Agroforestry Series: Volume I

AGROFORESTRY

CONCEPT AND POTENTIAL

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Faisalabad
Pakistan
1998

PREFACE

Agroforestry is receiving more and more attention from governments and development organizations around the world. These groups are finding that agroforestry has the potential to address several environmental and development problems at the same time. Developing countries are finding that agroforestry may be one important way of dealing with problems affecting their citizens.

Agroforestry is a way of managing land. Agroforestry is the term used to describe the deliberate growing of trees and shrubs together with agricultural crops or livestock. Agroforestry is known as a strategy which attempts to reduce land use conflict and increase what the land can produce.

Our approach to agroforestry is aimed at encouraging farmers to practise agroforestry on their lands so that the benefits/outputs are directly related to their needs and lives.

In view of high importance and potential of agroforestry and scarcity of literature on this comparatively new subject, a modest effort has been made to compile a series of booklets on various aspects of Agroforestry and make these available to the officers of Punjab Forest Department, students, teachers, and other interested persons for their study, concept clearance, practical use and further extension of this knowledge to other staff and persons.

The Volume-I of this series deals with the definition, concept, historical background, need and potential of agroforestry, its importance in Pakistan and its role in rural development.

Volume-II: It describes ecological, economic, social and institutional aspects of agroforestry in a concise form.

Volume-III: It gives classification of agroforestry systems alongwith its purpose and criteria. The role of woody perennials, their arrangement and interaction with other components in some agroforestry systems is also indicated. An important item of choice of species for agroforestry is also included in it.

Volume IV: The existing agroforestry systems in Pakistan have been described briefly. Existing agroforestry systems and practices in different parts of the tropics and sub-tropics the world-over have also been given.

Volume-V: Design, establishment and management of an agroforestry system has been given in this.

Volume-VI: This contains the procedure for financial analysis of an agroforestry system with some other useful and practical information. It has been compiled by Malik Muhammad Khan, C.F. who has got advanced training on the subject from USA.

This series of volumes on various aspects of agroforestry has been compiled by the authors on the basis of available literature on agroforestry most of which have been published by ICRAF. No originality is, therefore, claimed in these. A list of reference has been added at the end of each volume, which have been freely used in the preparation of these booklets. Authors are grateful to the previous writers whose publications provided a sound base for compiling this series.

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1 DEFINITION AND CONCEPT OF AGROFORESTRY

Introduction

Growing of woody plants with agricultural crops and/or livestock together on the same land is one of the oldest and most widely practised systems of land use. What is new is the use of the term 'agroforestry', reflecting the recent upsurge of interest in various multi-cropping systems in response to increasing pressure on land for food, fuel and materials, and the need to combat the erosion associated with cultivation (CAB, 1962). Agroforestry as a science is based on forestry, agriculture, animal husbandry, aquaculture and fisheries, land resources management, and other disciplines which all form the systematic background of land use.

Agroforestry is an inter-disciplinary approach to systems of land use. It implies an awareness of interactions and feed back between man and environment, between demand and available resources in a given area, which - under certain conditions require optimization and sustained management rather than ever-increasing exploitation. But, why should we not continue the already available traditional knowledge of agriculture and forestry to obtain a comprehensive picture of specific agroforestry systems? It is generally accepted that a forest is something else than an agglomeration of individual trees; a human being is more than the added weights or values of his chemical components. Likewise, agroforestry is different from the sum of its two major components, agriculture and forestry which form the 'agroforestry system'. That is why agroforestry, although not new in itself, requires new strategies and technologies as compared to traditional or modern agriculture and forestry (Anon, 1982).

Nobody denies the existence and in fact decisive role of competition in agroforestry when crop plants are grown in combination with forest trees, shrubs and/or livestock. At the same time, however, optimal use can be made of space in the horizontal and vertical directions as well as time. Moreover, it is a characteristic of agroforestry that many components of the systems, fully or partly, are interdependent. This helps to avoid conflicts and to harmonize diversified efforts in land use (Anon, 1982).

