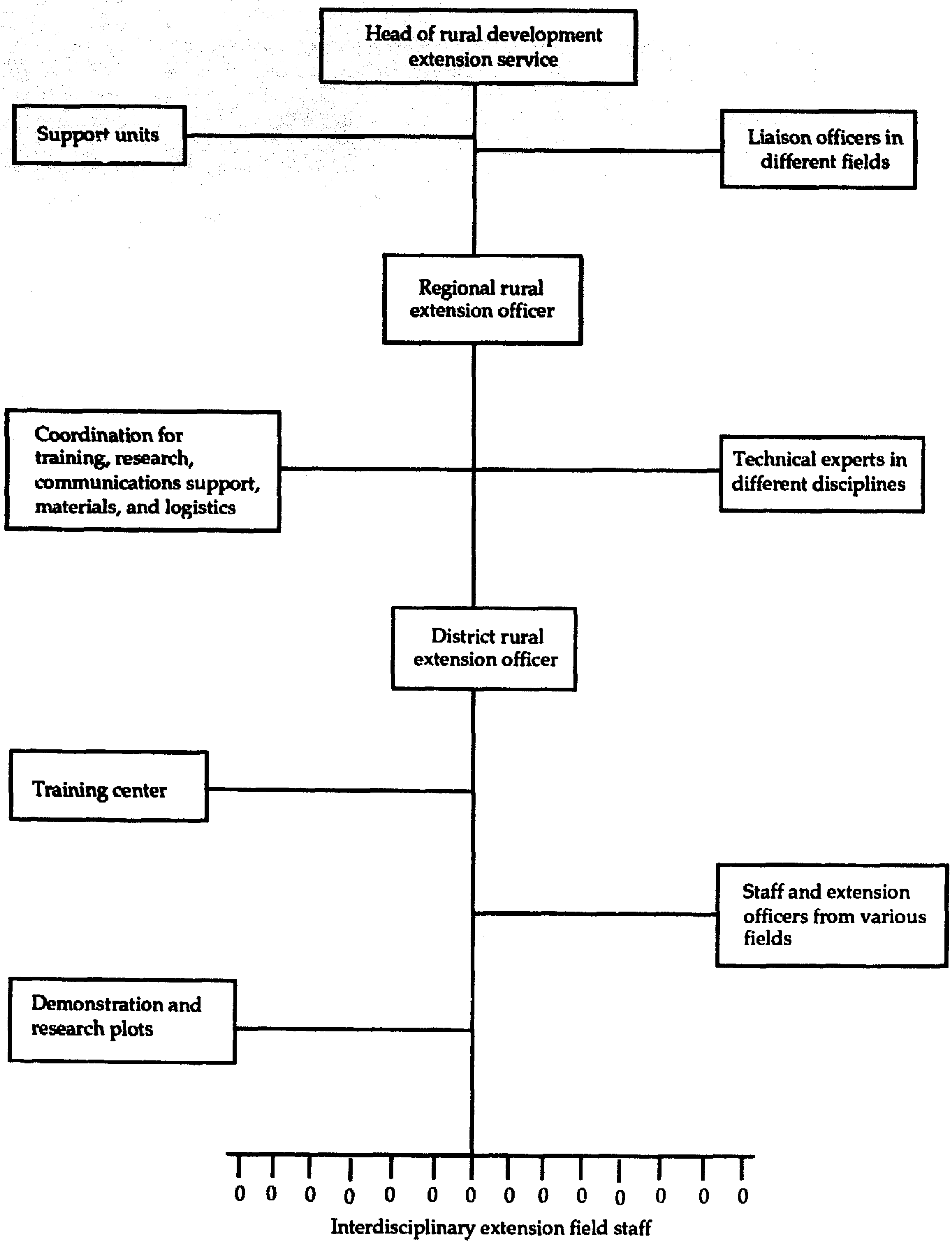
The Scope of Development NGOs in Social Forestry

The term NGO refers to any agency or institution that is not public. The term is often used more specifically to refer to private organizations that are active in providing services to communities and in helping them to develop themselves. The term "development NGO" is used in this sense. Another term, private, voluntary organization, is used in some countries to refer to a development NGO.

Ongoing development NGO activities

Hundreds of development NGOs are involved in social forestry, although the extent of their activities is not well known. The UNDP's Nongovernmental Liaison Office has begun collecting information about the involvement of NGOs and development NGOs in social forestry around the world (see International Tree Project Clearinghouse 1987, which describes more than 200 NGOs involved in forestry in Africa). The WRI held three workshops recently in Africa, Asia, and Latin America at which NGO representatives and other participants discussed the strengths, weaknesses, and potential future roles of NGOs in forestry. A report of these workshops has been published (Hazelwood 1988). NGOs are involved in many aspects of social forestry, such as developing agroforestry systems, organizing villagers to participate in programs, educating influential local people about the importance of helping rural populations to protect forest resources, and introducing improved cooking stoves.

Figure 11.3 Structure of an Extension Service for Integrated Rural Development



Source: Qamar (1979) as cited in FAO (1986a).

Box 11.2 Extension Activities in the Community Forestry Development Project: Nepal

The Community Forestry Development Project (CFDP) aims to establish 12,000 hectares of new plantations, bring 40,000 hectares of existing forest under sustainable management, and distribute 1 million seedlings for planting on private land.

The program depends on land tenure legislation introduced in 1978, whereby forest and other uncultivated land (which had been nationalized) can be returned to ownership of the panchayat (a group of villages with a population of about 5,000). A panchayat must apply for land to be handed over to it. The district forest office will then establish and run a panchayat nursery, and organize and pay for plantation establishment. In addition, farmers receive free seedlings.

An effective extension component is crucial to the success of a project of this kind, which is designed to depend on local interest and involvement. The problems facing an extension program in Nepal are, however, formidable. Most of the participating panchayats are far from a road, and most of the population in the hills is illiterate. There have been few forestry extension activities in the past, and the forest department was previously concerned exclusively with policing and controling illegal cutting in government forests. This inevitably fostered distrust of forestry staff by the villagers, which can be a constraint, particularly as the district forest controller is now responsible for both traditional "territorial" forestry and the community forestry program.

The extension component of the CFDP was developed with the help of the UNDP. In view of the problems mentioned above, right from the start the main emphasis was on personal contact between extension workers and individuals or groups. Printed materials and mass media methods have been developed, but their role is to support, not replace, the field workers.

Central to both extension and day-to-day operations are the community forestry assistants, who undergo a two-year training program and short in-service courses that stress extension methods. Village-level staff (nursery foremen and plantation watchers) are also encouraged to take every opportunity to explain the project to other villagers; extension is included in their two-week training course. As local people, they may find it easier to communicate with other villagers than the forestry assistants, most of whom come from the plains and have a different ethnic and cultural background. Because personal contact is central to the design of the extension service, lack of empathy between the forestry assistant and the villagers is perhaps the most common constraint to getting a village involved.

The range of supporting materials produced by the project includes a booklet, a flipchart, posters, nursery signboards, stickers, T-shirts for project staff, films and filmstrips, and a weekly radio program. A distinctive logo appears on all the material and is gradually becoming well known in project areas. A logo has the advantage of being recognizable by everybody, whereas written materials are useful only to the literate, and the radio program only to the small elite of radio owners. The film show has proved very popular because most people have had no previous contact with films, but carrying all the equipment around, including a generator, and maintaining it in remote areas does present logistical problems. Another danger is that the reality of local activities may not match up to the ideal presented in the film, resulting in disappointment and disillusionment. The best motivation is provided by a good quality nursery and a friendly and enthusiastic forestry assistant.

The project aims to establish a forest committee in each panchayat, so that the local community makes all decisions concerned with forestry activities. This will include such difficult subjects as the distribution of benefits from community land and the development of management systems for existing forest that are both sustainable and simple enough to operate effectively. It requires considerable political dexterity and diplomacy on the part of the forestry assistant to get a committee established that is not dominated by a particular faction, and even more so to keep enthusiasm high and to ensure that equitable decisions are made. CFDP is a typical example of a project in which the extension component is the main determinant of overall success.

From Stewart (1981-84); Manandhar et al. (1982); Pelinck et al. (1984 a, b).

The social forestry activities of development NGOs cover a broad spectrum. For example, the Chipko movement in Uttar Pradesh, India, has been very successful in promoting the preservation of natural forests and improving their management (box 11.3). CODEPLA, the development arm of the Council of Evangelical Churches in Haiti, is instrumental in promoting tree growing by local farmers and in helping them to market wood for a fair price (box 11.4). CARE is working with government agencies and local development NGOs in many countries to promote social forestry programs (box 11.5).

Box 11.3 The Chipko Movement: India

The Chipko Movement is one of the better known cases of successful activism by an NGO in Uttar Pradesh. The movement was launched in 1973 by a local NGO, the Dasholi Gram Swarajaya Mandal (DGSM), which became alarmed when the forest department began selling locally produced ash trees to urban industries instead of to local artisans. The DGSM organized a protest in which villagers hugged *(chipko)* trees rather than allow them to be cut for export out of the region. Eventually, the state government agreed to uphold local villagers' rights to the ash trees and began a moratorium on all cutting in critical catchment areas. Not only did DGSM prod the state forest department to become more socially and environmentally responsive to local needs, but it began its own reforestation campaign. This soon won support from the government, which leased degraded slopes to villagers for reforestation and helped pay for planting seedlings.

Box 11.4 Local NGO Works to Safeguard Farmers' Profits: Haiti

CODEPLA is the development arm of the Council of Evangelical Churches in Haiti. An indigenous organization with projects in several rural communities, CODEPLA began its social forestry activities with support from an agroforestry project funded by the USAID and the Pan American Development Foundation.

CODEPLA was providing seedlings to farmers who were interested in growing trees to produce charcoal. Then, it became concerned that charcoal producers were not receiving a fair price for their goods. Intermediaries were absorbing the profits from rising consumer prices. CODEPLA began its own project, for which it received funding from the Canadian International Development Agency, to cultivate fast-growing trees on land it rented from local farmers. Local participants work together to plant and maintain the trees. While the trees are maturing, CODEPLA is organizing village cooperatives that will sell charcoal in the urban market without profit losses to intermediaries.

From Thomas (1985).

Box 11.5 NGO Provides Support for Social Forestry in Many Countries

CARE is a U.S. NGO at the center of a network of 12 national CARE organizations with representative offices in many developing countries. The CARE international network is active in social forestry activities in 19 countries. For example, in Uganda, CARE is working with the forestry department in a World Bank-funded project to train extension agents and help establish village and private woodlots. In Niger, CARE has helped villagers in the Majjia Valley create extensive windbreaks that have increased agricultural production. In Indonesia, CARE is helping dryland farmers plant fuelwood trees and restore agricultural land at the same time. CARE also has social forestry projects in Guatemala, Mali, and Kenya, among other countries.

From CARE (1985).

Potential advantages of development NGOs

Development NGOs offer a number of potential advantages for social forestry work, including knowledge of rural communities, good relationships with local people, flexibility, autonomy, agricultural extension experience, and effectiveness as coordinators.

KNOWLEDGE OF RURAL COMMUNITIES. Many development NGOs—both large, international ones and small, indigenous ones—have had long-term experience in rural areas, particularly in organizing and providing services, such as health care, education, water, and agricultural extension, to the rural poor.

In the course of their activities, many development NGOs have acquired detailed knowledge of local organizations, economic structures, and political forces. This knowledge can be useful in many ways in a social forestry program. For example, whether or not they are directly involved in forestry activities, the development NGOs can help to identify local needs and preferences for wood products and species. They can locate local seed sources and sites for trials, demonstrations, and small nurseries, and they can identify local people who could manage them. A development NGO with local ties might also be in a position to know about and help resolve tenure problems related to the introduction of trees.

RELATIONSHIPS OF TRUST WITH LOCAL PEOPLE. Many development NGOs have established relationships of trust with local people and can work with people who are wary of public bureaucracies, such as a government forest service. This kind of relationship is a prerequisite for gaining local support for social forestry activity.

A development NGO that has good relations with a community may be able to act as an intermediary between the community and the government or other agency in terms of, for example, the allocation of forest resources. The development NGO can help explain the position of local people to the government and act to bring different interests together to achieve practical solutions to social forestry problems.

One reason for the orientation of development NGOs is that the people who are attracted to work with them tend to be motivated individuals who are willing to spend long periods in rural areas and to deal with local people. This is often a critical factor in gaining local trust and support.

FLEXIBILITY. Development NGOs generally enjoy a great deal of flexibility. Because they do not have the heavy administrative overlay of many development bureaucracies, development NGOs are freer to act quickly, to experiment, and to change the direction of projects in mid-course as opportunities arise. One reason for this is that the scale of their activities is often localized. Also, greater leeway in policymaking is possible in a small-scale project than in a nationwide program.

While the small scale of many development NGOs in terms of staff and operations is a potential advantage, it may create some risks when they become involved in large-scale public projects, which tend to put pressure on them to increase the scale of their operations. Because the effectiveness of an NGO's program often depends on developing close relationships with local people, a sudden expansion is likely to result in a less effective program, since such relationships take time and patience to establish. Furthermore, many development NGOs do not have the administrative capacity to manage a major expansion.

Taken as a whole, development NGOs are involved in a wide variety of programs and organizational structures with many possibilities for participation in social forestry. One NGO could help in the production and distribution of seedlings. Others could add farm forestry to their agricultural extension programs. NGOs with agricultural marketing programs could add the marketing of wood products. Even urban-based NGOs could help to link wood producers to wood users, especially in the case of small or cottage industries.

AUTONOMY. An important factor in the success of many development NGOs is the degree of autonomy they have over their activities. A balance is needed between coordinating the activities of development NGOs and ensuring their autonomy. Most development NGOs do not want to become appendages of government programs, and governments differ in their attitudes toward development NGOs. Coordination need not entail rigid controls over NGO activities and funding. By having a degree of autonomy, development NGOs extend the services of overburdened government agencies and explore new approaches to solving problems that government agencies, by their very nature, cannot deal with. However, NGOs must be aware of, and sensitive to, government planning policies.

AGRICULTURAL EXTENSION EXPERIENCE. As mentioned earlier in this chapter, one of the more limiting factors in social forestry is the lack of effective technical assistance or extension capacity. A dilemma in a number of national social forestry programs is whether the forest service should develop extension capabilities or the agricultural extension service should add forestry to its already full agenda.

Development NGOs can help fill the gap. Many have long-term experience in agricultural extension with small farmers. They often have the resources to train their personnel in agroforestry systems and the flexibility to experiment with new systems through demonstrations and pilot programs. Furthermore, as private organizations, development NGOs can cooperate with both forestry and agricultural services while avoiding the conflicts that can at times arise between large, public agencies. In this sense, they can help to bridge the gaps between agriculture and forestry.

COORDINATION. One of the issues in the involvement of development NGOs in social forestry is the difficulty of linking them with each other and with sources of funding. From the point of view of many development NGOs, dealing with the bureaucracies of governments and large donor agencies can be frustrating and time consuming. From the point of view of many donors, the administrative costs of dealing with a large number of small development NGOs may be excessive in proportion to the scale of their activities. Several approaches have been used to coordinate NGO social forestry activities within countries and to link development NGOs with domestic bilateral and international funding agencies. The KENGO Program and the Haiti Agroforestry Outreach Project are examples of two approaches (boxes 11.6 and 11.7).

KENGO and the Haiti Agroforestry Outreach Project provide two examples for coordinating assistance provided to NGOs in social forestry in ways that permit a smooth flow of resources from donors to the rural population. Other administrative mechanisms for involving NGOs in projects funded by major donors or lenders also exist. For example, the World Bank, whose projects are almost always implemented by member governments, has developed a variety of relationships with NGOs. Among the roles NGOs have played in World Bank projects are cofinancier, grant recipient, consultant for project development and evaluation, subborrower, subcontractor, and source of parallel and complementary projects (World Bank 1985e).

Strengthening the networking process

NGOs working in social forestry can receive technical assistance through a number of channels, especially at the junior technical level, which is sometimes not easy to obtain through domestic bilateral and international assistance programs. For example, the International Technology Development Group, Voluntary Service Overseas, and the U.S. Peace Corps can provide assistance to development NGOs. The Peace Corps in particular has expanded its social forestry program in recent years, including extensive training programs for volunteers and their local counterparts.

Links among development NGOs in social forestry are also being strengthened through regional workshops. For example, in 1985 the UNDP's Nongovernment Liaison Office sponsored a countrywide consultation on social forestry for NGOs and the government in Senegal, and the Society for Wasteland Development brought together NGOs in India to discuss forestry problems and their role in resolving them. The WRI has also been working to bring together development NGOs working in forestry.

Box 11.6 The KENGO Program: Kenya

The Association of Kenyan Energy NGOs (KENGO) consists of about 50 NGOs, 40 of which are small, community groups based in rural areas. KENGO has provided services to its members since 1981. Its technical assistance program has conducted regional workshops on social forestry in the coastal, arid, and semi-arid zones of Kenya. Smaller, district-level workshops have been held on tree planting, agroforestry systems, and fuelwood conservation. KENGO also has mobile units that provide technical advice on nursery management, seed procurement, and other topics. KENGO can provide member NGOs with some material inputs such as nursery tools and fencing. A newsletter keeps members informed of KENGO activities.

In addition to these services to member NGOs, which deal mostly with farmers, KENGO has developed a wood energy program to help develop more efficient wood technologies at an industrial level, such as bakery ovens, industrial furnaces, and crop driers.

KENGO links an impressive range of governmental and donor agencies (including NGO donors) with its members. The Norwegian and German bilateral agencies support the technical assistance program. KENGO is also participating in a USAID-funded renewable energy development project with the agricultural and environmental ministries. The wood energy program is financed by the Canadian International Development Research Center and is carried out in conjunction with the Appropriate Technology Centre of Kenyatta University. KENGO has published a survey of indigenous trees, supported in part by the *Kenya Times*, and is working on a tree seed improvement project with the Kenyan Agricultural Research Institute, the forest department, CARE, and the Mennonite Central Committee.

On one level, KENGO has brought together NGOs that are working on rural energy problems. On another level, it has linked NGOs with international donors, government agencies, and other institutions.

Box 11.7 The Agroforestry Outreach Project: Haiti

A somewhat different approach for linking a donor agency with NGOs is found in the USAID-funded Haiti Agroforestry Outreach Project. In this project, one NGO, the Pan American Development Foundation (PADF), serves as a conduit for technical and material assistance to NGOs working in rural Haiti to promote farm forestry.

The approach originated because the USAID mission in Haiti knew that many Haitian NGOs were interested in developing social forestry projects, but realized that making grants to individual NGOs would overwhelm its small staff. At the same time, among many of the NGOs in the country, large donor agencies had the reputation for red tape, delays in funding, and administrative requirements (such as reporting) that many NGOs were not equipped to meet in terms of personnel or experience. The solution was to make a large grant to a single NGO, which in turn would become a conduit for assistance in social forestry to other NGOs.

PADF has made subgrants to over 100 NGOs for farm forestry projects. Many kinds of NGOs have received assistance: international and indigenous, religious and secular, large and small, experienced in tree planting and inexperienced.

PADF can respond very quickly to requests for assistance; the flow of resources can begin the same day an application is made. A NGO must meet several conditions before it can receive a subgrant. It must already be active in a rural area, and it must agree to distribute seedlings to farmers, who in turn must agree to plant a minimum number of seedlings on their own land. The farmers are free to harvest their trees without interference from the NGO. Thus, PADF not only provides technical and material assistance, but the framework for a program as well. Where an NGO has the technical capability to manage a nursery, PADF will help with the funding. If an NGO cannot manage its own nursery, PADF will supply seedlings from another NGO nursery. PADF provides training for extension agents, who are usually villagers, as well as extension materials and follow-up questionnaire forms. In addition to providing assistance for field activities, PADF provides accounting and reporting services to recipient NGOs. A NGO need only provide receipts to PADF for cash expenditures (which in any case are kept to a minimum), while PADF provides full financial and narrative reporting to USAID.

Potential contributions of development NGOs in social forestry projects

The technical contributions many development NGOs can make in social forestry projects, from seedling selection and production to marketing and consumption, are listed below.

- **Species selection.** Development NGOs with ties to local consumers can be helpful in pinpointing needs and preferences for wood species and products. In many countries, local female NGO personnel would be in a better position than male forest service personnel to interview women about their preferences for cooking fuels. In addition to identifying appropriate species, many development NGOs have experience in planning and conducting species trials and can do so with their own resources. Even development NGOs without technical expertise may be able to obtain land for species trials, either by using their own land or by acting as an intermediary with other parties. Thus, development NGOs can be a valuable link in nationwide testing of species under diverse ecological conditions.
- **Seed procurement.** Good sources of seed for indigenous species are often dispersed and not widely known. NGOs can be important links with farmers who can identify local seed sources. NGOs can also help to organize small-scale marketing enterprises for the provision of seed to nurseries.
- **Nursery production.** Social forestry often entails the establishment of small nurseries close to planting sites. The incorporation of development NGOs into a regional network of nurseries can spread the effect of a social forestry program. Many development NGOs cover only

a small area. This can be an advantage in a decentralized nursery program, which needs to be widespread and concentrated locally at the same time. Not only can development NGOs set up and manage nurseries, they can also help villagers establish their own nurseries.

- **Outplanting and follow-up.** Many development NGOs have extension systems that can readily pass information about growing and managing trees to farmers. NGO extension systems can channel feedback about species performance and problems. Development NGOs with experience in small-farm agriculture will be sensitive to the need to integrate trees into existing farming systems and may have the capacity to experiment with new agroforestry systems.
- **Marketing.** Development NGOs can enter into the marketing of wood products in two ways: by helping producers to organize to gain greater control over the wood product market, and by helping to develop links between producers and specific consumers, such as bakeries and handicraft workshops.
- **Consumption: woodstoves.** The use of wood is no less important an issue than its production, but it involves technical and socioeconomic problems that many forestry agencies are ill-equipped to handle (see chapter 4). Development NGOs have been involved in the design, production, and dissemination of woodstoves. These NGOs have been useful in linking technical design to the qualities that consumers value in stoves.

Future approaches

The involvement of development NGOs in social forestry will expand because of their successful involvement in past projects. This will be particularly true for many field-level activities that require a fairly intensive local presence of technical assistance and motivation for change in the initial years. Development NGOs are unique and valuable resources in that they provide a framework or link for inducing desired changes and providing technical know-how in local communities. However, unless a conscious effort is made to assess the capabilities and roles of NGOs in social forestry and to secure their cooperation on future programs, their actual contributions are likely to be much more limited than their potential.

In the process of working more closely with development NGOs, a number of issues may surface that pose difficult and delicate political decisions, such as land tenure and rights to forest outputs. A positive way to approach these is to see them as major, underlying problems that will have to be addressed sooner or later. Under such circumstances, development NGOs, with their close relationships with local people and their ability to understand the broader problems of local environmental stability and competing claims to available resources, can play a very useful role in assisting government agencies to reach realistic compromise solutions.

Summing Up

There are many different organizational issues to consider in developing an effective and efficient social forestry program. Key factors are the extent of public involvement versus local community (private and local government) involvement; linkages between various public agencies, for example, in agriculture, production forestry and energy; appropriate forms of administrative arrangements for project execution; and appropriate forms of coordination between public and private sector activity.

No one right form of organization for social forestry projects exists. However, whatever functional form is chosen, it must involve government in a supporting role rather than a dominant and authoritarian role. While authoritarian actions have been successfully used in some programs, ultimately, it was village level organization and participation that carried activities beyond startup to functioning and sustainable social forestry programs. Nevertheless, strong government support is essential, including in some cases revisions of laws that govern land use and other activities that affect incentives for tree planting.

The critical importance of widespread local participation in social forestry and of strong linkages between local people and project management and technical support, and the design of appropriate extension activity and its organization become critical elements in planning an effective program. Extension agents will provide the main link between local participants and project management, technicians, and researchers.

One critical consideration is whether or not social forestry extension should be integrated into existing agricultural or general rural development extension. In a majority of cases, this probably will be necessary for budgetary reasons. However, it also generally makes sense so that programs can avoid confusing farmers by having two or more separate extension services or agents visit them with what oftentimes might be conflicting information and ideas.

As indicated, many extension functions and many methods of performing such functions must be considered when designing social forestry programs. An extension plan will help to sort these out and to choose the best combination for each program.

The final section of this chapter discussed the potential and actual role of development NGOs in social forestry and concluded that they have had widespread success. This is because they often have excellent knowledge of local communities and have developed the trust of local people; they have flexibility and autonomy, which government bureaucracies seldom have; and they have experience in extension and in coordinating small-group activities. There is the potential to use development NGOs to a much greater extent in social forestry projects.

12

MONITORING AND EVALUATING SOCIAL FORESTRY

In the past, systematic monitoring of social forestry projects was rare. Although records on the number of seedlings produced, the area planted, and production statistics are traditionally maintained for government-managed forests, this is done mainly as part of a long-term program of data collection. It is not geared to the shorter-run problems of managing the implementation of a new project or program. Now, however, both governments and external financing agencies are more aware of the importance of collecting monitoring and evaluation (M&E) data systematically and integrating the M&E process with project planning and implementation.

Social forestry projects in developing countries are frequently financed from foreign sources, including bilateral or multilateral agencies. This aid is normally provided as loans or grants for projects with fixed disbursement periods. These projects often finance only a short "time slice" of a social forestry program. Such projects can be viewed as part of the longer (and often larger) program of social forestry development. Rather than linking M&E to specific externally funded projects, policymakers should view it as an important part of the management and implementation of such longer and larger national programs.

Accordingly, countries are establishing monitoring and evaluation units (MEUs) as part of a process of institutional reform designed to sustain social forestry programs over time. Policymakers expect MEUs to provide information about the social and economic consequences of the public investment program in a way that permits them to judge whether the program's physical objectives are being achieved and how the program might be modified, or implementation procedures changed, to ensure maximum social and economic benefits.

The Role and Objectives of Monitoring and Evaluation

Most agencies entrusted with public monies must use these funds in accordance with established financial regulations and other rules and procedures. Expenditures must also be in line with specified objectives. Governments have developed systems of financial reporting to account for these monies and with them, standard ways to measure the progress of the physical work and other facilities on which the funds have been spent.

Conceptually, monitoring and evaluation are distinguishable from one another (see Casley and Kumar 1987). Monitoring is an assessment of the efficiency with which the program is being implemented, including measurements of the quantity and timing of input delivery and physical and financial progress. Evaluation is the assessment of the results of implementing the program. There is some argument about definitions (see Casley and Lury 1982; U.N. 1984; Belshaw 1984; and Clayton 1985 for a variety of opinions). Nevertheless, consensus is growing that monitoring, especially of rural development projects, primarily serves management, and that evaluation serves a wider audience (including management) over a much longer time span. In any case, these two aspects are closely related and can profit from being functionally integrated. Hence, the M&E system should stress the importance of monitoring as a time-bound aid to program management and link monitoring to the process of evaluation.

Evaluation can have several meanings. It may mean the evaluation, concurrent with the process of implementation, of the most important direct effects of social forestry interventions. This is often known as on-going evaluation or, less commonly, as beneficiary monitoring. Alternatively, it may mean mid-term or *expost* evaluation, or the execution of a complete impact analysis. These latter approaches, while not inherently undesirable, often do not address the short- and medium-term information requirements of management because the approaches are complex, have a huge appetite for data, require sophisticated analytical methodologies, and are long term. MEUs should usually eschew such ambitious investigations. Their evaluation work should be confined mainly to on-going evaluation. Thus, the principal functions of an MEU for social forestry can be summarized as follows:

- To help program management establish clearly defined objectives and targets for program implementation against which progress can be monitored (for example, the number of nurseries established, woodlots planted, seedlings produced, and farmers planting trees).
- To implement and operate a monitoring system, including the development and application of methodologies and procedures to collect and analyze information (for example, the design of proper reporting procedures for nurseries and other plantations, data retrieval, and standard tabulations of results).
- To collect information from existing administrative and accounting records, surveys, and studies to enable the periodic evaluation of progress and the project's effects, and to analyze, interpret, and report the findings to management and, through them, to other interested bodies (for example, the submission of regular reports on program components).
- To undertake, on an ad hoc basis, inquiries and studies to solve urgent problems for management.
- To plan and implement special studies or reviews of problems or issues not otherwise covered.

The actual M&E functions in a project or program may vary a little from those defined above. An example of the purposes of the MEU for a specific project are set out in box 12.1.

Box 12.1 Purposes of the MEU in a Community Forest Project: Nepal

The establishment of a separate MEU within the project management structure reflects the emphasis placed on monitoring and evaluation during project design. Since the nature of this project was so innovative for both the forest department and the country, project planners decided that monitoring and evaluation would be crucial to improve project management and find out what was happening in the field.

The M&E system was designed with the following purposes in mind.

1. To improve project performance by
   - providing timely information to management and implementing units on project operation and performance (inputs and outputs), with implications for support requirements;
   - generating socioeconomic information required for effective project implementation;
   - identifying and analyzing problems arising during implementation and suggesting possible solutions;
   - increasing communication between the local community and project staff and participation in project activities.
2. To evaluate project results and improve future planning processes through
   - measuring project effects and impacts;
   - identifying and analyzing factors affecting project success;
   - evaluating project concepts, assumptions, and models in the light of actual performance and rural conditions.

From Bhattarai and Campbell (1985).

An MEU should not deal with investigations that might be classified more accurately as research studies, even though they may be relevant. Examples are the impact of different silvicultural regimes on water and labor requirements; the impact of increasing fuelwood supplies on health and nutrition; the agronomic and economic interactions of trees and crops; and the changes in water retention by soils and changes in soil erosion and fertility resulting from tree planting. Not only are such studies long-term in that they must be carried out over many years for the results to have some validity; they are also costly, technically complex, may demand sophisticated data processing and analysis, and are, therefore, best carried out by research institutions (see chapter 14).

The Main Elements of Monitoring and Evaluation

Although M&E can embrace many methods and types of investigation, M&E for social forestry has three main characteristics.

First, an MEU should help to establish efficient basic reporting procedures to support the effective monitoring of seedling production and distribution, the progress of community woodlot programs, the implementation of strip and other tree plantations, and the prices of tree products. These components are central to the achievement of social forestry policy objectives. The approach should be simple, consisting primarily of keeping good records at each nursery and plantation in the program. From these records essential information can be abstracted, reconciled with financial data, and reported in strict accordance with a timetable previously agreed on with program management.

Second, the MEU should tackle what is probably the most demanding aspect of monitoring and evaluation in social forestry: the on-going evaluation of farm forestry. Through regular and efficiently designed sample surveys, the MEU should generate empirical data that provide a reliable and quantified evaluation of the main effects of this component and an assessment of which classes of households participate most frequently. Specifically, the unit should collect and analyze information on the following:

- seedling acquisition, species composition, and species choice;
- types of planting (block plantations or other, irrigated or unirrigated);
- seedling growth and survival;
- planting and cultivation techniques used;
- incidence and coverage of extension advice;
- use of own and hired labor for forestry;
- production and disposal of forest products;
- farmers' problems.

Similarly, the MEU should study village woodlots systematically. The establishment of such woodlots, particularly those dependent on self-help, has been problematic. In some places, the number of woodlots established has fallen far short of planned targets. Satisfactory solutions to the difficulties involved in the transfer of management and in the distribution of benefits have not been found. Fundamental policy questions continue to be raised. Are the targets unrealistic or is the program not adequately designed to meet them? Are community woodlots sociologically feasible? Can forest departments provide the kind of extension services woodlots require? To what extent can woodlots contribute to a community's needs for wood and related products? To what extent do people willingly participate in the establishment and maintenance of woodlots?

At the operational level, a number of other questions commonly arise. How much financial and technical support should forest departments provide to communities? What species and management models should be adopted? What form of agreement with the community is most workable? How can the equitable distribution of benefits to the poorest be ensured? How effective is forestry extension work in increasing people's awareness and participation? Does the timing of operations coincide with seasonal labor shortages?

Questions of policy and implementation such as these, as well as the complexity of the sociological issues involved, require that the on-going evaluation of village woodlot programs be as comprehensive as possible. Broad comparative studies, usually involving well-designed, but small, sample surveys, are required initially to uncover the range of variation and the social dynamics involved. Subsequently, more specialized, in-depth studies may be necessary for which skilled resources from outside the MEU are usually required.

The third main task of an MEU for social forestry is special or diagnostic studies. These should be launched to answer, in some depth, specific problems raised by the M&E results or in response to a query by management. In this sense, they cannot be predetermined. Examples of possible studies are the effectiveness of an improved stove program, the reasons why people are not planting recommended species or adopting extension advice, the value of foregone crop production in areas where trees are replacing crops, and the relationships between tree growing and livestock management. Whatever the topic studied, the investigation should be planned and executed as quickly as possible and be as scientific as the question demands.

Monitoring and Evaluation and Program Management

Successful implementation of the MEU's monitoring activities depends on two conditions: first, that the unit is, and that policymakers see it to be, an integral part of the management system of the social forestry program; and second, that the unit delivers information from monitoring activity and reports in strict accordance with a timetable agreed on ahead of time with program management.

Program managers commonly complain that MEUs provide information that is neither relevant nor timely. This is often a reflection of mutually reinforcing faults by both parties. On the one hand, management may perceive the unit as an imposition from outside or may not understand what the unit can or should do to help them. On the other hand, MEUs frequently embark on work programs that disregard the limitations imposed by available resources, and hence deliver results after long delays and with a consequential loss of credibility. Alternatively, MEU staff often lack the proper professional qualifications or are less objective than they should be, and hence produce poorly focused or irrelevant material. More seriously, MEUs sometimes fail to become part of the management structure and, therefore, fail to understand what information is needed. In either case, it leads to the unit being disregarded and disowned and, thus, to disillusionment of and disinterest by unit staff (see Feder and Slade 1983; Hyman 1985). Moreover, if the MEU is not integrated with management, it will become isolated and suspected of being an unsympathetic critic (see FAO 1986c). Program management and MEU staff must be alert to these potential problems and work closely together to avoid them.

In short, the ground rules for successful operation by MEUs are that they should

- be receptive to management's information requirements;
- establish an agreed reporting timetable with management;
- obtain the necessary data in time to avoid delays in analysis and reporting;
- analyze data as they are accumulated;
- present results objectively, with clear recommendations about actions that seem necessary, and in accordance with the agreed timetable;
- discuss the results with program management;
- be responsive to management's changing needs as the social forestry program develops and evolves.

As the main reason for monitoring and evaluation is to inform management of a project's successes and failures so that suitable corrective actions may be taken or lessons learned for the future, the head of the MEU must report to the most senior manager in charge of social forestry. In most cases, the unit should be integrated with, used, and directed by program management. In some situations, however, some separation of functions may be practical. For example, Hyman (1985) suggests that agencies outside the project should conduct some kinds of evaluation (box 12.2). In describing the circumstances of an MEU in Malawi, French (1985) demonstrates that a unit whose initial job was to question the basic assumptions of the project benefited from not being closely linked to the project's management (box 12.3).

Nevertheless, management must understand fully the purpose of monitoring and evaluation and not regard the MEU staff as an inspectorate or internal police force whose sole purpose is to criticize or report wrongdoing. If an MEU is to be productive, management should clearly delegate responsibility to the MEU and commit itself to the use of objective information coming from it.

Box 12.2 An Argument for External Impact or *Ex Post* Evaluations

Since monitoring differs from evaluation in its purposes, scope, and potential users, the appropriate location and organizational responsibilities for these two activities may differ. Early experience indicates that it is preferable for monitoring to be carried out internally by the project implementing agency with external assistance where necessary. In contrast, evaluations tend to be better if they are external, that is, carried out by outside organizations such as provincial or national planning or finance ministries, government evaluation departments, universities, research institutes, or consulting firms. The main reasons for this include (a) the availability of expertise, (b) the accountability and objectivity of the M&E staff, and (c) the likelihood of timely results. Since organizations and the conditions under which they operate vary a great deal across and within countries, the appropriate location and organization of MEUs may differ.

Most forest departments have the expertise to monitor the achievement of silvicultural targets and the reasons for accomplishments or shortfalls. However, few foresters have expertise in social science theories and methods or in the design of the sample surveys, interviews, and case studies needed to evaluate impact. Unless hiring, retaining, and promoting good social scientists within the forest department or providing extensive social science training to foresters currently on the staff is feasible, turning to an external organization for evaluations may be necessary.

Since monitoring is designed to meet the needs of project decisionmakers, an internal unit has a stronger motivation than an external agency for making monitoring a tool to increase accountability. Working in-house, monitoring staff have a better opportunity to demonstrate their competence and integrity to project management. Gaining the ear of decisionmakers informally may also be easier for an internal monitoring unit. However, evaluations require a broader view of the structural factors in an economy and a society that explains people's behavior. Internal evaluations tend to focus too narrowly on the competence or integrity of individuals on the project staff. In addition, an external viewpoint may be necessary to question a project's basic premises. Nevertheless, the project implementing agency must have confidence in external organizations conducting an evaluation.

From Hyman (1985).

Resources for Monitoring and Evaluation

Monitoring and evaluation are constrained by the resources available. At times, these resource constraints bind very tightly and either cannot be relaxed or can be relaxed only with great difficulty. At other times or in other places, flexibility may be greater. Nowhere, however, are resources unlimited, and those that are available must be carefully husbanded and used to their greatest advantage. Hence, the MEU should have a work program that minimizes the demand for scarce manpower and funds, yet delivers sufficient information to program management.

If the MEU has a limited mandate and is only expected to provide organized and interpreted information on the project's physical and financial progress, much of which, at least in its raw form, will be the product of existing administrative and accounting procedures, then it will need few additional resources. The work can be done by a senior officer with one or two competent support staff.

Box 12.3 Location of the MEU in a Wood Energy Project: Malawi

The [MEU] became problem-centered rather than project-centered. For example, instead of concentrating on seedling sales in relation to project targets, the [MEU] was...more concerned with whether lack of access to seedlings was a serious barrier to tree-planting in the first place. In other words, the [MEU's] job was less to measure the project's fulfillment of its targets than to tell whether the targets themselves were responsive to the larger context within which the project was being carried out.... This meant that the unit would first investigate Malawi's wood energy situation, and only then monitor and evaluate the project's responsiveness to this situation. By thus allowing the unit to view the project in its broader context, the initial, fortuitous separation between unit and project greatly enhanced the [MEU's] usefulness.... By monitoring the project's context [the unit discovered that the direction of the project should change].... For example, the project concentrated on seedling nurseries and largely ignored extension. By contrast, the situation in rural areas implied a dominant emphasis on extension, with only limited need for nurseries. Lacking information on the demand for wood, the project had spread plantations the length of the country. However, data on urban wood users suggested that plantations might best be concentrated near Blantyre, where both demand and problems of supply were greatest.

[This] ... situation had its disadvantages, as project managers felt somewhat isolated from the unit and its work. The unit tried to advance new ideas through informal daily contacts with other project staff, but its isolation sometimes made this difficult. For some staff, the unit became visible mostly when issuing its reports. Since these often advanced views contradicting the governing assumptions of the project, relationships between the [MEU] and the rest of the project were sometimes uneasy.

On the other hand, the unit's independence allowed it to look objectively at the project in its larger context. Isolation, therefore, had a productive aspect. The unit would have found its work much more difficult if it had been controlled more directly by those whose assumptions had determined the project's initial structure.

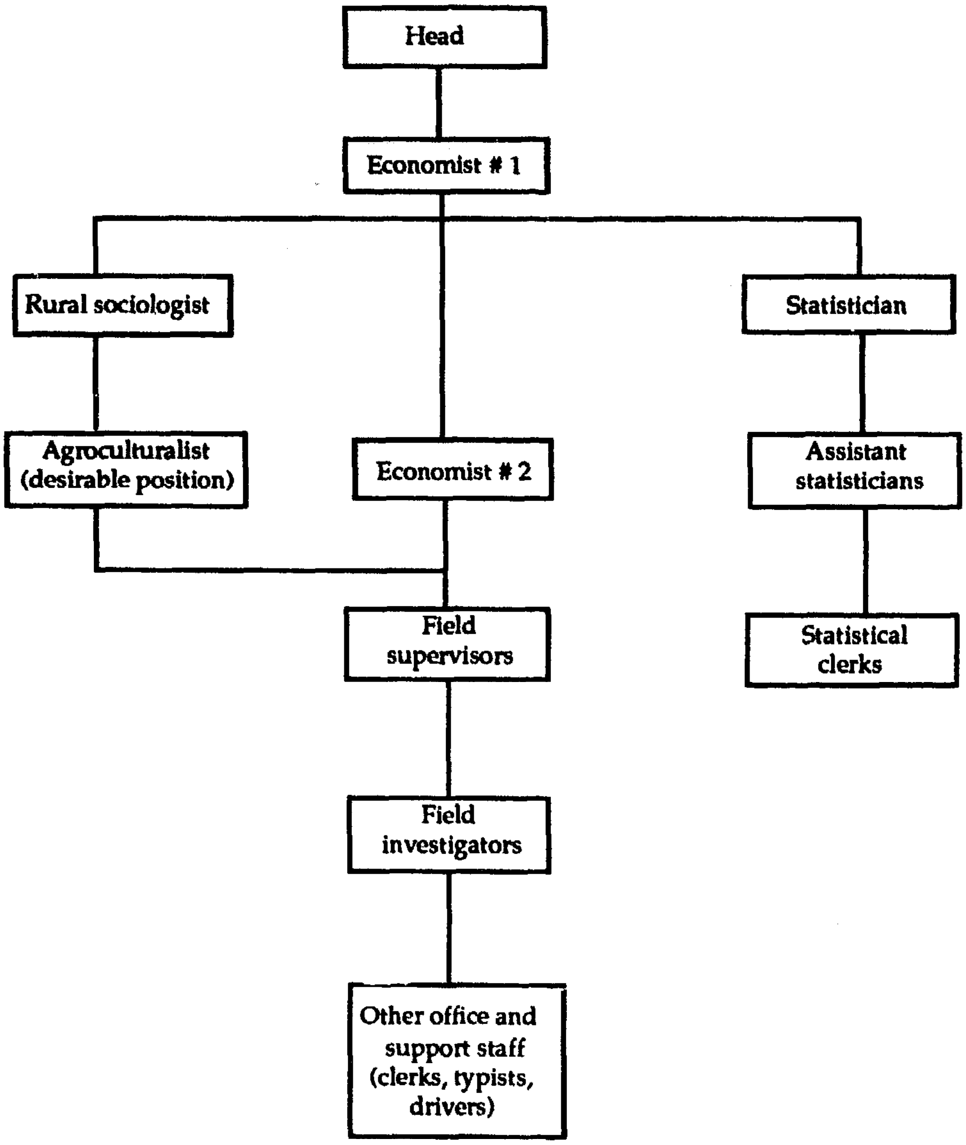
It may well be that isolation was advantageous to the unit while it explored Malawi's wood energy realities and measured the project against these. Assuming that the project's second phase is more in line with local conditions, however, the unit should find itself spending more time on conventional monitoring and evaluation of project variables. At that point, it would be logical to seek a more intimate relationship with project management.