Agroforestry, on the other hand, is but a 'tool' to serve man, a tool, as good or bad as others, depending on the qualification and good-will of those who use it. Agroforestry is not good or bad in itself but may well be the best answer to solving problems of rural development in specific sites or regions. For others, it may be just as good as any other land use or even less suitable. The responsibility of a proper choice requires careful weighing of many economical and ecological factors. Agroforestry, as others uses, should always be judged against the question 'does it pay'? (Anon, 1982)

Definitions and Concepts

The following are a few definitions drafted by the experts and scientists interested or involved in land use and related sciences based on their views and their individual understanding of what they call 'agroforestry':

(1) Agroforestry is a land use system that involves socially and ecologically acceptable integration of trees with agricultural crops and/or animals, simultaneously or sequentially, so as to get increased total productivity of plant and animal in a sustainable manner from a unit of farmland, especially under conditions of low levels of technological inputs and marginal lands. (Anon, 1982).

(2) Agroforestry is a sustainable land management system which increases the over-all yield of the land, combines the production of crops (including tree crops) and forest plants and/or animals simultaneously or sequentially, on the same unit of land, and applies management practices that are compatible with the cultural practices of the local population.(Anon, 1982)

(3) Agroforestry is a form of land use that successfully satisfies the needs of the crop farmer, forester and/or stock farmer. (Anon, 1982)

(4) Agroforestry is any land use system that:

-provides fuel as well as tree/shrub products (or the environmental benefits that may accrue from growing trees/shrubs);

-involves multiple mixed or zonal cropping, with or without animal production, in which woody perennials are grown for more than open purpose together with herbaceous crops or grasses.

Through these combinations agroforestry aims to maximize use of radiant energy, minimize losses of plant nutrients in the system, as well as optimize water-use efficiency and minimize run-off and soil loss. Thus it retains any benefits in these respects that may be conferred by woody perennials compared with conventional agricultural crops, and so maximizes total output of benefits from the land whilst conserving and improving it. (Anon, 1982)

(5) Agroforestry is not any one system, but a principle common to many potential and existing systems which:

-warrant social acceptability by breaking up long term ecological cycles in a sequence of easy-to-understand daily and seasonal activities, moulded upon local tradition but conceived so as to increase efficiency;

-aim at complete use of all in-organic resources in all available niches for useful plants and animals, as long as recycling of these resources is maximized;

-diminish risks for the individual farmer by means of a wide variety of useful plant and animal species enlarging the range of products, providing a self- protecting system and enhancing the quality of the daily environment. (Anon, 1982).

(6) Agroforestry is a land use system (a) in which woody perennials and herbaceous crops are grown in mixtures, zonally and/or sequentially with or without animals, and (b) which provides greater benefits for the land use than agriculture or forestry alone, including one or more of the following: Sustained soil fertility, soil conservation, increased yield, diminished risk of crop failure, ease of management, pest and disease control, and/of greater fulfillment of the socio-economic needs of the local population. (Anon, 1982).

(7) Agroforestry is the growing of trees in combination or in sequence with agricultural crops and/or pastures on small holdings or large estates. It is not synonymous with community forestry but is often an appropriate means of implementing a community forestry project. (Anon, 1982).

(8) Agroforestry:

-The art, and eventually, the science of combining herbaceous crops and/or animals with trees on the same unit of land in order to optimize multipurpose production and put it on a sustained yield footing.

-A new scientific paradigm which has arisen to fill the gap created by the time honored separation of agriculture and forestry.

-Any hybrid land use system spawned by the unbridled interaction of agriculture, forestry and allied disciplines. (Anon, 1982).

(9) Agroforestry systems are comprised of tree and non-tree components grown in close association. Their objective is the maximization of the long term yield of desired products. Yield is generally drawn from both tree and non-tree components, directly or indirectly via grazing animals, although on occasions one component, generally the tree, may be included only to improve the performance of the other. The essential feature of these systems is the close interaction, competitive or complementary, between the tree and non-tree components. The contrast between the components in their physical dimensions, their life spans and their physiological responses provide additional complexity which sets these associations aside from the general concerns of either forestry or agronomy. (Anon, 1982).