From French (1985). Reprinted with permission from the FAO.

If, however, the MEU is expected to collect and analyze a full range of data on the program's physical and financial progress and to provide, for example, regular and systematic information on seedling survival and other physical measures and the responses of rural people to program initiatives, experience suggests that the unit should be staffed and organized along the lines indicated in figure 12.1, when the social forestry program is at full development. Obviously, this is an ideal arrangement that must be tailored to the scale of operations. If the MEU's work program is developed and implemented gradually, this organization can be built up in phases (see Slade and Campbell 1987).

Consistent with the underlying concept of social forestry, the staff structure in figure 12.1 depends greatly on economists and sociologists, which forestry departments do not usually employ. However, such staff should also have a technical background in forestry. Finding suitable people willing to be trained in these disciplines and in M&E may take a long time. Alternatively, the forest department may be able to obtain suitable, experienced social scientists from other departments or organizations or to employ them on a contract basis for a period of years. Should the forest department exercise either of these options, it should treat such occasions as opportunities to send their own technical staff to training courses in M&E. Working with career staff is important because M&E requires staff continuity (see Hyman 1985). In addition, dependence on departmental staff preserves promotion opportunities.

Figure 12.1 Structure of a "Mature" Monitoring and Evaluation Unit



Staff, of course, are not the only resource required. The MEU must have sufficient office space and suitable equipment for both field and office work. The unit must have an adequate operating budget to cover transport costs, printing costs, stationery, and repairs to vehicles and equipment. Inadequate provision of these items will hamper the unit's operations and thus impair its credibility.

A special word on transport is warranted because support operations such as M&E often find themselves without adequate or timely transport. In M&E for social forestry, where field work generally encompasses a large area efficient and timely work is impossible if transport facilities are inadequate. Thus, it is vital that field supervisors and field investigators be provided with their own transport. Motorcycles are often satisfactory. This, however, is not enough to ensure high quality M&E work. Higher level staff (those usually stationed at headquarters) must visit all field staff frequently to gain firsthand knowledge of the work done by junior staff and of field conditions. This is essential if senior staff members are to interpret field data in a manner useful to management.

The cost of providing these resources will vary according to the intensity of the M&E effort and the cost structure of the country involved. In India, for example, the capital costs in 1986 prices of a fully equipped MEU, excluding the cost of office space and the purchase of computers, are about US$45,000, and the annual recurrent cost is about US$70,000. In a project with a total cost in 1986 prices equivalent to about US$25 million over five years, the total cost of the MEU would be around 1 percent of project costs. Given the inherent economies of scale in M&E, this might well fall to 0.5 percent in a project with total costs of US$100 million, and would be greater than 1 percent in small projects costing less than US$10 million.

Managing Monitoring and Evaluation for Effective Results

Even if the requisite resources—manpower, machines, and equipment—are provided and deployed, M&E will not be effective unless all involved refuse to be diverted to other tasks. Each year, MEU personnel and management must draw up a detailed plan of action for the MEU and execute it diligently. Early slippage will not only become cumulative, but compounded, to the point where the M&E system becomes unmanageable. The most straightforward mechanism for dealing with this problem is the careful construction of a work program. This can be accomplished by preparing simple bar charts. The value of such charts cannot be overemphasized. They require right at the outset that a clear decision be made about which main tasks are to be undertaken and when. Once this has been settled, each main activity and all related subactivities must be listed and the time needed for their execution estimated. With this list, identifying activities that are critical (in the sense that other activities depend on their completion) is easy. The resulting list of critical activities must then be ordered in correct sequence on the bar chart. Noncritical activities must be fitted in so that they support and do not hinder the completion of the main elements (see Slade and Campbell 1986).

If the MEU follows the operating mode suggested, it will have done much to avoid the problems that often afflict monitoring and evaluation. For example, some MEUs collect too much or too little data, with the result that management's questions cannot be answered or the answers are delayed because of data processing and analysis problems. Frequently MEUs launch sample surveys without carefully considering their purpose or how they will analyze and present the data. All too often they ignore the rigorous requirements imposed by the theory of sampling and make no efforts to estimate sampling errors or to limit nonsampling error arising from poor staff training and field work (see Hyman 1985). Often, reporting is also inadequate. Reports are too long, crammed with description, lacking in analysis, or contain poorly focused analysis based on the use of wrong or inappropriate techniques. The MEU must be alert to these problems and take thoughtful, well-organized steps to eliminate them. In principle, the MEU should be a model of efficient management and organization within its own domain. Slade and Campbell (1987) review these matters more extensively and provide detailed guidance on how to design and implement an efficient monitoring and evaluation system for social forestry.

The Utility of Monitoring and Evaluation

If the above precepts for effective monitoring and evaluation are followed faithfully, what, a manager might ask, will be gained? This question could be answered by prescriptions about timely information flows and better decisionmaking and other generalities that, although true, often seem unconvincing. Describing some selected results of M&E is probably the most useful response.

Before proceeding, two caveats are necessary. The first is that social forestry is relatively new and that monitoring and evaluation of it is even newer. Hence, information covering a number of years, which is of particular value in long-term projects and programs, is not yet available. The second is that the utility of M&E is, in principle, limited only by the imagination of the evaluator in responding to management's need for information. In practice, the dearth of skilled practitioners and the general absence of computerized data processing both constrain the implementation of the evaluator's ambitions.

In one project, the monitoring of nursery activities revealed that in 1983, 210.9 million seedlings were produced and 195.7 million were distributed. Of these, 185.5 million went to private individuals, 4.2 million to government undertakings, and 5.7 million to other organizations. The seedlings distributed to farmers were allocated as follows:

Size of landholding (ha)	Holding in project area (%)	Seedling recipients (no.)	(%)	Seedling distributed (millions)	(%)	Average seedlings per recipient (no.)
0.1-2.0	44	76,198	67	65.6	43	861
2.1-4.0	24	22,746	20	50.3	33	2,211
4.1 or more	32	14,784	13	36.6	24	2,476
Total	100	113,728	100	152.5	100	1,341

These data clearly show that the bulk of recipients were those with the smallest landholdings, but that their share of the total seedlings distributed was barely proportional to their share in the total population. Moreover, the project had a rule that no one recipient should be allocated more than 1,500 seedlings. Although on average this ceiling was not breached, most of the recipients with more than 2.1 hectares of land were allocated many more than 1,500 seedlings. As a result of these findings, the maximum seedling allocation and the procedures for distributing seedlings were reexamined and revised. The collection and analysis of similar data in subsequent years has provided a continuing check on whether the new system is operating as designed.

In another project, as part of a farm forestry sample survey, evidence was collected from farmers on whether they had received advice on tree husbandry when they collected their seedlings from the nursery. The results revealed that despite the requirements that all farmers be advised on such matters as species choice, pit preparation, fertilizer use, spacing, watering, weeding, and pest control, they received advice very unevenly. For example, while most were instructed in pit preparation, just over a third were advised about weeding. This led to greater emphasis on the training of nursery staff and on ways to improve the advice given to farmers. This included stepping up visits to farmers on their farms after they had taken delivery of seedlings.

In another project, a sample survey provided clear evidence that, contrary to many popular claims, only a few farmers were planting trees on arable land and thus displacing other crops. The results were as follows:

Percentage of Farmers Planting Seedlings in Different Locations

Location	Year trees planted 1982-83	1983-84	1984-85
Previously fallow land	51.7	37.1	32.9
Previously cropped land[a]	6.9	8.4	7.1
Bunds, boundaries	41.3	38.8	42.3
Homestead, houselots	5.7	16.3	19.4
Total[b]	105.6	100.6	101.7

a. For the three years shown, the average area displaced, in chronological order, was 0.14, 0.04, and 0.02 hectares.

b. Totals exceed 100 percent because some farmers planted trees in more than one place.

In the same survey, information was collected from farmers on whether the seedlings they required were available at the nursery. The percentage of farmers reporting that all species required were available ranged from 21 percent in 1982-83, to 50 percent in 1983-85, and 39 percent in 1984-85.

Subsequent questions in the survey established not only which species farmers wanted, but also the probable quantities of each species that they intended to plant the following year. Thus, management had useful information with which to plan the next year's nursery production program. To conclude, box 12.4 summarizes a selection of results from a project in Nepal.

Information, deductions, and the stimulation of action are the central ingredients of monitoring and evaluation for project or program implementation. However, project organizers must not forget the more evaluative and reflective role of M&E. It should aim, in the long run, to improve the understanding of what motivates farmers to plant trees; provide estimates of the increment (in terms of wood and other products) to production; and answer questions about other fundamental matters, for example, the determinants of seedling survival for different species under different agroclimatic and edaphic circumstances. Above all, M&E must focus on the size and distribution of costs and benefits (see Hyman 1985). Hence, an M&E system should always strive to acquire reliable information that can be used not only to address shorter-term, essentially operational, questions, but also to address long-term evaluative issues.

Monitoring and Evaluation and Computers

Nowadays, the use of computers for data processing and analysis is almost axiomatic. Current trends suggest that microcomputers are appropriate. Increasingly, they are being deployed to process data from M&E studies. Their versatility is expanding rapidly as their power increases and the range of prepackaged software continues to grow. Nevertheless, computerization is not a panacea, and managers should be aware of the issues involved.

First, in 1986 prices, a suitable system is likely to cost about US$3,000 to 5,000 for the hardware alone; proper housing (particularly air conditioning) and protective devices, regular maintenance, software, and special stationery will add significantly to both the capital and annual recurrent budget. Nevertheless, the costs are small compared to the budgets of many MEUs.

Second, without clearly defining the work that the computer will do and identifying the need for the increased data that it will help to produce, obtaining a computer is pointless.

Third, although the use of computers unquestionably enhances the range and complexity of data analysis (box 12.5), it is not always faster than older and much tried methods. In any system poor data will produce poor (invalid) results, but with electronic data processing, data must be carefully cleaned of errors (validated) and properly structured before analysts can use it profitably. Computers place a high premium on data quality. Hence, the application of well-conceived data collection procedures in the field and elsewhere is of primary importance.

Finally, dependence on computers may result in major delays and disruptions when they break down (as surely they will), and speedy repair is often not possible. Hence, a backup system is advisable.

The importance of these drawbacks, however, is gradually diminishing, and computers, especially microcomputers, do offer major advantages in the storage, retrieval, and analysis of M&E data. Once installed and working they allow easy comparison of current data with that of previous years and the creation of timely, highly focused reports in response to management queries. They also greatly reduce the tedium of mundane calculations and permit the application of more advanced analytical methods. They can also greatly speed up analysis and, therefore, report preparation.

Finally, the use of computers need not be confined to MEU data collection and analysis. These machines have a role to play in improving the handling of data for many aspects of social forestry programs, from accounting and inventory control to report writing. They provide an additional avenue for promoting the integration of monitoring with management: the very foundation of good monitoring and evaluation.

Box 12.4 Examples of Monitoring and Evaluation Findings and Results: Nepal

M&E finding: Annual targets for private planting set during appraisal were considerably exceeded in the field. *Source:* annual monitoring reports.

Corrective action: The target and budget for seedling distribution were greatly expanded.

M&E finding: While targets for panchayat forest planting were being exceeded, those for enrichment planting in panchayat protected forest were not met and, in the opinion of field workers, such targets were often not necessary. *Source:* annual monitoring reports and annual meetings.

Corrective action: The target and budgets for panchayat forest and panchayat protected forest plantations were combined to allow for more of the former and fewer of the latter in those districts with larger areas available for panchayat forest planting.

M&E finding: The demand for and rate of use of improved stoves was high, but early models suffered from cracks, particularly on the front lip, and could not accommodate cooking pots of different sizes. They were also poorly maintained. *Source:* stove use survey.

Corrective action: The rapid expansion of the program was continued, but the number of districts covered was limited. The stove was redesigned to strengthen the front lip and improve installation. A layer of mud was added to the top of the stove to increase strength and accommodate a larger array of pots. A wall chart and illustrations in the distribution register were developed to show proper installation and maintenance methods.

M&E finding: Knowledge of the availability of free tree seedlings among villagers was confined to only half the panchayat's population after two years of operation. *Source:* socioeconomic household survey.

Corrective action: A signboard was designed to highlight the availability of free seedlings to all. An intensive radio campaign was launched during the planting season, and large numbers of wall posters were distributed to increase awareness.

M&E finding: Knowledge of the provisions regarding the community's ownership of forest resources in panchayat forests and panchayat protected forests was low after two years of the project. *Source:* socioeconomic household survey.

Corrective action: Additional publicity materials explaining these provisions were developed, and community forestry assistants were trained to use them. Project organizers decided to encourage the organization of forest committees in each panchayat and among smaller groups of users where necessary.

M&E finding: The most significant cause of seedling mortality in panchayat forest plantations was the small size of seedlings at the time of planting. *Source:* plantation survival survey.

Corrective action: Project organizers devised a planning document for nursery operations and trained community forestry assistants in its use to improve operations. They mounted a national effort to remove the hurdles that resulted in delayed release of the budget so that operations could be started in time in the fall.

M&E finding: Among the exotic species tried in field locations, *Pinus patula* showed high survival rates between 1,500 and 2,000 meters, but the *Eucalyptus*, *Robina*, and *Leucaena* species had very low survival rates under most conditions. *Source:* plantation survival survey.

Corrective action: *P. patula* seeds continued to be supplied for planting at this altitude, but the amount of seeds of the other species was curtailed and confined to certain districts.

M&E finding: The preparation of management plans for panchayat forest and panchayat protected forest was very slow. *Source:* monitoring reports.

Corrective action: Targets for plan preparation were included in the annual district work plans and budgets.

M&E finding: Many nurseries were not meeting the private demand for the most desirable fodder species because of the high cost and difficulty of seed collection. *Sources:* participatory evaluation, field visits, annual meeting, socioeconomic household survey, monitoring reports.

Corrective action: A separate budget line item for collection of fodder tree seeds from private farmers was established for each district. An annual calendar with a reminder of which species are to be collected and sown that month was designed and distributed to all field staff, nursery foremen, and forest committee chairmen.

M&E finding: Most of the mortality of seedlings planted privately was because farmers lacked sufficient knowledge of planting techniques and seedling care. *Source:* private planting survey.

Corrective action: An extension pamphlet on planting methods was prepared and distributed to seedling takers. Pictures of these methods were included in new distribution registers. Nursery foremen were given additional training in the importance of this subject.

From Bhattarai and Campbell (1985).

Box 12.5 Microcomputers and Monitoring and Evaluation: Nepal

Data processing and analysis has been conducted entirely by the staff associated with the M&E unit .... Given this limited manpower, and the other demands on our time, we have had to develop relatively efficient systems for data processing and analysis, which rely heavily on the use of a small microcomputer ....

Monitoring ... data on project outputs is maintained in both written, graphic and electronic media forms. As data are received from the field through monthly, trimesterly, and annual monitoring reports, details regarding the targets achieved are recorded in a set of registers maintained by the Unit Chief and then passed on to the computer operator for filing until the time for the annual report is due.... At the end of the fiscal year, targets and achievements are entered into the financial spreadsheet computer program for printing and calculating various totals and ratios of achievements. From this software program, the data are also transferred to a graphing program ... which outputs various types of graphs to illustrate progress.

The greatest benefit from using the microcomputer has been the processing and analysis of the annual on-going evaluation surveys, the baseline survey, and other one-time surveys. Data entry and simple tabulations which would otherwise take three to four man months of hand tabulation ... can be accomplished by the single computer operator/tabulator in one or two weeks with considerably greater accuracy. Part of this efficiency was gained by our learning to develop a pre-coded survey form designed for direct entry via the computer keyboard, thus eliminating ... intermediate step(s)....

The use of the statistical software programs for ... analysis ... has made possible a much more rapid and sophisticated level of understanding of the data.... At the simplest level, a custom package permits two-way cross-tabulation of variables to produce pre-formatted tables with percentage, mean and chi-square values.... Using a much more comprehensive commercial software package ... a large number of statistical tests can be interactively performed. This package has been heavily used for multiple linear regression analysis.... One of the most useful applications of this method has been to estimate the relative contribution of different causes for seedling mortality....

Even if a general statistical program were available on the recently installed large national computer, it is evident that the increase in cost, loss of flexibility, and competition for time that use of this system would entail, would far outweigh the advantages achieved by (using the) ... microcomputer.... The total cost of this system including software, supplies, and repairs over the three years of its operation has been roughly US$7,500.

From French (1985). Reprinted with permission from the FAO.

Sample Surveys

Much of the MEU's work will be estimating achievements in individual communities and communities' responses to program interventions. Because farmers and villages are geographically dispersed and very numerous, the MEU cannot study each one. Hence, systematic study requires the use of sample surveys that permit rigorous inferences about the population with a predetermined (or calculable) level of precision. Although sampling is a formal technique of investigation based on a large body of statistical theory, the design and selection of samples does not have to be complex, time consuming, or expensive. It is not essential for samples to be large in order to make valid inferences about the population from which they are drawn, nor does their size depend on the size of the population. A common, but quite erroneous, belief in that a sample must cover some prespecified proportion of the population. Put simply, the size of a sample depends on the variation in the population of the characteristic being studied and the level of confidence (precision) required in the results. These issues are comprehensively treated in most statistical textbooks. Moreover, Casley and Kumar (1987) provide a straightforward but general account of sampling in monitoring and evaluation, while Slade and Campbell (1987) give detailed guidance on how to design and execute sample surveys for social forestry.

The level of precision for a given sample survey will not normally be the same for all variables of interest. Survey designers and analysts, therefore, usually find it convenient to identify a key characteristic in the population and to design the sample to yield an acceptable estimate of the mean value of this characteristic, and to subsequently (after collecting the data) calculate the precision with which the survey measured this and other characteristics. In the case of farm forestry, a major component of most social forestry programs, the characteristic that might be of greatest interest is seedling survival rates. This is because seedling survival depends not only on the robustness of the planting material, but also on the quality of farmers' tree husbandry. In farm forestry, survival rates are thus a good measure of the interaction of farmers and their trees and a plausible indicator of the program's likely future success. MEUs need not confine sampling to the study of farm forestry, however, as they can easily apply it to research on many other components of the program, for example, village or community woodlots.

The main point to remember is that all surveys should have specific data collection objectives, and the questionnaire to be used should consist only of relevant questions. Often, however, many questions are relevant but cannot be included if the time for survey field work is limited, respondents are not to be alienated, and the information collected is to be speedily and easily processed. Hence, the designers of sample surveys must select questions carefully.

Questionnaires should always be fully translated (with the possible exception of instructions to investigators) into the spoken version of the relevant local language. This should be a careful translation during which the designer (question formulator) and translator maintain a constant dialogue. The translation must be a colloquial one, understandable when read to illiterate villagers. See Slade and Campbell (1987) for examples of questionnaires designed specifically for social forestry sample surveys.

The Role of Special Studies

Although computers can bestow major benefits, and sample surveys are an efficient method of collecting data, MEUs should avoid undue concentration on these methods. Such techniques are inappropriate if a speedy, less formal answer to a problem is sought. A more useful approach in this context is to undertake a special study, sometimes called a diagnostic study.

The staff and managers of MEUs should not view special studies as superficial adjuncts to the MEU's work program, but should treat them as highly flexible, versatile tools. They can use them to respond to particular questions posed by management, to gain deeper insight into a specific problem, or to address issues that lie outside the domain of routine monitoring. The studies may be small, quick, and specific or larger, longer, and more refined. In general, the best approach is for the MEU itself to conduct special studies that are small in scale and short in duration. More ambitious undertakings should be contracted out to qualified institutions or individuals.

Special studies undertaken by the MEU should not disrupt its essential work program. That program should be flexible, and fitting special investigations into slacker periods should not be difficult. Moreover, they should only be undertaken in response to either clearly articulated requests from management or demonstrable gaps in knowledge identified by the unit itself. Such studies should also be carefully designed and planned. In addition, within the unit, responsibility for each study should be clearly allocated. Such accountability tends to encourage interest and enhance productivity among the staff working on the study.

The unit should adopt a different approach to studies commissioned from outside individuals or institutions. The MEU should use outsiders for work for which the unit lacks the resources and specialized skills. This does not, however, imply that the unit is absolved from responsibility for such studies. On the contrary, it should be actively involved in designing and planning them, monitoring their progress, and providing overall management. Ultimately, the unit must be responsible for the results.

Good special studies depend on the use of informal investigation techniques, such as key informants, group meetings, and participant observation. Sociologists are more familiar with these methods than economists or statisticians, hence, the presence of a sociologist on the MEU's staff is likely to greatly aid the conduct of these studies. Examples of topics investigated using special studies include why farmers prefer certain species, the effectiveness of different extension methods, or the sociology of group activities.

Summing Up

Social forestry is a dynamic process that will continue to raise new issues. Those carrying out monitoring and evaluation (M&E) activities should respond to this process by being alert, disciplined, technically competent, and above all, flexible.

M&E should be regarded as an essential part of good management. The functions of a monitoring and evaluation unit (MEU) should be to help management set targets and develop criteria for judging the progress of projects or programs; to collect and collate information from existing records for use in program evaluation; and to undertake, on an *ad hoc* basis, inquiries and special studies to solve problems specified by management.

The main elements of M&E include development of

- efficient reporting procedures needed by management for various activities associated with tree nursery development, farm forestry, community woodlot management, and other functions included in a program;
- sample surveys and special (diagnostic) studies related to the resolution of various policy and program issues.

The ground rules for successful implementation of social forestry M&E by units assigned these tasks are the following:

- to be receptive to management's information requirements;
- to establish with management an agreed reporting timetable;
- to obtain the necessary data in a timely manner;
- to carry out practical, understandable assessments of data;
- to present results objectively in accordance with agreed criteria;
- to discuss results with program management and make recommendations where appropriate;
- to be responsive to changing needs of management.

If MEUs follow these ground rules, they can provide an invaluable service to program managers.

13

EDUCATION AND TRAINING

As previous chapters indicate, much of the technology and biological knowledge used in social forestry is also used in other types of forestry. However, social foresters—administrators, managers, planners, extension agents—also have to deal with a number of factors that foresters who work primarily with industrial-commercial forestry, forest protection, conservation, and management of public forests are not familiar with and do not normally deal with. Among other things, social foresters generally have to deal directly and continuously with local villagers and farmers, and must work with them in a supportive way rather than in the role of police officers guarding the forests. The educational programs developed for social forestry must reflect these differences, both at the formal professional level and in training programs for technical and managerial people working in the field. Also, information about the costs and benefits of social forestry must reach policymakers at the national and sectoral levels.

The term *education* is used here to mean a general provision of knowledge that is needed to understand the various dimensions of social forestry, whereas training focuses more narrowly on teaching specific functions and skills, to those who will be, or already are, working with social forestry programs. This chapter reviews the types of people that need training and education related to social forestry programs, and what kind of information they need. Its final section suggests ideas on approaches to formal education and training dealing with social forestry.

Who Needs to Know What?

All participants in social forestry programs need some training or education to deal effectively with their responsibilities. Table 13.1 summarizes the general types of knowledge and information that those involved in social forestry need, ranging from the policymakers and politicians who develop the strategies that guide social forestry programs, to the farmers who undertake and benefit from social forestry activity. Consider, for example, the needs of different groups with respect to wood energy. Politicians should have a general appreciation of its relative importance and its potential and the constraints that exist on realizing that potential. Energy sector planners need specific knowledge of the magnitudes of the needs and supply potentials that exist in the country so they can develop sector strategies. Sector- and project-level planners and administrators need detailed information about the needs, constraints, and so on, in their specific project region or area. Local community leaders need to know whether the situation in their community is serious or not, but they generally do not need to have detailed information unless they are going to take an active part in program or project management. Field staff, in addition to requiring a good knowledge of the resources and people in their areas, need specific skills. Individual farmers need very specific information about how to meet their needs and how best to participate in social forestry programs.

The first four types of information listed in table 13.1 are combined under the heading of **background information.** They are needed to identify appropriate social forestry policies, strategies, and programs. First, actors and users need to understand the **potential benefits** forthcoming from social forestry and the **linkages with other sectors.** For policymakers and senior planners and administrators, a general appreciation of benefits and linkages such as provided in chapters 1 through 5 will suffice. Project planners need much more location-specific information.

Second, actors and users must understand the community and national needs for social **forestry-related outputs** and activities before they can formulate objectives. The third category is related to the **constraints to meeting identified social forestry needs**. Such constraints can often be identified and understood only in a broader, rural, social and economic context. For this reason, social forestry training should emphasize rural sociology, economics, and cultural anthropology. Finally, actors and users need background information on the **resource and technology requirements** to overcome constraints so that needs can be met. In other words: What techniques can be used? What can research and development contribute to these? How do future land and labor requirements compare to current ones? What level of funding do the organizations involved require?

Table 13.1 Who Needs to Know What about Social Forestry: Types of Information and Knowledge

	Background information on								
Actors or users	*Benefits and linkages*	*Needs*	*Constraints*	*Technology and resource require-ments*	*Techniques of social forestry planning*	*Project design, evaluation, and appraisal methods*	*Technical options*	*Project manage-ment and organi-zation*	*Field techniques*
Politicians and policymakers	A	A	A	A	—	—	—	—	—
Macro-level planners	A	A	A	A	A	—	—	—	—
Sector-level planners and administrators	S	S	S	S	S	S	A	—	—
Project-level planners and administrators	LS	LS	LS	LS	S	LS	S	LS	LS
Field-level staff	LS	LS	LS	LS	—	—	LS	LA	LS
Local leaders and NGOs	LA	LA	LA	LA	—	LS	LS	LS	LS
Farmers and other participants	LS	LS	LS	LS	—	LS	LS	—	LS

— = not required

Key:
A = general appreciation
S = specific knowledge
LS = local specific knowledge
LA = local general appreciation

To generate, analyze, and interpret the background information, people have to be trained in the **techniques of social forestry planning**. Specifically, they need to know about the tools required, the appropriate statistical/analytical approaches, the survey and sampling methods best suited for social forestry, and so forth.

Information on project design, evaluation, and appraisal methods is important for a number of those involved in social forestry, but to differing levels of sophistication and detail. For example, through extension or training, farmers can learn some very elementary yet useful ways to assess the advantages of alternative uses of their land. At a completely different level, sector-level planners need to understand the basic methods of project design, appraisal, and evaluation. As with the other types of information discussed, much of the knowledge required is general to forestry and is required for any kind of forestry project, but differences in emphasis are needed in social forestry training programs. For example, as discussed in chapter 6, the designer or appraiser of a social forestry project is more likely to need skills related to the assessment of nonmarket values and the design of incentive systems for local populations. Similarly, identification of nontechnical constraints that must be overcome or considered in project design and assessment is much more important in social forestry than in commercial forestry. Therefore, education and training programs related to project design, appraisal, and evaluation should give these topics correspondingly greater emphasis.

The **technical options** column in table 13.1 embraces an array of topics related to the general body of technical knowledge about growing and managing trees. Because much of social forestry involves integrating tree crops with other crops, as well as livestock, actors and users need information related to agroforestry and farming systems, as discussed in chapter 3. Much of the focus of social forestry extension programs is also on transferring technical options to local farmers. In addition, this category should include market information on products, prices, and outlets.

As discussed in chapter 11, social forestry projects require a different form of **management and organization** than conventional, commercial forestry projects because of the large number of participants involved, the feedback mechanism to ensure their continuing participation, and the likely involvement of several agencies. For example, the use of NGOs is becoming more prevalent in social forestry projects. Education and training programs need to pay special attention to alternative organization structures and management techniques.

The heading **field techniques** covers a wide variety of knowledge and information that should be included in training and extension programs for social foresters. Subjects include planting and tree-management practices, field sampling, mensuration and soil analysis techniques, and extension techniques. These techniques are generally transferred to field personnel through in-service training programs (workshops and short courses). The field personnel in turn transfer the appropriate techniques to farmers and other participants through various extension methods. Participants in turn may transfer the techniques to fellow land users by informal means. Several good manuals are available on relevant training techniques for field personnel (see FAO 1986a, 1986b; Buck 1987; and references cited therein).

These nine categories cover the main types of knowledge and information needed for social forestry. As mentioned earlier, much of the required information and knowledge is provided in traditional forestry education and training programs. Yet, much of it will be new and will have to be incorporated into programs that are unique to social forestry.

Organizing Education and Training Programs

Building up training and education for social forestry will place an added strain on public resources. To conserve resources and avoid waste, training organizers need well-prepared assessments that provide sufficient information on which to make decisions to commit manpower, funds, and other resources to education and training programs. For formal education, a review of existing curricula in forestry, agriculture, natural resource planning, and energy will indicate where social forestry topics can be introduced to provide more balance. For training those who will be employed directly in social forestry programs, the preparation of a manpower development plan is a recommended first step, followed by a training needs assessment, and then design of specific training programs.

Educational institutions

A number of universities are adding social forestry to their regular forestry programs, recognizing that the core courses are as relevant for social forestry as for industrial, urban, or other types of forestry specializations. However, only a few institutions have a good track record and a proven curriculum. The oldest and best established social forestry curricula are found in Indian schools. The Philippines and other countries also have programs. For example, Thailand has developed a social forestry curriculum at Kesetsart University with the support of the FAO; the Oxford Forestry Institute in the United Kingdom offers short courses that include social forestry as a theme; and the EDI offers social forestry courses. Also, many governments—often with the support of international donor agencies—offer special short courses.

Programs

Since the educational requirements for a well-rounded social forestry program have not yet been established and adequately tested, a model curriculum or syllabus cannot be set down. However, appendix 13.1 contains a model curriculum designed for India as an illustration of what might be included.

Training should emphasize that the new social forestry orientation is the result of political and policy changes and does not reflect on the past performance of traditional forestry personnel. Also, stressing social and institutional issues in programs is as important as stressing technical issues. The general objective of training programs is manpower development to perform specific functions. Thus, a manpower development plan is needed to identify specific training requirements.

MANPOWER DEVELOPMENT PLANS. A manpower development plan specifies the types of jobs to be filled and the number of people needed in each job; provides standards for each type of job in terms of skill and knowledge requirements; determines general training needs to ensure that skills are adequate; determines specific training needs for existing staff; and establishes standards for judging the level of skills of entrants into specific jobs (for example, managers, researchers, technicians, extension workers, and skilled and unskilled laborers).

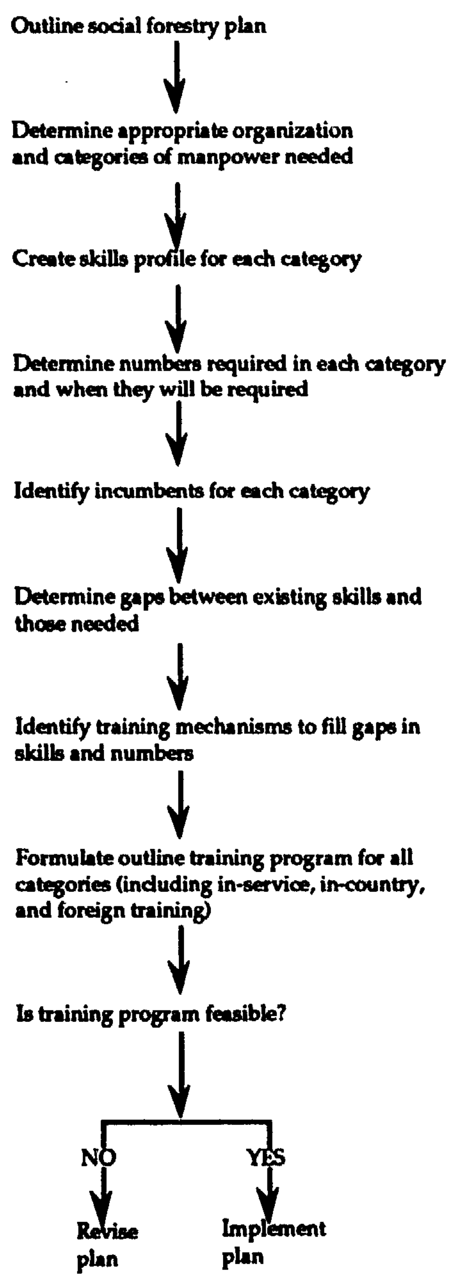
In essence, the manpower development plan shows the estimated types and numbers of persons needed each year for a program. The first task is to identify categories of manpower requirements and then to build up a skills profile for each category. The second task is to estimate the number of persons required in each category and the phasing of their appointments. The third task is to analyze likely skills gaps (figure 13.1). Developing a skills profile is a critical element. In many cases, the skills will be similar to those required for existing jobs in agriculture, forestry, or industry. Thus, these other jobs can provide insights for the newer jobs in social forestry.

TRAINING PLANS. With the manpower development plan in hand, administrators and training specialists can develop a practical training plan that outlines the types of training components needed and the magnitude of the training needs over time. The training plan involves the difficult task of assessing the gap between the level of skills the existing staff possess (and those being recruited) and the desired level of skills. This assessment is needed for budget purposes and to decide on what type of program to establish; for example, conducting training in schools, organizing an *ad hoc* program of short courses on an intermittent basis, or using a combination of both. Consideration will also have to be given to continuing education and retraining programs for existing forestry staff; social forestry training for agricultural workers, including agricultural extension agents if they are to extend social forestry technology and methods through agricultural extension channels; and training needs for key local community officials and staff.

The next step in developing a social forestry training plan is to determine the supply of teaching and training facilities, their capacities, and their qualities. This is particularly important because there can be a significant trade-off between program quality and the time needed to impart skills. This question of quality can be particularly important for social forestry, since many of the skills involve sociological and psychological insights and methods of applying them, and teaching such topics involves developing attitudes more than memorizing facts and techniques.

Since social forestry is new as a formal subject in most countries, several options are available, namely, to develop new capacity (as Thailand is doing); to send key staff overseas for training, for example, to short courses like those the Oxford Forestry Institute, EDI, FAO, and other international groups offer; to hire expatriates with the prerequisite skills who can then train local people; or to obtain the services through programs such as the U.S. Peace Corps or development NGOs. In the long run, local training facilities are desirable, particularly for specific training needs. Overseas training—either in short courses or in universities—is mainly relevant for those in higher positions who need basic education rather than hands-on training in specific social forestry-related tasks. Among other things, the cost of overseas training is high and will thus have to be limited to a few persons in most cases.

Figure 13.1 Stages of a Manpower Development Plan



Training methods include field workshops, seminars, degree and certificate courses, and undergraduate and graduate-level university education. The particular needs for effective social forestry relate more to sociology, psychology, household economics, and agroforestry techniques than is the case in traditional forestry programs. Specific topics of interest include tenure rights, common property management, rural economics, and technology transfer and diffusion (see appendix 13.1).

Summing Up

A number of different types of people will be involved in social forestry programs, from politicians and policymakers to individual farmers or landowners. Each have different roles to play and thus have somewhat different needs in terms of information to help carry out their tasks.

To be effective, education and training programs for social forestry must address all the different information needs in ways that suit the types of people needing the information. In this regard, a distinction was drawn between two general forms of information transfer: education and training. Education was described as a general learning process, quite often associated with formal schooling. Training was characterized as a more narrow process of teaching specific functions and skills needed by persons who are working directly in social forestry-related activities.

Much of the training and education needed for social forestry work is the same as is required for any kind of forestry activity, yet, many areas of information are different. For example, social foresters must be familiar with farming systems, agriculture, and agroforestry; they need to understand sociological concepts that will help them work better with local communities; and they need to understand rural organization and incentive systems.

There are only a few formal social forestry education programs in colleges and universities, although a number of programs are in the initiation stages, however, quite a few countries and international organizations provide training in social forestry-related subjects. Their short courses cover topics such as social forestry project planning techniques, agroforestry, and rural organization.

A manpower development plan is a useful tool to identify the types of skills needed and the numbers of persons that need to be trained in a country. This can be linked to a training plan that specifies investment needed in training facilities and trainers and a reasonable timetable for training activities. Training methods can include workshops, short courses, and various other activities.

Appendix 13.1 Outline of Training Requirements and Suggested Curriculum for Forest Rangers, Foresters, and Forest Extension Workers Employed in Social Forestry: India

The substantial change in job content of staff involved in social forestry calls for a restructuring of preposting training provided by the Social Forestry Department (SFD). It is recommended that ranger training be restructured by first providing basic forestry sciences and skills required by rangers in all fields of SFD work, then be supplemented by specialist training in social forestry, wildlife, traditional forestry, and so on according to the individual ranger's posting. Staff subsequently transferring or moving from one specialized field to another would be required to take the appropriate specialized course prior to transfer.

The lower the level of training, the easier it is to make training specific to the job required. Therefore, one can plan training for foresters and forest extension workers in accordance with the needs of specific social forestry programs. The best of the staff in each category will qualify for promotion, and foresters who have received initial training for social forestry work and are promoted to ranger level should receive appropriate training.

The following topics are suggested for inclusion in ranger, forester, and forest extension worker training for staff likely to be employed in social forestry programs, though at different depths for the different levels of staff:

- technical aspects of agroforestry,
- farming systems,
- soils and soil fertility,
- rural sociology and village economics,
- communication and extension skills,
- watershed management,
- soil and water conservation and conservation engineering,
- irrigation and drainage,
- government policies in social forestry,
- supervisory and management requirements.

In all cases, some of the training needed can best be given in formal training situations, but much of it—both for existing staff and for new staff—can be best provided by a series of in-field training sessions to supplement the formal training. This is already being done for the separate cadres of social forestry staff that have been established in Maharashtra and West Bengal. The following recommendations take experience in these two states into account, as well as experience elsewhere in India and in other countries.

Social forestry curricula should include the following:

1. Technical Aspects of Agroforestry Combinations

Learning Objectives: Trainees should have a clear idea of the practical options for agroforestry crop considerations in such key areas as choice of species; planting; spacing; direct sowing versus traditional pot planting; and management methods for obtaining maximum yields of fodder, fuelwood, and poles.

Curriculum Content:

- definition of most common tree/agriculture/livestock combinations for the particular state;
- quantification of number of trees needed to satisfy domestic needs for fuelwood, fruit, fodder, poles, and other products;
- alternative technical approaches for establishing agroforestry plantations (e.g., direct sowing, close spacing, biomass, block-planting, and boundary planting);

Source: World Bank (1983).

- calculation of optimal seedling rates, spacing, and rotation ages for the above categories;
- management systems for obtaining maximum yields of fuelwood, fodder, pole production (pollarding, coppicing, etc.);
- harvesting systems for agroforestry combinations;
- economics of fuelwood and fodder production;
- field trials (planning, layout, supervising, harvesting, and recording).

2. **Farming Systems**

Learning Objectives: Trainees should be familiar with the requirements and production practices for farm and garden crops, livestock, and natural and improved rangelands and should be able to evaluate field sites in different regions and understand optimum crop and livestock systems for those sites.

Curriculum Content: This should include

- soils and climatic requirements and cultural practices for the common fruit, vegetable, and grain crops of India;
- management of livestock;
- range management;
- farm planning;
- combination forest tree and food crop production systems;
- field trips to observe and discuss various crop and livestock systems;
- farm planning, how to evaluate resources in a rural farming area and develop plans for farming operations, various types of natural and improved range, and identification of common forage plants.

Special emphasis should be placed on how forestry can most effectively contribute to increasing agricultural productivity and meeting fodder needs.

3. **Soil Fertility**

Learning Objectives: Trainees should be familiar with the principles of soil fertility and fertility management and be able to prescribe soil amendments for agricultural and forestry situations.

Curriculum Content:

- plant growth and nutritional requirements;
- basic soil/plant relationships;
- soil and nitrogen fertilizer;
- soil and phosphorus fertilizer;
- soil and potassium, calcium, magnesium, and sodium fertilizers;
- sulphur and microelements;
- use of organic manures;
- manufacture and properties of fertilizers;
- liming;
- soil fertility evaluation;
- soil fertility management;
- role of leguminous trees in contributing to soil fertility;
- techniques for green manuring with fodder and tree crops.

4. **Rural Sociology and Village Economics**

Learning Objectives: Trainees should be able to describe the social structure of rural communities in India in different regions; state influences that can shape particular societies and determine how they operate; understand basic needs concepts and the role of forestry in contributing to those needs; and illustrate positive and negative aspects of natural resource conservation and development in local community development.

Curriculum Content:
- the nature and characteristics of rural social systems in general;
- particular social and ethnic groupings of people in India;
- interactions in rural communities, status, roles, castes, and values;
- culture and religion and its role in shaping societies;
- community health, welfare, and education;
- social and economic power;
- basic needs and cash-earning activities in rural communities;
- creation and distribution of wealth;
- self-sufficiency and interdependence;
- role of natural resources conservation in community development (benefits and problems);
- village leadership, interaction of leaders with social forestry activities, and approaches to involving the whole community in development activities.