(10) The term 'agroforestry' covers a variety of land use systems combining forestry with agriculture or range management on the same land. Agroforestry aims at solving problems of rural development, predominantly in the tropics, by

- increasing and improving the yields of food production;

- safeguarding local energy supply;

- production of timber and a variety of other raw materials for the farmer's subsistence, for industrial use and - if applicable - exports;

- protection and improvement of the production potential of a given site and environment; increasing the human ecological carrying capacity;

- safeguarding sustainability through appropriate intensification of land use;

- improving social and economic conditions in rural areas by creation of jobs and income and reduction of risks;

- development of land use systems which make optimal use of modern technologies and traditional local experience and which are compatible with the cultural and social life of the people concerned. (Anon, 1982).

(11) Agroforestry denotes systems of land management which involve the use of trees and shrubs in combination with agricultural food or fodder crops and livestock and are designed to optimize output of usable products, and to maintain or improve the productivity of the soil.

In its narrow sense, agroforestry reforms to systems in which trees and agricultural crops including pastures and range species are grown simultaneously, in relay, or sequentially on the same piece of land and used for a range of purposes.

In its wider sense, agroforestry develops the concept of using trees as a component of the overall management of land resources to meet the needs of the people for food, fuel, and shelter and income. The systems used need to be socially, culturally and economically acceptable, to maximize total output at a given input levels, and to minimize damage to the total environment.

In agroforestry, all trees and shrubs are regarded as crops and their management varies according to their main uses and the needs of the associated plants and animals. For the traditional agriculturist, agroforestry corrects a long time neglect of trees as soil improvers, soil protections, producers of fodder, food, fuel wood, timber and other useful products. For the forester, agroforestry corrects a long time lack of intimate concern for the welfare of rural people as distinct from guarding and managing forest resources 'for the benefit of society'.

Agroforestry in its applied aspects is a set of management techniques combining elements of agronomy, animal production and silviculture with those arising from the interaction of plant and animal species of different sizes, growth patterns and requirements.

Agroforestry is a complex applied science requiring knowledge of the environment, agriculture, forestry and people. Although much is known about the components individually, relatively little is known about the interactions between them apart from largely empirical observations. Hence, existing knowledge needs to be examined afresh and new

knowledge sought on the interactions between the components. Agroforestry thus provides an important additional dimension to the scientific approach to natural resources management. (Contant, 1980).

Agroforestry is not a new enterprise since it has been practised under different conditions and in diverse locations for more than a century. The system originated with the Burmese hill-farming experience using teak as the forest crop. Since then, the system, though called by different names, has spread throughout Asia, and to Africa and Latin America. The basic conditions that favour its adaptation are those of unemployment and shortage of farmlands. However, over the last two decades during which critical political decisions have had to be made under severe socio-economic climate, agroforestry has become increasingly popular, not merely as a regeneration technique but increasingly as a comprehensive rural development programme. The tremendous employment opportunities generated as well as the social infrastructures and multiple effects thereof have enhanced the popularity of the scheme. The real increase in the quantity and variety of food stuffs due to agroforestry in addition to its role in soil rehabilitation and in conjunction with other land use agents are now widely recognized. The potentialities of agroforestry compel a land-use management which eschews the false dichotomy of agriculture and forestry which conserves the ecosystem, and which at one and the same time provides food and wood. Therefore, there is an urgent need for a new cadre of forest managers not only trained in multiple production systems but also fully aware of the significant role of the pertinent socio-economic inputs. The future of agroforestry is intimately related to the development of appropriate expertise and implementation techniques.