5. **Communication and Extension**

Learning Objectives: Trainees should be familiar with extension principles and alternative modes of communication with target audiences, and with basic training approaches. They should be able to identify and diagnose constraints to the adoption of recommended practices; speak with authority and confidence to individuals and groups; organize and run small group meetings and field days; design, prepare, and use an appropriate range of visual display materials; and use available mass media resources to support extension programs.

Curriculum Content:
- principles and practice of extension;
- communication skills, public speaking;
- training techniques, teaching aids;
- group dynamics, committee procedures;
- role of mass media and production techniques for and use of mass media (posters, leaflets, newspaper articles, radio programs, etc.).

6. **Watershed Manaement**

Learning Objectives: Trainees should be able to evaluate a drainage basin and understand the principles behind the preparation of management plans that optimize water yield and quality within the constraints of multiple use.

Curriculum Content:
- institutional and social considerations (water law, regional codes of water use, constraints on ecosystem manipulation, drainage basin treatments);
- water quantity, water conservation and use;
- control of streamflow regime;
- control of water quality;
- the management plan (objectives of management, watershed inventory and analysis, the treatment plan, implementation, and evaluation);
- understanding the factors affecting preparation of management plans for a watershed with mixed forestry and agricultural land uses.

7. **Soil Conservation**

Learning Objectives: Trainees should understand the processes of erosion and sedimentation, India's erosion problems, and the factors that influence evaluation of a drainage basin and be able to design a complete soil and water conservation plan.

Curriculum Content:
- problems of wind and water erosion and sedimentation with particular reference to India;

- physical principles of erosion processes;
- ecosystem factors that affect erosion rate;
- measurement and prediction of erosional soil losses;
- soil and water conservation measures and their design and implementation;
- drainage basin evaluation and development of conservation plans;
- evaluation of erosion hazards, measurement of erosional soil loss (with emphasis on the planning, design, and management aspects of conservation implementation).

8. Soil and Water Conservation Engineering

Learning Objectives: Trainees should understand the factors affecting the design of various structures for soil and water conservation and flood control.

Curriculum Content: simple design, layout and construction of terrace systems, grassed waterways, holding basins, drop control structures, ponds, dams, levees, floodways, etc.

9. Irrigation and Drainage

Learning Objectives: Trainees should understand the principles behind designing irrigation and drainage systems for agriculture and forestry in India.

Curriculum Content:
- water resources for irrigation;
- water transport in the ecosystem;
- chemistry of irrigated soils;
- measurements for irrigation design and control (soil surveys, water status of the soil, evapotranspiration, water status in plants);
- design of irrigation systems for various types of topography;
- crop water requirements and prediction of irrigation needs;
- drainage systems for removal of excess water;
- land evaluation for irrigation;
- measurement of water status of the soil and plants;
- measurement of evapotranspiration;
- design and layout of an irrigation and drainage system;
- estimation of water requirements and irrigation scheduling.

10. Government Policies in Social Forestry

Learning Objectives: Trainees should be fully conversant with government policies relating to social forestry programs, the roles of government staff involved in social forestry work, and the laws relating to trainees' work.

Curriculum Content:
- objectives of social forestry programs and current development plans;
- work relationships in social forestry between different government agencies;
- people/land relationships and customary rights;
- agrarian laws relating to agroforestry;
- role of the commercial sector in social forestry activities.

11. Management and Supervisory Skills

Learning Objectives: Trainees should be fully conversant with their managerial and/or supervisory roles and responsibilities; be able to plan, supervise, and evaluate field programs; and be proficient in supervising and developing subordinate staff.

Curriculum Content:
- job definition, performance evaluation;
- work planning and organization;

- labor management;
- financial and labor records;
- training responsibilities of managers and supervisors;
- monitoring and evaluation, survey methods;
- reporting.

Field Experience in Preposting Training

Practical experience to supplement classroom instruction is very important in the fields of rural sociology and extension. The development of appropriate, supervised field work will be needed in social forestry training at all levels, and it is recommended that formal training of rangers and foresters in social forestry include the following.

Students (individually or in small groups) would live in selected villages to work with the community under the immediate control of the panchayat. Guidance would be provided by district forest offices and their staff, and students would be visited by instructors from their training institute or college during their field assignment. The aims of this practical experience would be to:

- emphasize the need to work with and through the local community in all development projects, and to recognize that to achieve this, a knowledge of their total pattern of life is essential;
- learn about the community's needs and begin to identify ways in which these might be met;
- assist the community in small development projects by physically working with them;
- encourage the young to develop a more positive attitude toward the conservation of resources by undertaking a small, regular teaching commitment in the local school;
- consider the most appropriate extension techniques that might be used in that panchayat and the ways in which cooperation could be fostered between officials of different Government of India departments;
- develop powers of observation to analyze the total natural resources of the panchayat and to identify likely trends (e.g., further deforestation, soil erosion) and needs for collective action.

Evaluation of Field Experience

Analysis and evaluation of field experience is of great value in helping reinforce learning from trainees' experiences. Course curricula should provide time for trainees' to evaluate their field experience and present their conclusions, including lessons learned, mistakes to avoid in the future, and how best to further personal development. Teaching would be by analysis of workbook and reports submitted, oral presentation to fellow students and staff in seminars, and group discussions.

14

RESEARCH TO SUPPORT SOCIAL FORESTRY

For maximum effectiveness, research should be closely linked to extension and education, so that new knowledge, the dissemination of information, and the creation of skills form a network that helps to remove barriers to the progress of social forestry. The key here is that the whole research, extension, and education (RE&E) system should involve a feedback process as farmers, extension agents, and researchers interact to develop productivity-increasing technologies that are acceptable to local people, given their culture and preferences, and are sustainable, given environmental conditions and resource constraints.

Few developing countries have the type of integrated RE&E system that is needed to gain widespread participation in productive social forestry. The Republic of Korea's experience is one case in which a RE&E system has worked in a coordinated fashion to deal with the fuelwood crisis. Local adaptive research has also been combined with education and local community-oriented extension activity in a productive, feedback process in India, Kenya, Malawi, Nepal, and the Philippines, to name a few countries.

Some key elements in these types of integrated systems include

- closely linking social forestry RE&E to agricultural and, in some cases, energy RE&E systems;
- including farmers in the RE&E feedback process (demonstrated to be effective in successful agricultural extension programs);
- involving nonfarmer groups in the process.

This last point is particularly important because the aim of most social forestry projects goes beyond support for tree growing by established farmers. The RE&E system must consider the problems of, and opportunities for, the landless, often a significant proportion of a rural community's population with their own tree-related needs.

Several factors help to shape the direction in which the social forestry RE&E system should proceed. The first, stressed throughout this book, is that social forestry involves rural people managing existing forest or planting and tending trees. Thus, understanding the existing socioeconomic situation and technical constraints of target populations is a prerequisite to moving into field operation activities (see chapters 7 and 8). The RE&E system should help to develop and disseminate this understanding.

A second factor is that the largest number of participants in social forestry generally will be farmers. In many countries, substantial investments already have been made in agricultural research to help farmers improve agricultural production. The challenge now is to extend this work to social forestry and coordinate it with the successful, ongoing programs for agricultural development.

This chapter reviews the overall research priorities for social forestry, distinguishing between short- and long-term research, and keeping in mind the priorities of different countries and the constraints on trained manpower and other resources. The benefits of international research networks, twinning arrangements with external agencies, and linkages with farming systems research are discussed with reference to their potential contribution to research programs and the augmenting of local research resources.

Finally, the chapter discusses the potentials of new biotechnological developments for social forestry. While these new technologies are not yet freely accessible to social forestry, they hold possibilities for the future that need to be considered when formulating research programs and assessing the direction of research and education.

In 1981, the World Bank and FAO presented an updated general ranking of forestry research priorities for development (table 14.1). The new priorities have been widely accepted in the forestry and development sectors. Of the priorities listed in table 14.1, the first three—agriculture and rural development, energy forestry, and natural vegetation management—directly concern social forestry.

Table 14.1 Forestry Research Priorities for Development

1. Forestry in relation to agriculture and rural development
   (a) Sociological and institutional research
   (b) Farming systems using trees
   (c) Watersheds (catchments) and range management
   (d) Wildlife in relation to rural welfare

2. Forestry in relation to energy production and use
   (a) Silviculture of biomass fuelwood species and systems
   (b) Yield, harvesting, and properties
   (c) Industrial research related to village technology
   (d) Comparison with alternative fuels (social, technical, and economic efficiency)
   (e) Wood-based derivatives

3. Management and conservation of existing resources (mainly natural forests)
   (a) Resource survey
   (b) Conservation
   (c) Silvicultural systems for natural forests
   (d) Whole tree use
   (e) Use and marketing of secondary species
   (f) Wood preservation

4. Industrial forestry
   (a) Silviculture and management
   (b) Wood properties

Source: World Bank and FAO (1981)

Short- and Long-Term Research

Research may be classified in a variety of ways. However, whatever the basis of classification, there is always the distinction between short-term and long-term research.

In social forestry, the priorities are largely for short-term research to solve immediate problems (including those detected in farming systems analyses). The major topics form components of technology systems, such as seed collection and treatment, production and handling of other plant material, ground preparation, planting and culture techniques, and weed and pest control. Research stations can design and conduct low-risk research on these topics simply and cheaply, and demonstrate positive results on farms in a straightforward and easily understood way. Farmers must view the results as feasible within the constraints of their available land, labor, and capital.

Long-term research aims to solve technical and institutional problems and to determine the environmental and economic effects of new technology systems, which may include unfamiliar species, genetically improved material, and radically different methods of tree propagation and management. High-risk, long-term research must be conducted initially at universities or on governmental research stations and only expanded to on-farm research when a technology system is reasonably secure. An on-station experiment that fails to produce successful economic yields may yield valuable information to the researcher, but would cause opposition to tree planting if seen by farmers.

Networks and Twinning

Links between national research programs and regional or international networks of research organizations can be beneficial. These networks can provide genetic material for trials, designs for experiments, guidelines for research management and assessment, assistance with data processing, and a free flow of information. Networks also economize on the use of research material, land, and financial resources by carefully designed comparisons of systems and system components on a variety of site types to estimate genotype (the genetic constitution of an organism)/site/management interactions, and to predict possible systems for untested sites (see Plucknett and Smith 1984; Burley 1985).

The international agricultural research institutes have organized a number of networks for agricultural crops and systems. Networks for forest tree research usually concentrate on species and provenance testing, largely for industrial species, in both temperate and tropical conditions. However, networks of species trials have been established recently for multipurpose trees, particularly for semi-arid lands. Examples of these are the FAO/International Board for Plant Genetic Resources (1980) program for fuelwood trees and the Oxford Forestry Institute's program to explore and evaluate Central American species (see Burley et al. 1985). A network of trials of species and cultivars of *Leucaena* is coordinated through the Nitrogen-Fixing Tree Association in Hawaii. Figure 14.1 uses the long-established Oxford Forestry Institute network for tropical pines to illustrate typical linkages and activities of such networks.

In addition to these networks, both short- and long-term research in developing countries is facilitated by twinning and multiple twinning, that is, by establishing formal links between two or more national research units in different countries for specific purposes. Twinning can provide developing countries with continued technical support, education, and training while they build up a local research staff.

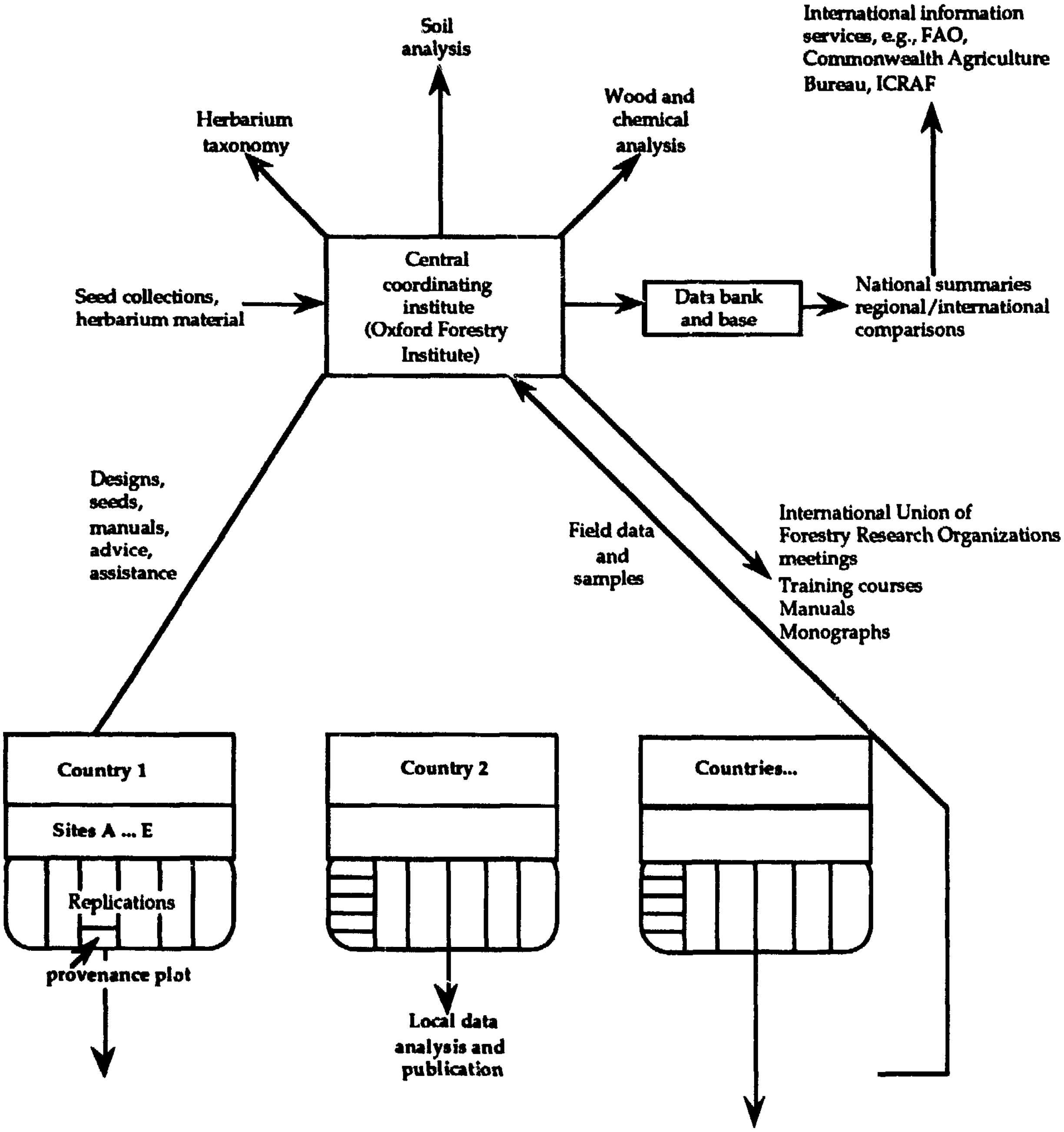
Social Forestry and Farming Systems Research

In the last decade, a profusion of literature has appeared relating to farming systems research. Farming systems research has been acclaimed and used by the international agricultural research institutes and by national agricultural research and extension services (see Simmonds 1985). In cases in which trees are included in the system, ICRAF has modified farming systems research to its diagnosis and design system (see chapter 7). Both farming systems research and diagnosis and design programs attempt to formalize and systematize what researchers had previously done based on their judgment and experience to identify the causes of problems and to suggest solutions.

The standard classifications of agricultural systems (for example, Ruthenberg 1980) and of silvicultural systems (Troup 1952) essentially describe the crop types and the broad physical and temporal arrangements at the macro level for their establishment, management, and regeneration. Farming systems research, however, seeks to describe, analyze, classify, and understand the structure, management, and products of farming systems at the micro level and the whole network of interrelated social and environmental factors.

Figure 14.1 Example of a Research Network

Forestry Institute Network for Tropical Pine Research



Simmonds (1985) listed the characteristics of small farmers (see box 14.1). All of these are relevant to tree planting activities, but some are particularly significant. For example, small farmers are poor with little ready cash, unable to obtain or afford loans, conscious of an uncertain environment, averse to risk, and generally face uncertain or remote markets. Thus, the introduction of trees into existing systems must offer demonstrable benefits in terms of cheap and easy sustainability of food, fodder, and fuel production, while also providing diversification of marketable goods and lowering total economic risk. By relating these characteristics to researchers' technical perspective, farming systems research helps to link the identification of farmers' priority problems and opportunities with the research and extension process.

Farming systems research is totally applicable to systems involving trees. A challenge for researchers is to fit social forestry research within a farming systems framework, and at the same time not lose track of the social forestry research needs not associated with farming systems.

Box 14.1 Characteristics of Small Farmers

The socioeconomic characteristics of small farmers may be summarized as follows:

1. They are poor and have little ready cash.
2. Loans are usually unavailable or expensive.
3. They are conscious of an uncertain environment, of cash shortage, and of family responsibilities and, therefore,
4. They are averse to risks.
5. They often suffer cyclical labor shortage and underemployment.
6. They may have opportunities for competing off-farm employment.
7. They are economically rational, but not necessarily profit-maximizing, because
8. They (like the rest of us) have their own scales of utility.
9. They live in countries in which the infrastructure of markets, supplies, and communications is often weak and not to be relied upon.
10. They live in societies that normally have fairly clear codes as to what is socially acceptable and what is not.

From Simmonds (1985).

Research Topics for Social Forestry

Translating priorities into specific research programs requires the formulation of research topics to provide the technologies and fill the information gaps. Table 14.2 contains a checklist of research topics for social forestry relevant to the priorities listed in table 14.1. Elaboration of these topics in the following pages demonstrates their potential for strengthening social forestry and indicates how they may be handled.

Technological Research

Each system of tree growing and management identified in chapter 6—blocks, strips, individual trees, natural forest—requires research to determine the best ways in which to develop and manage the resource while maximizing benefits and products in perpetuity. The classical stages of silvicultural and genetic research apply to all except natural forestry. For all four systems, existing forestry research must be evaluated to determine what is applicable to social forestry.

As outlined in table 14.2, the following fields of research fall under the general category of technological research.

SEED RESEARCH. Where trees are to be established from seed and seedlings (as opposed to vegetative propagules such as cuttings), research may be needed on seed collection (age of mother tree, time of year, method of harvesting), extraction and drying (machinery and conditions), storage (moisture content, temperature, containers), and testing (laboratory or nursery tests of viability and germination). These are particularly important when farmers are to use little-known exotic species or are encouraged to gather and sow their own seed.

NURSERY RESEARCH. Efficient nursery systems are required to minimize loss and to produce healthy, vigorous seedlings. This requires research on seed sowing (season, germination medium, pretreatment of seed), size and type of containers (bags, tubes, pots, bullets), soil medium (physical and chemical properties), fertilization, irrigation, and shading.

Table 14.2 Checklist of Research Topics for Social Forestry Programs

Technological research	
Seed Research	*Species trials*
Collection	Elimination
Extraction and drying	Testing
Storing and testing	Proving
Nursery Research	*Provenance trials*
Seed sowing	Rangewide sampling
Containers	Narrow sampling
Soil medium	Provenance proving
Fertilization, irrigation, and shading	Family-in-provenance testing
Vegetative propagation methods	
Cultural research	*Genetic research*
Ground preparation and planting	Phenotypic selection (selection by visible rather than genetic traits)
Spacing, thinning, and shading	Seed orchard establishment
Weeding	Progeny tests and selection plantings
Fertilization and mulching	Reconstruction of seed orchards
Pest control	Selection in second generation
Water harvesting and irrigation	Vegetative propagation
Yields	Biotechnological techniques
Intercropping (agroforestry)	
Institutional research	
Permits, regulations	
Tenure and protection (land and trees)	
Beneficiaries and benefit flows	
Taxes, subsidies, incentives	
Marketing features	
Organizational research	

CULTURAL RESEARCH. Researchers need to determine the ecologically and economically optimum system for raising single trees and plots or larger plantations. This research includes studies on ground preparation and planting techniques (plowing, pitting, ridging, terracing), tree spacing, weeding (method, season, frequency), fertilization, irrigation and water harvesting methods, and pest and disease control. See Ghosh (1977) for a description of afforestation methods applicable to India, or Wood, Burley, and Grainger (1982) for technologies for the rehabilitation of degraded land.

Plots and plantations may require additional research on respacing (thinning). Planting single trees requires knowledge of tree management (pruning, pollarding, lopping, coppicing). In the case of agroforestry systems, researchers need to study the interacting effects of tree, crop, and animal components, particularly through two-way spacing experiments (trees and crops) or tree density/animal stocking density studies (trees and livestock).

SPECIES AND PROVENANCE RESEARCH. The major technical factor affecting the success of social forestry is the choice of tree species and, for species with wide natural ranges, the choice of optimum provenance, that is, the source of the seeds that are best adapted to local conditions. The recommended species must be biologically productive, managerially feasible, and culturally acceptable. Natural genetic variation between populations within a species may be considerable; it is sometimes as great as the differences between species. Local races (interbreeding groups within a species), have developed for a number of species through unconscious or deliberate selection by local people. Tree evaluations should include information about these.

Although rural people may prefer indigenous species (for example, *Acacia albida* in the Sahel), deforestation in many areas is already so extensive that these species have disappeared. In other areas, indigenous species grow slowly or are poorly adapted to artificial planting. In such cases, exotic species—that is, those not from local sources—often grow faster, offer more diverse products and benefits, and tolerate both plantation and open field conditions. An example is *Leucaena leucocephala*, which is planted widely in many lowland tropical countries.

Burley and von Carlowitz (1984) record 2,000 species of trees as having multiple uses, and ICRAF has a methodology for evaluating multipurpose trees (Huxley 1984a). The National Academy of Sciences (1980a) also lists species of multipurpose trees. The Oxford Forestry Institute has published a basic guide to all stages of species and provenance research: exploration, seed handling, design, analyses, and assessment of trials, including statistical aspects (Burley and Wood 1976).

GENETIC IMPROVEMENT. When researchers have determined the optimum species and provenance for a given site type and set of objectives, tree breeding may enhance yields significantly. For example, industrial plantations have obtained economic gains of 20 to 30 percent in the first and second generations of tropical and subtropical pines and eucalyptus. The same levels of overall gains are possible for multipurpose species used in social forestry (see Burley 1980a; Namkoong et al. 1980).

Assuming that extensive plantings of single trees or plots of the optimum provenance have been established, the major steps in a tree breeding program include the selection of the best phenotype, based on physical appearance and/or measurement of all properties of interest in comparison with those of neighboring trees; the establishment of clonal (genetically identical) or seed production orchards of these select phenotypes for the mass production of improved seed; the concurrent establishment of comparative tests of open-pollinated or control-pollinated progeny to evaluate the genetic superiority of the selected phenotypes; the reconstruction of seed orchards by thinning or replanting to eliminate inferior genotypes and to enhance the superiority of subsequent seed; the establishment of selection plantings for second-generation selections of superior phenotypes of genetically superior families; and the determination of methods for clonal propagation.

Throughout the course of tree breeding, researchers must maintain a broad genetic base to minimize the risks of changes in pests, diseases, climate, markets, management systems, and available sites (see Namkoong et al. 1980). Unlike many agricultural crops, which are now at such an advanced stage of breeding and genetic uniformity that future gains may be difficult to obtain and involve high risks, no tree species—with the exception of a few fruit and oil species—are more than three generations removed from the wild. Strategies must be planned to maintain the genetic variation of trees over many generations.

Maintaining genetic variation is important when vegetative (asexual) propagation is used. Many multipurpose trees can be propagated simply from cuttings. Many investigators are also interested in using tissue culture, to propagate selected or bred genotypes. Plantation systems using these methods of propagation require conscious efforts to conserve the genetic diversity of the species being grown, either *in situ* or *ex situ*.

THE SPECIAL CASE OF SEMI-ARID AREAS. Semi-arid areas in the tropics are characterized by relatively low but increasing populations, variable but low rainfall, acidic and infertile soils, extremes of temperature, nomadic pastoralism, shifting crop agriculture, a paucity of trained officials willing to work under local conditions, and insufficient infrastructures (roads, markets, schools, extension services, and so on). Knowledge of the management and maintenance of natural woody vegetation and the range of social and institutional factors that inhibit people from planting trees are lacking.

The research topics already discussed are relevant and necessary if tree planting is to be initiated and sustained, but some topics are of greater importance than in wetter zones, especially the choice of species and source of seeds. Species that will provide fuel and fodder in dry zones are now being tested (see National Academy of Sciences 1980a, 1983a; Burley and von Carlowitz 1984; Webb et al. 1984; Burley et al. 1985). However, few of these species have been tested in community plantings or on farms subjected to the rigors of poor tree management that is typical in semi-arid lands. The preferences of the local populations for indigenous species are marked, but few of these species from the Sahelian-Sudanian zones of Africa have been planted or compared with exotic introductions.

Other aspects of a technology system that are critical in drier zones include seed-handling methods, type of plant and container (cheap but suitable for raising hardy plants able to withstand poor handling and severe climatic conditions); protection of trees from browsing by domestic animals (because fencing material is often scarce, this requires social research of people's perceptions of trees and extension activity to obtain their compliance), and the interaction between trees and agricultural crops.

NATURAL VEGETATION. Researchers have studied the management of more-or-less natural woody vegetation for amenity, sporting, and conservation purposes, particularly in Europe. Natural regeneration methods for production have long been used in the state forests of Europe, North America, and India. Recent pressure on tropical moist forests has increased the need for ecological and managerial research, but little attention has been given to the extensive semi-arid lands in which social forestry is most needed and most likely to be supported. The mixed forest and grassland vegetations currently support silvopastoralism, but they are increasingly threatened by increased human and livestock populations, the energy crisis, and desertification.

The objective of research in such areas is to ensure the maintenance of mixed natural communities of trees, shrubs, and herbs so that they will continue to protect against desertification and satisfy the requirements for food, fodder, wood, and traditional products. As Bongoungou and Catinot (1986) stressed, the technical tool to achieve that objective is management. Since deliberate management of natural vegetation has rarely been carried out (except perhaps in Senegal), models of silvopastoral management and natural regeneration are urgently needed. This requires the establishment of a research program to map and inventory vegetation types and stocks by remote sensing and ground assessment; determine growth rates through recurrent measurement in permanent or temporary sample plots; study the dynamics of the vegetation, including soil, seed banks, predators, survival, and ecological succession; examine current management and harvesting systems, including livestock stocking density and yields of fodder, forage, fuel, and other products; and compare innovative management systems, including regeneration systems and harvesting methods.

This research could best be conducted in pilot management centers for each major ecological zone with comparative management plots in each center. The centers would be analogous to model farms as a stage between on-station and on-farm research for systems involving planted trees and crops. The pilot centers would also be the location for training specialized personnel and for extension service demonstration.

Research on socioeconomic considerations

Research into sociological and institutional factors can be divided into two parts: first, studies of the existing institutional framework before a social forestry intervention (project or program) is initiated (see chapters 7 and 8); and, second, research to determine the effects of the intervention (see chapter 11).

Foresters and agriculturalists who have been trained in professional schools or universities and who have worked only in ministries of agriculture or forestry are frequently unfamiliar with each other's work and with sociological concepts. Conversely, sociologists conducting studies of the structure and behavior of populations are often unaware of the biological, environmental, and technological implications of what they record or recommend.

In preparing social forestry policies and projects, all types of researchers—foresters, agriculturalists, economists, and sociologists—are needed, and they must work together to seek a fuller understanding of the existing and proposed systems. Above all, they must work together within the framework of economic (including socioeconomic) analysis. Research on tree components or complete social forestry projects should be integrated with agricultural and rural development projects. All projects require methodologies for evaluating the social and economic benefits.

PREPROJECT BASELINE INFORMATION. In theory, governments regulate land tenure through legal instruments and support national development policies through taxes, subsidies, welfare payments, the provision of services, national and local marketing arrangements, and by controlling infrastructures, such as roads and transport facilities. Usually, planners analyze these policies rigorously for agricultural projects and, to a lesser extent, for traditional forestry production. They are seldom analyzed with respect to the products and benefits that can result from social forestry. Detailed research is needed for social forestry programs to determine current institutional links and the need for, and effect of, institutional changes.

Land and tree tenure is a critical issue in social forestry programs and should have careful, site-specific inquiry (see chapter 10). Even a seemingly simple task such as a review of extant law may require detailed and costly research, particularly when several ministries have some influence on land use, or when many traditional ownership and inheritance patterns exist. All land-use projects require determination of the legal and customary ownership, uses, responsibilities, and rights to all land and crops, together with studies of the relationship between tenure and use of land.

In addition to these national institutional issues, detailed research should be considered on the social structure, hierarchies, decisionmakers, cohesion, mutual supportiveness, and benefit flows in rural communities. Racial, tribal, and caste differences influence local acceptance of any change in a land-use system and often reflect educational status and, hence, the likelihood of physical inputs into, and benefits from, a project. Traditional, aesthetic, cultural, and religious behavior patterns, including differences between sexes and age groups, have marked effects on attitudes toward land use, plant use, and tree planting (see Skutsch 1983; FAO 1985d), but planners of social forestry projects are often not aware of them. Above all, sociological research should include a determination of people's perceived needs and estimates of production and consumption (see FAO 1983c for examples relating to fuel and fodder).

SOCIOECONOMIC RESEARCH WITHIN A PROJECT. Methods for comprehensive and comprehensible risk analysis are needed. Social forestry programs are inherently susceptible to the risk of damage or loss attributable to poor tree planting and culture, fire, livestock, insects and diseases, climatic extremes, poor management and supervision, irregular supplies of labor and transport, and fluctuations in market prices. To minimize the effects of such hazards, multispecies, multipurpose land-use technologies should be developed.

One of the most important areas of research needed is investigating methods for motivating individuals and communities to plant and care for trees. Politically, socially, and economically acceptable incentives are required.

Research on taxes and subsidies is needed to determine the right balance and the best points of application to encourage tree planting over other, competing land uses. Taxes and subsidies may be applied to land, trees, or other crops (subsistence or cash); to standing crops or harvested material; to individuals or communities; and on one occasion or periodically. Research is also needed on the availability, acceptability, and control of credit for land management.

These issues are also fundamental to farming systems research and the determination of points of leverage or intervention in existing land-use systems. Even when policies and incentives are favorable, farmers are unlikely to invest more than their family labor into tree planting. Low-input technologies are required with seed or virtually free seedlings and with little need for fertilizers or pesticides.

The New Biotechnology: Research for the Future

Classical plant breeding techniques established by Gregor Mendel and his successors fueled the green revolution in Asia and Latin America in the 1960s. Early yield gains from genetically superior grain crops, including rice (*Oryza* sp.) and wheat, were impressive. However, recent yield improvements using these classical techniques have not been as great. Moreover, these techniques have been applied to tree crops on a small scale due to trees' long cycle of growth. The emergence of new biotechnological opportunities offers tantalizing prospects to expedite tree breeding programs and further enhance yields of agronomic crops in agroforestry systems (Swaminathan 1982).

Until recently, the manipulation of biological systems was limited by organisms' genetic constitution. Research culminating in the 1980s removed this barrier, and a biological revolution is under way (see Torrey 1985 for a complete review of the development of plant biotechnology). The new biotechnology has been defined as the selection, isolation, and transfer of a gene from one organism to another; the technology of manipulating genetic material to create new products and processes; and using living organisms or their components to improve plants and animals.

For forestry, the new biotechnology applications encompass much more than genetic engineering (altering the heritable genetic makeup of an organism by means other than standard breeding techniques). They include many aspects of producing tree seedlings, increasing growth rates, protecting forest plantations, processing wood , developing new forest products, and using wood by-products. Biotechnology research and development has the potential to alter many aspects of social forestry.

Production of tree seedlings

Trees of the future will be superior to those harvested in plantations today (Farnum et al. 1983). Researchers have already used classical genetic techniques to improve several species, such as *Eucalyptus, Sequoia, Populus,* and *Betula* spp. (Bey et al. 1986). The selection and propagation of superior trees has resulted in improved straightness, vigor, disease resistance, and wood properties. Although standard breeding and selection techniques are effective, they are also expensive, long-term projects in which few institutions in developing countries have participated.

Vegetative propagation

Biotechnology research promises to decrease the time required to identify and propagate superior trees. Currently, researchers use vegetative propagation from cuttings to clone trees with desirable traits (see box 14.2). The success rate of vegetative propagation varies greatly with tree species and is relatively low for conifers. Although rooting of cuttings is a problem with some species, rapid production of selected clones is possible (McKeand and Weir 1984). The major problem with vegetative propagation is the time lag involved in the selection of superior trees at maturity. In addition, propagation from cuttings is only partially successful, which adds to the problem. The Tata Company of India has distributed improved *Eucalyptus* and *Tectona* stocks that have been propagated vegetatively for establishment of plantations that will provide feedstocks for chemical production.

Box 14.2 Vegetative Propagation of *Eucalyptus*: Brazil

In Brazil, vegetative regeneration of *Eucalyptus* is being used in combination with other management techniques to increase stemwood yields to as much as 70 cubic meters per hectare. This operation may be a harbinger of what researchers can do if they apply techniques more extensively (with the proper safeguards).

However, high yields cannot be expected in all tropical localities. The maximum yield of the land has limits that are set by climate, soil, and genetic constraints of the vegetation that can grow on a particular site. Although effective land management can remove many of the constraints, productivity limits and differences among sites will always exist. The cost of management and of new technologies must also be considered when projecting higher yields.

From Lugo (1985).

Tissue culture

Plant tissue culture may provide an alternative means of cloning superior trees. Cells excised from meristemic tissues of woody plants can be grown as cell suspensions or as callus. Cultured cells become organized and form plantlets following inducement by appropriate growth hormones. Currently, more than 200 woody species, representing more than 40 genera in 20 families, have been established in callus culture (Bonga and Durzan 1987). Differentiation of plantlets from tissue culture and the genetic instability of some cell lines limit the application of this technology. Further research is needed to develop these techniques for a broad range of species.

In addition to cloning superior genotypes, tissue culture offers the potential for rapid screening of superior genotypes (Libby and Rauter 1984). With *Populus* species, the rate of tree growth under natural conditions has been correlated with the rate of callus production *in vitro*. *Pinus* species with abundant tissue culture bud production show a good correlation with rapid growth in the field (McKeand and Weir 1984). Tissue culture techniques may be used to screen for desirable traits such as growth efficiency; photosynthetic efficiency; stress tolerance; and resistance to disease, frost, drought, salinity, herbicides, and toxic soil chemicals. Further basic research may elucidate biochemical traits of cultured cells that correlate with wood quality factors such as specific gravity, lignin content, production of extractives, and fiber length (Farnum et al. 1983; Burley and Lockhart 1985).

Selection of highly desirable traits using tissue culture techniques assumes their existence in the gene pool of a given species. Traditional breeding methods have relied on the broad natural variability of genotypes within breeding populations or the introduction of mutated genes (Bonga and Durzan 1987). New methods in biotechnology include transfer of specific genes into the host plant, which involves introducing foreign DNA into host cells (McCown 1985). Several methods are being developed to accomplish this (Torrey 1985). Improvement of agronomic and tree crops in the future will likely be done using other techniques, such as protoplast fusion and multiple gene transfer (Saito 1980).

Commercial propagation of genetically superior forest trees using tissue culture has been successfully implemented at several locations in North America, Europe, and Asia (Bylinsky 1985). Plantek International of Singapore is clonally propagating oil palm and distributing superior planting stock to small-scale farmers as well as using the stock in its intensively managed industrial plantations in Asia. Several other corporations in Europe, Asia, and North America have also invested heavily in tissue culture research and are producing limited planting stock for species of *Eucalyptus, Sequoia, Populus, Pinus, Betula,* and other genera.

Increasing growth rates

Of special interest is research related to increasing forest tree growth rates by manipulating soil microbiology and artificially inoculating trees with symbiotic organisms, including bacteria, fungi, and Actinomycetes.

SOIL MICROBIOLOGY. Forest soils are often nutrient poor, and the high price of nitrogen fertilizer has curtailed its use even on some high-value food crops. Biological fixation of atmospheric nitrogen can offset the need for commercial nitrogen fertilizers (Chatarpaul and Carlisle 1983). Symbiotic nitrogen fixation is of special interest because it occurs in close proximity to the plant roots so that little of the fixed nitrogen is lost to competing organisms. Several examples are known in trees: *Alnus, Elaeagnus,* and *Casuarina* nodulated by Actinomycetes and leguminous trees nodulated by bacteria of the genus *Rhizobium*. In New Guinea, an *Ulmacea* species was recently found that is nodulated by *Rhizobium* and fixes nitrogen, which offers the hope that a wider range of tree families can be nodulated (Kirk et al. 1983). Conifers have not yet been shown to have symbiotic relationships with nitrogen-fixing bacteria.

Development of nitrogen-fixing clones or varieties of the tree species that already fix nitrogen is feasible (Normand and Lalonde 1982). Creating hybrids between nitrogen-fixing species and other desirable tree species may be possible, perhaps by protoplast fusion. Better strains of symbiotic nitrogen-fixing bacteria can also be developed. Creation of a symbiotic nitrogen-fixing conifer may require genetic engineering of both the tree and the bacterium and is a long-term prospect that should not be discounted.

Currently, it is possible to use different methods of forest management to encourage free-living, nitrogen-fixing microorganisms. One possibility is to interplant nitrogen-fixing trees or shrubs infected with Actinomycetes with conifers (Chatarpaul and Carlisle 1983) or to use them in agroforestry systems.

MYCORRHIZAE. Forest trees grow poorly unless their roots are colonized by symbiotic fungi that form root fungus structures known as mycorrhizae. Mycorrhizae benefit trees in many ways, the major one being to enhance nutrient uptake, especially of phosphorus and nitrogen. They have also been shown to increase disease resistance; reduce root shock in transplanted seedlings; and increase tolerance to drought, salt, toxicants, and pH extremes (Dixon and Marx 1987). Researchers have observed several-fold increases in the growth rates of broadleaf and conifer seedlings in nursery and field situations after artificial inoculation with specific mycorrhizal fungi.

Even though the benefits of mycorrhizal associations to tree growth are increasingly appreciated, insufficient attention has been given to mycorrhizae in forestry practice. In many parts of the world, natural inoculum for trees is absent, and attempts to establish exotic pine forests failed until inoculum was provided (Vozzo and Hacskaylo 1971). Because many species of mycorrhizal fungi have varying benefits for a given tree species on a given site, natural inoculation, where it does occur, may not provide the optimum association.

Experiments on inoculation of pines with selected strains of the fungus *Pisolithus tinctorius* have dramatically increased survival and growth on adverse sites around the globe (see box

14.3). Progress toward commercial production of *P. tinctorius* inoculum has been rapid (Marx et al. 1984), and it may well become the first fungus used for large-scale nursery inoculation. *P. tinctorius,* however, is only one of more than 3,000 species that can be exploited worldwide. Much remains to be done in mycorrhizal research. One of the most serious bottlenecks is the current inability to culture certain types of mycorrhizal fungi separate from their host plants. These fungi are responsible for mycorrhizae formation in many tree species and virtually all agronomic crops used in agroforestry systems (Dixon and Marx 1987).

Box 14.3 Artificial Inoculation of Pines with Specific Ectomycorrhizal Fungi: Liberia

The Liberian Forest Corporation started a forestry program in 1975 to establish exotic pine plantations in the interior regions. Seedlings are grown in paper pots containing peat moss in nurseries using routine fertilization and irrigation techniques. *Pinus caribaea* and *P. oocarpa* seedlings are inoculated with forest soil inoculum to form ectomycorrhizae prior to outplanting to ensure adequate survival and growth. Soil inoculum is collected from exotic pine plantations established in the 1960s.

A major disadvantage in using forest soil inoculum is that the technology to select and manage superior species of ectomycorrhizal fungi does not exist. Moreover, the dominant and persistent fungi in the soil inoculum may function poorly following tree transplanting. During the past decade, considerable research around the globe has revealed that specific fungi, such as *Pisolithus tinctorius* (Pt), will stimulate three- to five-fold increases in the growth of pines on routine and adverse forestry sites. Inoculation of *P. caribaea* and *P. oocarpa* seedlings in Liberia with *Pt* improved field survival 10 to 25 percent over seedlings receiving natural inoculum. Height and diameter growth of seedlings inoculated with *Pt* was improved 100 percent after three years in the field. Differences in seedling field performance were attributed to the ability of *Pt* to colonize pine roots and improve mineral and water absorption.

From Marx et al. (1985).

Protection of forest plantations

The application of chemicals to forest trees to control insects or diseases has met with only limited success, is environmentally compromising, and is often not cost effective (Entwistle 1983). Biotechnology is also playing a role in the development of biological control agents, particularly for insect pests.

Alternatives to the chemical control of forest pests are abundant and are most effective when amalgamated into integrated pest management programs (box 14.4). *Bacillus thuringiensis* is a bacterium that infects the larvae of a wide range of insects, including the gypsy moth, which is causing serious defoliation of forests in the northeastern United States. Recent trials with *B. thuringiensis* have given promising control of the gypsy moth in those forests (Ignotto 1981). Several other microbial insecticides are available commercially. Many other microbial pathogens of forest insects are also known, some of which hold considerable potential as control agents for insects. Controlling forest diseases biologically may also be possible, as has been demonstrated for chestnut blight in Italy, where researchers discovered a virus that kills the chestnut blight fungus (Anagnostakis 1982). Genetic engineering can introduce new properties into biological control agents, such as enhanced virulence, broader host specificity, and longer shelf life.

Box 14.4 Biological Control of Pests

In recent decades, researchers have evaluated many alternatives to chemical insecticides for commercial control of forest insects. Insect pathogenic microorganisms offer one solution for control. Many of the microparasites, including viruses, bacteria, fungi, protozoa, and rickettsiae, have commercial merit. Awareness is increasing that viruses may be an extremely powerful tool to control insect pests. Examples of successful programs in which pathogenic viruses were employed to control serious forest pests are given below.