The definition put forth by King and Chandler (1978) is very generally accepted and is reproduced below:

(12) " Agroforestry is a sustainable land management system which increases the overall yield of the land, combines the production of crops (including tree crops) and forest plants and/or animals simultaneously or sequentially, on the same unit of land, and applies management practices that are compatible with the cultural practices of the local population." (King and Chandler, 1978)

In the above definition by King and Chandler the phrase "on the same unit of land" seeks to emphasize that zonal arrangements of agricultural crops and forest crops are not considered to be agroforestry, and to imply that the mixtures of the combined agricultural and forest crops should be intimated. However, it is still considered that the definition is inadequate, because, for example, it does not tell us what is meant by a "unit of land", and hence cannot help us to comprehend fully what is the degree of intimacy required to distinguish agroforestry systems from systems in which agriculture and forestry are, to some extent, zoned or occupy adjacent but distinct blocks, or in which there are strips (or lines) of forest trees alternating with strips (or lines) of agricultural crops (King, 1980).

The definitions are inadequate in another respect, in that they do not distinguish the many types of systems that may possibly fall within their ambit. Accordingly, King

(1980) attempts to add to the definitions, to explain more fully the concepts of agroforestry and to delineate various sub-divisions of the subject as under:

Agroforestry should be considered to be a generic term that embraces the following specific components:

(a) Agrisilviculture: the conscious and deliberate use of land for the concurrent production of agricultural crops (including tree crops) and forest crops. This is perhaps the most common form of agroforestry.

(b) Silvopastoral: the land management systems in which forests are managed for the production of wood as well as for the rearing of domesticated animals.

(c) Agrosilvopastoral: in which land is managed for the concurrent production of agricultural and forest crops and for the rearing of domesticated animals. This system is in effect, a combination of agrisilviculture and the silvopastoral system.

(d) Multipurpose forest tree production systems: here forest tree species are regenerated and managed for their ability to produce not only wood, but leaves and/or fruit that are suitable for food and/or fodder.

The question of intimacy of mixture, and of the width and extent of zones, blocks, strips and rows are still not resolved, however, by these definitions. King (1980) suggests, as a working hypothesis, that agroforestry might be considered to be practised whenever trees and agricultural crops are grown in mixture, provided that the combined widths of the rows of agricultural crops do not exceed the heights, at maturity or at the end of the selected rotation, of the forest tree crops with which they are grown in mixture; provided further that the combined widths of the rows of the forest tree crops do not exceed the height of the tree crop at maturity or at some selected rotation. This suggestion takes into account, to some extent, the possible competitive influence of the tree crop on the growth of the agricultural crop. It assumes that agriculture crops that are grown in strips, etc., that are no wider than the final height of the trees, will be positively influenced by the ameliorating effects of the trees on the site.

Agroforestry comprises combined land use practices which, observing ecological criteria, aim at improving agricultural production to the direct advantage of the local population (Mueller, 1982). Agroforestry implies production system and technologies which are adapted to the needs and to the cultural background of the population concerned. It aims directly at social development in rural regions, applying self-help strategies.

Agroforestry may involve the integration of trees into farming systems or crops and livestock into forests (ICRAF, 1983 a). In practice, a high proportion of agroforestry systems involve the growing of trees on what is primarily agricultural land. Crop or livestock production on land devoted primarily to forestry is less common but also within the scope of agroforestry.

Reid and Wilson (1985) say agroforestry is a result of new inter-disciplinary approach to the problems of producing food, energy, clothing and shelter. It allows mankind to integrate the enormous variety of useful tree species with the already accepted agricultural techniques of a community - be it the capital intensive farming systems of the western world, or the labour intensive subsistence plots of developing countries.

In one sense, agroforestry is easy to define. It is the combination of agriculture and forestry on the same land, with livestock or cropping enterprises running underneath a regime of wide spaced trees, either simultaneously or in sequence. But the definition begins to blur from them on (Reid and Wilson, 1985). This is because of the infinite variety of combinations possible in mixing agricultural pursuits with the growing of trees. Also, current management practices in many horticultural orchards, where fruit trees have interplantings of annual crops, or grazing of livestock, make the definition difficult to use with the degree of accuracy most research workers would like. It is something they grapple with the some frustration when a practical yardstick of agroforestry is sought by farmers.