The rhinoceros beetle (*Oryctes* spp.) is indigenous throughout the tropics and causes serious damage to coconut and oil palms. Since the early 1900s, the Asian species *O. rhinoceros* has been spreading through the Pacific and Melanesian islands. The African species *O. monoceros* is also spreading rapidly and severely defoliating plantations. Beetle control studies with baculovirus by Entwistle and colleagues revealed that infection and release of virus-infected adults in coconut plantations in Malaysia was an effective method of controlling populations. Although these techniques were extremely effective, this work should be extended to identify other biologically active agents that could be used as an alternative to chemical control.

The tussock moth is a serious pest of tropical pines. An outbreak in Papua New Guinea in 1976 led to the death of 40 percent of the oldest stand of Lapegu forest in the highlands. The termination of this outbreak was accompanied by the presence of a virus. In 1982, viruses pathogenic to the tussock moth were released by helicopter. The moth populations were killed by the viruses. Papua New Guinea is applying for further research support to develop this biotechnology and to train local people in the application of biological control of insects.

From Entwistle (1983).

New forest products

Traditionally, the primary products derived from woody plants have been building material, paper, food, and fuels (Kirk et al. 1983). Because of the great diversity in the chemical composition of tree species, trees represent an excellent and renewable resource for expanding commercial production of useful products (Hinman 1984). In addition to lignin and cellulose products, the types of chemicals derived from woody plants include resins, phenolics, enzymes, waxes, flavorings, furfural, and pharmaceuticals. Other products of bioconversion include fertilizers and protein for animal feed (Burley and Lockhart 1985).

To exploit the chemical uses of woody plants fully, intensive screening of leaves, fruits, exudates, and whole tree chips is needed (Hanover 1984). The biomass may be collected from plantations, natural forests, or harvest residues. Currently, this resource is vastly underutilized in all countries. For example, annual production of oils from sandalwood (*Santalum album*) in India is 150,000 tons. Oils derived from *Eucalyptus* are also produced in cottage and village industries at a rate of 140,000 tons annually. India has more than 100 oil-bearing species, but fewer than a dozen are currently exploited. A review of the literature indicates that of some 300 multipurpose tree species, 5 produce waxes, 17 produce essential oils, 30 yield gums, 26 yield tannins and dyes, and 1 produces latex. One species, *Azadirachta indica,* which occurs in arid and semi-arid lands, yields at least one extract in each plant component (roots, shoots, leaves). Hinman (1984) recently summarized the commercial potential of several new crops in agroforestry systems.

Priorities for biotechnology research

Biotechnology research has the potential of benefiting social forestry in many areas, including producing and cultivating trees, processing wood, developing new wood products, and disposing of wastes. For example, through tissue culture techniques, it may be possible to regenerate tree species whose seeds have short periods of viability, a characteristic that is typical of many tropical primary forest trees and hinders their use. Furthermore, propagation and conservation of endangered genetic material could be accomplished through tissue culture techniques (Dvorak and Laarman 1986). The most immediate application of tissue culture techniques in social forestry programs is to develop systems for the selection and propagation of genetically superior trees for planting.

Genetic engineering will be used in the future to design superior trees and microbes. Microbial technology will improve soil properties and tree nutrition and health. Development of superior mycorrhizal fungi, nitrogen-fixing bacteria, and microbial pesticides would have immediate applications in social forestry programs. For example, half the land within tropical latitudes has soil that is deficient in phosphorus and is unfit for agriculture or continuous tree cropping without large applications of phosphorus fertilizers. The inoculation of plants with mycorrhizal fungi can reduce the need for these fertilizers. Additional land could be made available for tree planting following inoculation of plants with mycorrhizal fungi to increase salt tolerance and drought resistance. Similar improvements in nitrogen nutrition can be realized through inoculation with nitrogen-fixing bacteria. Methods of tree seedling inoculation are being developed in India, Liberia, Sri Lanka, Tanzania, and Thailand.

In wood processing, biotechnology offers prospects for biological pulping and leaching. Alternative uses of wood through bioprocessing can also be envisioned, particularly for residues and wood not suitable for pulping. Fermentation of biomass to high-value chemicals is already being practiced and could be included in social forestry programs. Bioconversion of lignin in small-scale fermentors is now possible.

The most pressing research needs are in the basic biology of trees and microorganisms. Gaps in the understanding of forest tree physiology and genetics impede the use of genetic engineering techniques. For example, although scientists are developing improved methods for transferring genes into plant cells, the genes responsible for desired traits are not usually known for trees that are grown outside developed countries.

Applications in social forestry

Whereas the green revolution improved yields by developing crop varieties for maximum production on the best available land, emerging biotechnologies may extend social forestry to all regions (Brady 1985). Applications in genetic engineering and microbiology have the potential to encompass far larger rural populations, including those who exist on marginal soil where small-scale, subsistence commodity production has persisted for centuries.

One of the principal features of biotechnology is its generic nature, that is, the applicability of the techniques to any living organism. This aspect permits genetic improvement of a wide range of woody plants, from redwoods to sagebrush (McCown 1985). In contrast to the green revolution, in which a few crops were emphasized at major research centers, emerging biotechnologies offer the opportunity to exploit many minor tree crops of interest in social forestry programs. For example, genetic engineering initiatives could develop a range of multipurpose tree species to suit sociocultural preferences for charcoal, fodder, and fiber production.

The potential of forest biotechnologies has created a new awareness among those concerned with forestry development programs in developing countries. India, the Philippines, Thailand, and several other developing countries have established national biotechnology institutes or programs. The United Nations Industrial Development Organization recently proposed the establishment of an International Center for Genetic Engineering and Biotechnology that would conduct research and develop applications of interest to developing countries (Zimmerman 1983).

The effects of biotechnology on forest production in developing countries may be more profound than in developed countries. Multinational forest product companies, genetic research firms, and universities are developing a wide spectrum of forest biotechnologies (Bylinsky

1985). The principal areas of research that will have an immediate impact on social forestry programs include yield improvement, stress resistance, and nitrogen fixation by nonleguminous trees. Achievements in any of these areas could have a far-reaching impact in Sub-Saharan Africa on millions of hectares of barren soil that are unsuitable for planting traditional, multipurpose tree species such as *Acacia* or *Leucaena*. The development of trees that could thrive in these marginal environments would enable social forestry programs to establish and maintain productive agroforestry systems without large capital expenditures for fertilizers, pesticides, irrigation, or other energy-intensive inputs (Swaminathan 1982). Trees genetically engineered for rapid growth or improved protein content of leaves could be multiplied by clonal propagation to alleviate fuelwood and fodder shortages. Biotechnology prospects for enhancing the yields of renewable sources of food, fiber, and fuel exist for nearly every aspect of social forestry.

In contrast with the green revolution, indications are that private capital investment will be the principal agent in the development and transfer of forest biotechnologies (Buttel et al. 1985). Corporations in industrialized nations possess biotechnology that is far superior to that available to international agricultural research centers or other centers of research in developing countries. Because of the international nature of forest-based industries and the large, untapped sales potential of developing countries, this is where many forest biotechnology firms see their future. In recent years, multinational corporations in the field of biotechnology have established product development and marketing facilities in developing countries. For example, Native Plants Incorporated, a U.S. firm in forest biotechnology, has established a joint venture in Singapore under the name Plantek International. The parent company will apply genetic engineering techniques to develop superior tree genotypes, while the joint venture will provide access to a large gene pool available in the tropics, transfer emerging biotechnologies to Asian institutions, and market the products of the collaboration (Bylinsky 1985).

Private investments have an additional impact on the transfer of forest biotechnologies. The instrumentation, facilities, and personnel required for current biotechnology research and development programs are far more sophisticated and expensive than those associated with the green revolution. Developing countries may not be able to raise the capital necessary to invest in forest biotechnology. For example, the proposed United Nations International Center for Genetic Engineering and Biotechnology is projected to have an annual budget of US$8.6 million and a staff of 168, including 50 Ph.D.s (Zimmerman 1983). Genetech, a leading U.S. genetic engineering firm, has an annual research and development budget of US$21 million and a staff of 350, of whom 70 hold Ph.D.s (Abelson 1983). The science and technology gap between developing and industrialized countries may be widened further by emerging biotechnologies.

Applications in forest biotechnology also introduce questions of patents and proprietary information (Adler 1984). Patents for new organisms and legislation to protect genetic proprietary information has limited the free flow of scientific and technical information in the United States. The Union for the Protection of Plant Varieties is promoting legislation within developing countries to ease private sector access to germplasm and to create favorable marketing conditions.

Ensuring that scientists in developing countries have an up-to-date understanding of biotechnology is a challenge. Training managers in biotechnology applications requires curricula modifications. Forest researchers and managers need to embrace biotechnology and incorporate it into traditional silvicultural practices. Undergraduate and graduate forestry training in developing countries needs dramatic modernization if biotechnology applications are to be exploited. Investment in university faculty and laboratories is required if contemporary, competitive scientists and forest managers are to be trained.

Summing Up

To be most effective, research for social forestry should be integrated with education and extension. This will help ensure that research is relevant to the problems faced and that it addresses priority needs as identified through an interactive extension program and educational process.

Research is needed in a number of areas. Specific priorities for research will have to be determined at the country and project levels. However, in general terms, the broad priorities concern forestry in relation to agriculture and rural development, energy production, and management and conservation of existing resources for sustainable development. Both technological (physical/biological) research and social science/institutional research are needed to address the most pressing social forestry problems.

Specific biological research topics of importance are in the areas of seed research, nursery research, cultural research, species trials, provenance trials, and genetics research. In the institutional area, research topics include tenure, incentives, organizational models, benefits distribution, and marketing. The relatively recent biotechnology research related to forestry also holds some promise for social forestry, although the benefits from such research are not likely to be immediate.

In developing research programs, attention should be paid to the distinction between short-term and long-term research, opportunities to integrate programs with farming systems research, and to the extent feasible, the involvement of institutions in networks or twinning arrangements to maximize the benefits from investment in research.

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INDICATIONS FOR THE FUTURE

Just over ten years ago, the FAO (1978) and the World Bank (1978) gave their support to what was then a rather novel, and in many quarters unacceptable, thesis: that social forestry, or forestry for local community development, needed to receive much more attention and support from the international aid and technical assistance community, as well as from the developing countries themselves. This increased emphasis did in fact come to pass. For example, World Bank support shifted significantly to social forestry-related investment, from about 5 percent of total forestry lending during the 1967-1976 decade, to more than 60 percent during the 1977-1986 decade. Many countries also initiated major efforts in this area. Yet much more needs to be done.

The warning signals that led to this change in emphasis and investment were mounting environmental degradation; increasing declines in agricultural productivity; more serious and widespread shortages of wood, particularly for energy, but also for other uses; and a growing awareness that governments alone could not solve the mounting crises. Governments and international agencies recognized that only local communities themselves, with appropriate government and NGO support, could solve the problems, primarily through changes in land-use practices that would lead to reduced rates of deforestation in developing countries and increased overall productivity.

Changing land-use practices from nonsustainable to sustainable ones is not easy when the population is growing and the land base is fixed, as is the case in much of the world. Thus, there is no room for complacency and a slacking off in efforts. However, neither is a negative or "doomsday" attitude justified, since some areas have made progress in reducing deforestation and solving problems. A number of countries have achieved greater food security, environmental stability, and improved resource management during the past ten years. Unfortunately, others are still striving toward these goals with little apparent success.

Countries can only attain long-term food security if they introduce technological advances with environmental stability and, therefore, if they introduce sustainable land-use practices into agricultural systems. The basic concepts and principles of social forestry stress sustainability in meeting local needs for tree-related outputs, and enhancement of agricultural productivity and environmental stability through the use of trees in agricultural systems. Thus, social forestry is a central strategy for moving toward more sustainable land-use systems and food security in many parts of the world.

The wealth of experience that has accumulated since the mid-1970s shows that the basic tenets that resulted from the early analyses of the potential of social forestry were essentially sound, and that the shift in international support to social forestry was justified. Thus, this book's major conclusions are largely the same as the FAO and World Bank's earlier ones, namely:

- The problems that social forestry programs address are critical and immense (however, in some cases, they are much more severe than early studies of the subject recognized).
- Local community initiative and direct voluntary involvement in social forestry programs are essential for success in attacking the problems. Governments alone cannot accomplish what is needed.
- High-level political commitment is essential in all cases if the problems are to be addressed on an adequate scale.
- In many areas, local financial and technical resources are inadequate; international support is essential to get programs established on a scale where they become meaningful in relation to the size of the problem being addressed.

• While situations vary widely from location to location, common factors are associated with social forestry successes, and others are associated with failures (that is, some common lessons can be learned).

The present review and analysis of social forestry experience strengthen the main arguments put forth in the mid-1970s. The major issues and problems identified then remain the major ones facing us today. Suggested solutions to the problems put forth in earlier years were based mainly on conjecture, since little empirical evidence was available. Experience to date largely confirms the validity of the earlier suggestions, although many refinements have occurred and new approaches have been developed.

From the point of view of policymakers and program and project planners, two areas of concern have emerged that are particularly critical for progress, namely, (a) issues associated with generating widespread, local, voluntary involvement in sustainable social forestry activity; and (b) issues associated with the effectiveness and efficiency of outside intervention to help local communities plan, organize, finance, manage, and implement social forestry projects and programs. These two sets of issues are, of course, interrelated. Within each of them are more specific issues that emerged from discussion in the previous chapters. They are reviewed briefly in this chapter.

Issues Relating to Stimulating Widespread, Voluntary, Local Participation

While no hard and fast rules exist for generating widespread local interest and involvement in social forestry activities, a review of experience does provide some indications of what has and has not worked. Of course, one should not apply what worked in one case to another case without considering the implications. With that caveat in mind, the following conclusions are offered about factors associated with stimulating active local initiative and involvement in social forestry projects.

Understanding and involving local communities early in the planning process

Successes in social forestry are associated with situations where outside institutions—forest services, NGOs, and other groups—have come in to help local people solve their problems and have made the effort to understand how the community perceives those problems and what the local people want to and can do about them. In several cases outsiders have come into a community and have started fuelwood planting programs, thinking that a local scarcity of fuelwood was obviously the main tree-related concern of the local people. Only after the project had failed to gain support, and after significant resources and time had been lost, did it come to light that the local population's main tree-related concern was, for example, scarcity of building poles and tree fodder, with fuelwood supply in third place. Since the trees planted were not suitable for the higher priority use, at least in the community's estimation, local enthusiasm was lacking. Early interaction with the community's could have avoided this problem. In general, project planners should think in terms of multiple-purpose species, where fuelwood is only one of the outputs. Experience indicates that farmers seldom plant trees for only one purpose.

Understanding the local situation takes time, particularly if one is dealing with a complex community comprised of many factions with different ideas that respond to different incentives. Yet, experience indicates that project planners must take the time to understand the community's structure, workings, and incentives. Social scientists need to be involved early in project and program development. As indicated in chapter 7, several social science approaches can generate relevant community information.

The issue is not whether or not project planners need such information, but how much they need and how accurate it should be. The answer depends directly on the nature of the communities involved, the budget available, and the time and other constraints surrounding the program or project being planned. For example, in a fuel-deficient area with adequate land, the solution may be quite straightforward and easy to design. In heavily populated areas suffering from overgrazing and extreme pressures on the land, the appropriate solution may be complex and require considerable additional effort to understand the local environment, incentive system, and land-use system.

Reducing conflicts between land uses and between community factions

Social forestry projects often create significant conflicts between community factions about the use of communal lands, between the types of social forestry activities men and women want, and so forth. Conflict resolution is a critical, everyday issue facing most social forestry personnel. Project planners must identify potential conflicts and address them early, preferably before field operations begin. Again, information on the incentive and conflict resolution systems operating in participating communities must be obtained at an early stage.

The previous chapters covered a number of ways to deal with conflicts or potential conflicts. These include (a) clearly designating rights to specific forest or tree outputs at specific times to various community groups; (b) making sure that every group in the community will benefit from some aspect of the project or program (to avoid groups undermining the program because they do not benefit); (c) ensuring that all villagers understand the project and the rules and regulations involved (for example, who gets the outputs); and (d) making use of idle and agriculturally unproductive land suitable for tree growth, before using land that could be, or is being, used for crops and livestock. An important means of avoiding land-use conflicts is to introduce or expand the use of agroforestry techniques in which crops and trees complement each other.

Many of the conflicts in social forestry exist because of misinformation or lack of information. Thus, extension agents, as well as a project's monitoring and evaluation units, can have a central role to play in conflict management and resolution. An important issue here is the way in which social forestry advice is introduced. If a separate social forestry extension unit is created alongside its agricultural extension counterpart, the two might give conflicting advice to farmers. However, if the agricultural extension service handles social forestry, trees may be ignored. Monitoring and evaluation of extension functions can help reduce this potential problem by providing feedback to project management that can be translated into revised extension guidelines and training programs.

Starting small and simple and building up participation through the demonstration effect

A number of the previous chapters pointed out that projects that started too big, with expectations that were too high, have failed because of the disillusionment of local participants and project staff. However, based on the experience cited from Africa and from NGOs, those projects that started small and simple and built up participation through demonstration have been relatively successful.

Simple technologies that can be developed and copied easily have also been associated with successful expansion of social forestry practices. They generally have the added advantage of being cheaper. In the Republic of Korea's tree planting program, the project planners sought species that were easy to plant and tend under a wide variety of site and planting conditions. They recognized the widely varying skills of those who would be planting and tending the trees and the importance of high seedling survival to avoid discouragement.

The same point can be made about nurseries that supply seedlings for local use. Experience has shown that decentralized nursery operations are important for success, despite a possible problem with seedling quality in such nurseries. Tree growing activities usually expand more rapidly where small, locally run nurseries supply seedlings.

To be sure, some social forestry programs that started big have succeeded. However, they are the exceptions and generally involve situations where major inputs of skilled human resources were available to the programs (Korea and India) over an extended period of time, and where a fairly rigid, authoritarian structure was imposed, or where monetary returns were high. For most parts of the world, the best advice is to start small and simple with limited expectations and rely on demonstration and participatory extension to increase participation. Such an approach appears to be justified both for logistical reasons and for social and cultural reasons.

Building on market incentives

One clear conclusion reached from reviewing social forestry projects around the world is that market forces provide a powerful incentive for farmers to grow trees. Rapidly rising prices for tree products encourage investment in tree growing once prices reach levels at which reasonable rates of return on investment can be obtained. Social forestry programs can encourage the working of market incentives in a number of ways.

If access to markets is difficult or expensive, outside support for infrastructure development may be called for. In other cases, access may be difficult because of middlemen who exploit the smallholders or forest workers who are the intended beneficiaries of programs. In such cases, program planners can develop or expand marketing cooperatives, forest associations with access to their own transport, or other forms of organization to ensure reasonable retention of sale revenues (profits) in the local communities. The greater the revenue locals retain, the greater the incentive for them to grow trees. In other cases, projects guarantee minimum prices to the tree growing smallholder to provide some security.

As indicated in chapter 5, even if income from tree growing is attractive, smallholders can face cash flow problems if they invest in tree growing. In this case, outside intervention is needed either in the form of loans with sufficient grace periods, outright grants, or through prepayment of part of the value of the expected crop. The right kind of credit must be available, with credit terms that recognize the special problems of timing associated with tree growing.

In some cases, prices are high for the tree-related outputs produced by the initial group of smallholders involved in a program. However, as more people enter the program and outputs increase, markets can become saturated rapidly and prices can fall, leading to discouragement. Early planning and a good understanding of the depth as well as the breadth of markets are critical for social forestry projects involving commercial activity. Similarly, early planning is needed to minimize other market-related risks to program participants.

Chapter 5 pointed out that commercialization can have negative aspects. For example, a growing, urban fuelwood and charcoal market can lead to deforestation as rural inhabitants harvest more wood to sell in the cities. As long as free wood is available for gathering, prices will be low and the incentive to invest in replacing the natural forest that is being depleted is lacking. This is one of the key market-related issues that needs to be addressed in the future. Various forms of taxes, price controls, regulations, and subsidies can be used to resolve the problem, but the full implications of each measure and combination of measures need careful study. For example, high minimum price controls can help stimulate investment in tree growing, but they also can result in more rapid and widespread deforestation. Another negative aspect to commercialization is the burden it can put on the very poor, particularly in urban areas: what they previously obtained for free they now must buy with scarce money. And if wood for the urban and industrial markets is being grown on farms that previously produced food crops, food prices may also increase and some rural, landless people may find themselves without the jobs they had when more intensive agricultural activities existed. Attempts to avoid these problems need to be made through advance planning.

Using subsidies, but with care

The review undertaken shows that most social forestry-related projects and programs involve some elements of subsidization, including industrial plantation projects in developed countries. Quite often, such subsidies are justified for political rather than economic or social reasons.

Subsidies must be used with care, since in many instances the ultimate result of indiscriminate subsidization has been not only considerable public cost, but also failure to generate longer-term, local enthusiasm and involvement. As subsidies are phased out, local people, who previously were induced with subsidies to plant and tend trees, become resentful. In other cases, villages not included in a program refuse to plant and tend trees for their own use because they see another village getting paid to do so through a subsidy.

Because of the fungibility of cash, the most appropriate types of subsidy are often those that are given in kind—seedlings, fertilizers, tools, food—and are tied to specific output or performance criteria. In cases of a land constraint, the most critically needed subsidy is often the free use of public lands or idle, private lands. Experience with subsidized credit for farm forestry activity has not been satisfactory, and subsidized credit is generally inappropriate for village or community forestry activity. The key factors in credit are the length of the grace and payback periods and the interest rate charged.

Many incentive mechanisms are available, as indicated in chapter 9. It is important that the right package be chosen to suit the conditions in the project environment, and that the subsidy not become so large that commitment of resources by local beneficiaries is unnecessary. Experience indicates that successful projects require commitment of some of the participants' own resources to generate a minimum level of responsibility and interest that can sustain the social forestry activity once outside intervention is reduced and eventually terminated. Experience also shows that tying subsidies to specific outputs or responsibilities of people receiving the subsidies is wise.

Finally, experience indicates that subsidy programs need to be thought of in broad terms or in a systems context. When considering subsidies, merely looking at the tree planting is not enough. Tending, harvesting, transporting, and processing components may also require some outside support to make the whole process viable and attractive to local people.

Finding land or tree products for the landless: the challenges of community woodlots and use of public lands

Clear knowledge of who will get what and when is essential to generate interest in participation in social forestry activities. Successful involvement of the landless can be generated through programs that give, or assign on a long-term basis, use rights for public lands to them. A key is that participants feel secure that the rights assigned to them will not be removed once the trees have started to grow and mature for harvest or other use, such as fruit or nut production. Often hidden, informal use rights exist for a piece of common land. Careful study is needed to make sure that social forestry activity is not started on such lands in a way that leads to conflict. All affected parties need to be satisfied to avoid some group undermining the project.

Dealing with the use and management of natural forests

In many instances social forestry programs have focused only on planting new trees and have overlooked significant opportunities to work with existing natural forests and woodlands. This latter option appears increasingly to be an important one, particularly in many of the countries in the dry or semi-arid zones of Africa. Evidence is accumulating to indicate that costs per increased unit of output can be lower than unit costs in planting programs. Projects in Nepal and elsewhere have also shown that successful development of social forestry based largely on natural forest management and use is possible. In many cases, it may be the only realistic option open to a local community seeking a sustainable land-use system.

In countries where large-scale concessions are given to firms for forest exploitation or management, some sensitivity must be shown to local forest dwellers and their rights, however informal they may be. In some cases, they have been exercising these rights for centuries. Too often, they are ignored as the government focuses on the possibilities of significant returns to the treasury and expanded foreign exchange earnings.

Building on existing practices, provided they are sustainable

The less change that has to be introduced in the way people do things, the greater the chance that they will participate in a project. The key is to find how to achieve social forestry objectives for a given population with the least disruption to its environment and existing system of activity. Almost always there are a number of ways to achieve a given objective. The best alternative generally will be the one that can achieve the objective in the simplest way possible, while being in harmony with existing cultural and social values and practices. This also tends to be the most replicable alternative. Often, the appropriate solution may not be apparent from the results of pilot projects with heavy inputs of outside, skilled human resources. Since such high levels of input should not and cannot realistically be sustained in expanded, major programs, results should be analyzed on the assumption that there will be much lower levels of outside assistance. In doing so, one often comes back to the dictum: make the solution simple and easily understood and adaptable to local conditions and incentive systems.

Ensuring adequate benefits for, and participation of, women

Because rural women in most developing countries are so directly involved with the local activities associated with the use of wood and tree products, and because they have been neglected in some early social forestry programs—often to the programs' detriment—women must be given special consideration, both in terms of their participation in planning and in terms of ensuring their share of the benefits from social forestry activity.

Reducing risk and uncertainty for participants

Risk is a critical concern in social forestry projects. Poor farmers are naturally reluctant to take on new risks. Therefore, they avoid anything that is unfamiliar and associated with potential risk. For this reason, all elements of a program must be very clearly developed, explained, and agreed upon. It is also for this reason that land tenure rights need to be clarified early, benefits need to be assured to targeted beneficiaries who participate in social forestry activities, and reasonable government guarantees may have to be provided (for example, through crop insurance, price guarantees, or loan guarantees) to generate the confidence needed among local communities.

Ensuring short-term benefits and avoiding cash flow problems

The major benefits from social forestry activities often do not occur until a number of years after trees have been planted. If planting involves cash outlays by farmers, then cash flow problems can arise if outside intervention does not provide ways to reduce such problems (for example, through loans with adequate grace periods or through subsidies of one kind or another). Furthermore, with high preferences for present benefits or consumption, local people may be reluctant to become involved in tree-related activities from which benefits occur far into the future. In such cases, complementary activities can generate benefits and employment in the shorter term (for instance, complementary agricultural activities, income from minor forest products, or publicly supported, income-generating activities). A number of programs have successfully integrated tree-growing activities with other forest-related activities, such as the collection and sale of oak and pine mushrooms, bark products, honey, wax, fruits, ornamental plants, and fodder. Off-farm employment in tree-related cottage industries is a major possibility in some areas.

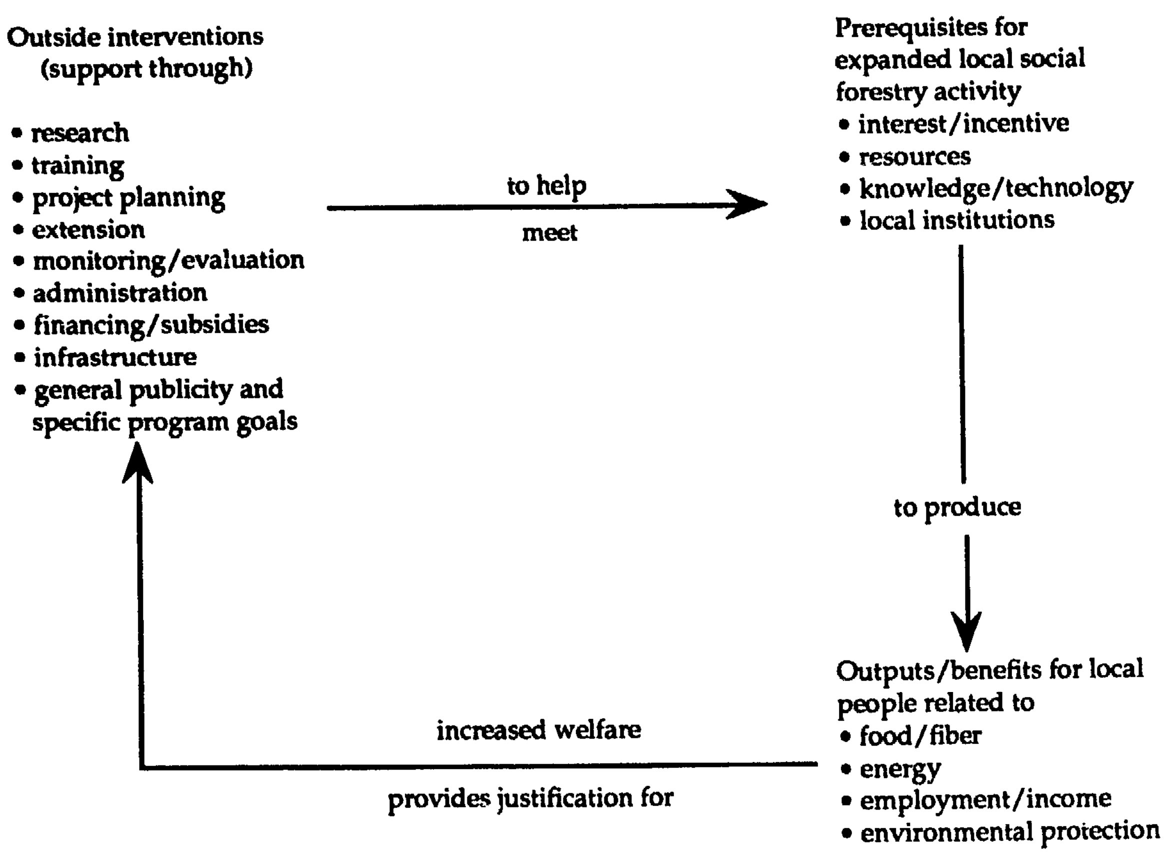
Recognizing the importance of fodder and grass

Early social forestry efforts often failed to devote sufficient emphasis and resources to tree fodder and grasses, partly because this was outside the realm of interest of foresters, and partly because foresters did not recognize the importance of such outputs. In recent years, much more information has come to light on this subject. For example, foresters now know that in many parts of the Sahel, tree fodder supplies some one-third of the animal feed, and that in parts of the Himalayas, tree fodder and forest grasses provide the major part of animal feed. Furthermore, uncontrolled grazing is responsible for much of the damage in the forests of upland communities in many parts of the world. Since they are so important for many local populations, social forestry programs must consider forest grazing and tree fodder.

Issues Relating to Implementing Social Forestry Programs and Projects with Outside Support

The types of social forestry programs discussed in this book generally involve outside intervention or support for successful implementation. In essence, as indicated in figure 15.1, outside interventions (support services) help to meet local prerequisites for new or expanded social forestry activity, which provides benefits for the local communities involved as well as for those who live downstream, as in the case of watershed management benefits. Increased welfare in turn justifies outside intervention. As indicated earlier, several issues need to be considered in developing the capacity for successful outside intervention.

Figure 15.1 Outside Intervention in Social Forestry Projects: Its Role and Impact



Generating political support

Because social forestry tends to involve a number of quite diffuse and not readily observed or quantifiable activities—planting trees around homesites or fields, collecting minor products in the forest, tending small areas of natural forest—developing an appropriate theme on which to build political support and a political constituency is often difficult. Yet, experience has shown that such support is essential to the success of social forestry efforts that have been large enough to be meaningful in a development context.

Political awareness and support has to be built on the realization that social forestry can contribute directly to overcoming major development problems of concern to political leaders. Such issues include environmental deterioration, food insecurity, energy crises, rural/urban migration, and unemployment. The general relationships between these issues and social forestry were laid out in detail in part I. Specific relationships will have to be established in each country.

Social forestry may require separate legislative support in addition to the support of high-level public officials, since most existing forest laws do not consider social forestry options and needs. Furthermore, because of the necessary close ties between social forestry and agriculture and rural development in general, legislation may be needed to establish policies that bridge the various fields of activity and to legitimize the organizational and administrative functions related to social forestry programs. In the initial stages of developing a program, a major portion of the effort might have to be devoted to establishing an appropriate and productive set of policies to guide and support social forestry activity.

Overoptimism about what social forestry programs can accomplish can lead to discouragement when results fall short of expectations. This point has been discussed already with regard to gaining local participation in programs over time. It applies equally to generating continuing, high levels of political support for social forestry programs. If program personnel promise, but do not deliver, higher-level decisionmakers become discouraged with the program. This point applies to expectations about how rapidly successful programs can be established, as well as to expectations about physical targets that can be accomplished. For example, in a watershed rehabilitation program, promoting trees and their positive effect on erosion and flood control is meaningless unless concurrent steps are taken to include and promote the impacts of other soil and water conservation practices, such as grazing and land-use controls and structural measures. Ultimately all these activities interact to produce the final result downstream; and that is what interests the decisionmaker.

Building flexibility into programs

Review of past and existing social forestry projects shows clearly that most projects have turned out quite differently than originally planned; projects that actually proceed as planned are the exception rather than the rule. Recognizing this, initial plans for projects should build in the flexibility to adjust operations as conditions warrant. The establishment of a monitoring and evaluation system helps to systematize the process of learning and adapting in the light of experience. Contingency funds also help to increase flexibility, although their use must be controlled carefully. The ability to transfer committed funds from one activity to another is probably more important. Working with multipurpose species also helps to build flexibility into programs. Many other options exist, as discussed in earlier chapters.

Choosing the appropriate administrative organization

The issue of where social forestry fits best in the organizational structure of a government is a perplexing one. In one case, a social forestry program succeeded partly because the agency responsible for the program was moved from the ministry of agriculture to the ministry that handled local village affairs in general, including policing functions. In other cases, quite successful programs have evolved with social forestry having its home in the ministry of agriculture, in a separate social forestry department, or in a forest service. Again, there is no one prescription for success in every case. Decisionmakers at the highest level must be open to suggestions.

In considering the appropriate home for social foresters, decisionmakers can keep some general points in mind. First, social forestry must have a close relationship with agriculture and farmers. Social forestry must not be isolated from the rest of agriculture; and social forestry trees are no different from the trees that farmers have always had around them and have worked with for centuries. Second, programs must be staffed with people having the best technical know-how available. Third, social forestry is much more closely integrated with rural community life in general than is traditional industrial or forest service forestry aimed at production of a limited range of commercial products and other outputs. Thus, wherever social forestry is housed organizationally, clear and easy lines of communication with those organizations that deal directly with village life and rural development are essential. This is particularly critical when large numbers of landless are among the intended beneficiaries of social forestry programs.

Retraining foresters or getting new personnel involved, and reducing forest service resistance to social forestry

In connection with the above issue is a debate about whether it is better to retrain field foresters for the special skills and attitudes involved in social forestry or to develop a new and separate cadre of "social foresters." Both approaches have been tried, and both have resulted in successes and failures. In some cases, a combination of retraining traditional foresters and establishing new village forestry officer positions has been used. In other cases, professional foresters have worked with local village extension agents who handle both agriculture and forestry. Many other approaches exist. The point to note here is that this issue needs to be considered explicitly and early in social forestry planning to ensure availability of staff.

In many countries, widespread resistance among forest service employees to the ideas, objectives, and methods associated with social forestry programs is still evident. Many well-meaning foresters continue to see themselves primarily as guardians of the forest, with the major objective being to keep people out of the forest to avoid damage: illegal harvesting, starting of fires, and so forth. Retraining foresters will not be enough if their attitudes are not also changed, which is often difficult to accomplish with career foresters steeped in the old traditions and views.

Working with the right local leaders and institutions, including NGOs

In addition to giving thought to an appropriate organizational home for social foresters, planners must think about the local institutions or units of social organization that will be approached for involvement and leadership. Experience from around the world shows that successful programs may involve schools, local womens' organizations, cooperatives, churches, other local voluntary organizations, and local industry. No group should be excluded from consideration. Rather, the focus should be on the relative effort required to motivate a given group to participate in, or lead, an activity, and its potential for carrying out the required tasks. Planners can make choices on the basis of resources available and expected outputs or benefits in relation to the effort required to generate participation. Realistically, the choice of local institutions and groups to work with in implementing a project is generally determined through the local political process. Groups negotiate and reach compromises to protect their interests in the best way possible. Most decisions in this area, therefore, arise from community leaders and project personnel working together. Recognizing this point early is essential to successful design and implementation.

Experience with development NGOs or private, voluntary organizations in the development field have generally been positive. They have shown a good ability to mobilize local support and local project personnel. Continuity in projects has been improved when the development NGO has had long-standing experience in a community, even if in a field other than social forestry.

Organizing extension activities

Experience with social forestry extension is accumulating, although not enough to resolve clearly the dilemma of whether extending social forestry through existing agricultural extension networks or through separate units is better. That remains a matter of choice based on individual circumstances. Obviously, if the agricultural extension system is ineffective, as it is in many parts of the world, then a new, perhaps integrated system is called for, recognizing that costs for a separate social forestry extension system can be high. In many cases, some combination of input from social forestry specialists and use of existing, field-level agricultural extension units will be the best choice. In still other cases, separate social forestry extension systems, using local village facilitators, paid or volunteer, has worked.

Whatever the system used, extension agents must think of themselves as "makers of opportunities" as well as transferrers of technology, and must realize that part of their function is to bring ideas and information to project management so it can learn about local communities and their evolving needs and interests. Social forestry extension personnel must also recognize the close linkages that exist with agriculture in general and avoid conflict with agricultural programs. Finally, there is a greater probability of success in programs that build as much as possible on extending existing successful practices in the involved communities and do so in a farming systems context.

Ensuring that logistical support is adequate

A major constraint in social forestry programs has been inadequate logistical support, when the right materials or the right extension input are not available at the right time. Conversely, successful projects have considered the complexities of logistical needs when dealing with often isolated, rural communities and have made sure the appropriate logistical support is in place. Chief among planners' concerns should be seedling availability and extension support. Seedlings are often best produced in small, local nurseries. Although quality control can be a problem, local nurseries producing seedlings at the right time for planting have been a positive factor in getting widespread tree planting going. With regard to the logistics of extension, as mentioned above, use of local village residents as "animateurs" or facilitators has been quite successful: they have overcome some of the problems associated with lack of familiarity with local customs, needs, and wants, and with distrust of outsiders. This generally is also a low-cost approach to solving the logistical problems of social forestry extension.

Including adequate monitoring and evaluation efforts

Many of the points made above probably could be made with much more confidence if more projects had included well-designed monitoring and evaluation (M&E) components from the beginning. Currently, this is considered as a necessity in social forestry programs. For example, the Government of India is implementing a major M&E system nationwide for its social forestry program. M&E activities provide information both for adjustments in on-going projects and for use in planning future projects.

Financing social forestry

The problems of financing social forestry can be complex, both in terms of obtaining funds from the national government and in terms of financing activities at the farm and community levels. A great deal of early thought needs to be given to design of projects in a form where realistic financing options exist.

At the national level, the challenge is to develop measures of output that are meaningful to budget decisionmakers and to build a political concensus that supports social forestry activity and, thus, can ensure an adequate program budget. The lack of appropriate measures becomes a problem when, for example, trees are to be planted around homesteads, along roads, and around fields for a variety of nonmarket outputs instead of in traditional block plantations, where decisionmakers can be given a solid figure of so many hectares being planted to produce a predictable volume of commercial timber.

Experience also indicates that when subsidized financing is used at the community or individual level, a real danger exists of developing local dependence on subsidies or an outright unwillingness to carry out tree-related activities without subsidies. Thus, in the early stages, planners must consider the transition from a subsidized initial effort to a self-financing and locally sustainable social forestry activity financed by the local community. Similarly, at the national level, governments can come to depend on international sources of financing. A mere substitution of outside for national funds can result, with no increase in the resources devoted to social forestry investment and with development of an undesirable dependence on outsiders.

Focusing research on the right problems

Only in the best of cases do countries have sufficient capabilities for a strong, integrated physical/biological and social science research program. In reality, resources, including skilled researchers, are generally severely limited and governments must make hard choices between alternative research directions. There is no clear agreement on the research needs for social forestry, even for a given environment. In some parts of semi-arid Africa, a clear priority is research on appropriate species for the harsh environmental conditions found there; yet, arguments still arise concerning the relative emphasis that researchers should place on physical/biological research, on species choice, and on social science research related to appropriate and acceptable tree-management and incentive systems.

One approach that appears to be working in some cases is to develop more integrated and applied research activities that combine elements of research directly with development of social forestry programs in the field, rather than being carried out in more expensive and isolated research facilities. This approach has the advantages of harnessing limited research capability to ongoing, pragmatic field operations, of ensuring more rapid application of positive research results, and of reducing the chance that research and diffusion efforts will become isolated from each other. It can have the disadvantage that research is less thorough, thus providing less of an opportunity to build a cumulative body of verifiable, scientific knowledge that can be used in further research. However, this practical, field-oriented approach may be the only feasible one in cases where resources are not available to fund a more expensive, traditional research program in social forestry.

For the short-term, expanding research on existing "best practice" techniques will provide measurable improvements, and for the longer-term, developing research networks and linkages with international and bilateral organizations will hasten improved technology development.

Reconciling technical and social welfare objectives

The types of activities, objectives, and organizations that fit under the label of "social forestry" vary a great deal. This can lead to confusion about the relative priorities of different goals and objectives. For example, some programs that start out as social forestry projects, with social welfare objectives being dominant, can quickly change into production-oriented programs, with economic efficiency and market-oriented objectives dominating. The result can be decreases in actual welfare for the rural poor, at least in the short run. Planners must make a conscious effort to keep the original social welfare objectives clearly in mind if they want to continue developing the project or program in a social forestry context.

This concern also relates to a common phenomenon, namely, that project personnel talk about trees planted rather than welfare gains accomplished. There are many reasons why the number of trees planted is often used as a focal index. Among other things, it is a concrete number that can be used to impress political decisionmakers. However, the number of trees planted is not an adequate measure of the changes that will result in welfare. Among other things, survival rates of trees planted by local, unskilled people seldom reach 50 percent, and surviving trees are mainly what lead to welfare gains. Second, key points are where the trees are planted, by whom, and for what purposes (that is, who will eventually benefit). Developing multidimensional measures of project impacts should be a central theme and focus in monitoring and evaluation activities for social forestry.

Concluding Comments

The suggestions made in this chapter, while not universally applicable, provide food for thought in the process of planning, organizing, and implementing social forestry programs. They provide some guideposts, each of which has to be considered in a practical context for each new situation. Much more experience must be accumulated, sifted through, and analyzed before firmer and more specific models for social forestry can be developed. Furthermore, social forestry activities can be extremely complex and involve unique, location-specific combinations of circumstances and factors that defy categorization or classification. Yet, even in such cases, something positive can be learned from experiences elsewhere.

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