Nevertheless, agroforestry is readily definable using the various practical examples of it throughout the world. It also comes under a number of different names which may be confusing to the beginner, but which adds up to the same kind of thing - an alternative land use system for sustained production of food and fibre. So, the definition can be a land use system which combines wide-spread trees with livestock or cropping enterprises (Reid and Wilson, 1985). Under this heading comes all the various names for agroforestry systems, such as: multi-tier farming or three-dimensional farming; agrisilviculture or silvi-pasture system; forest farming, forest meadows; the taungya system; farm forestry; intercropping, and multipurpose plantation forestry. All these terms attempt to describe what is now termed agroforestry.

(13) Probably the best description of agroforestry has been used by the International Council for Research in Agroforestry (ICRAF). It is: "Agroforestry is a collective name for land use systems and technologies, where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land management unit as agricultural crops and/or animals, either in some form of spatial arrangement or temporal sequence. In agroforestry systems there are both ecological and economical interactions between the different components".

The ICRAF definition is also superior in its acceptance of multipurpose tree growing. In it wood is only one possible product for use or sale; others can be nuts, livestock fodder, bark or leaf products or essential oils and pharmaceuticals. The multipurpose definition can include shade and shelter, soil erosion control, recycling of nutrients, energy cropping, and wildlife habitat. (Reid and Wilson, 1985).

Components of an Agroforestry System

Agroforestry is, however, more than the simple amalgamation of farming and forestry as already stated. It requires new management practices and technologies which

understand the complex interactions of the various components of the system. Various components are (Reid and Wilson, 1985):

i. Land
ii. Environment
iii. Agricultural component
iv. Forestry component
v. Management strategy

Agroforestry will require, from both scientists and farmers, a new way of looking at their work. They must appreciate the system as a whole, involving the complementary and competitive interactions between the various components. It is also a system for sustained stewardship of land that belong not only to today's farmers, but to generations of farmers as yet unborn.

Reid and Wilson (1985), however, say that they do not see agroforestry as an antidote for all the agricultural problems facing the world today, but rather as a much-neglected alternative and husbandry which should be considered with equal standing alongside other land use possibilities. It is obvious that the degree of integration of trees into the agricultural mainstream and the nature of that integration, will vary depending on the climatic, soil and the economic environment. Sometimes the best solution would not involve trees at all. Also on the other hand, the agricultural component might be undesirable in some cases. It should be understood though that between these extremes lies a continuum of infinite combinations known as agroforestry.

Social Forestry

With the renewed interest in the role of trees for environmental conservation and for meeting the day to day needs of the people respect of various forest produce much has been written on the subject. The terms used for various programmes of extending tree cover to non-forestry areas, used rather loosely in Indo-Pak subcontinent are: social forestry, farm forestry, agroforestry, community forestry, environmental forestry, tree farming, forest farming, village woodlots, small scale forestry, bio-aesthetic plantations, energy plantations, three dimensional forestry (conservation, tree crops and livestock), forestry for 4-F (fuel, forage, fodder, fertilizer), etc. (Tiwari, 1983). The list of such terms goes on increasing with every seminar, symposium or workshop dealing with the role of forests in meeting the energy crisis, environmental conservation rural development, etc. Very few of these terms have been properly defined.

The concept of Social Forestry in India is to make available tree based produce in the form of firewood, leaf, fodder, small timber, fruits, edible flowers and a variety of other materials like bark, gum, resin, etc. for rural cottage industries within easy reach of the people in such a way that people feel that they have actively participated in getting it. The emphasis has to be more on people and in fact like democracy, social forestry may be called forestry of the people, by the people and for the people (Tiwari, 1983). While the

objectives may be quite clear, a precise definition has the effect of bringing the ideas of the programme to the level of an operational model.

Social forestry has been defined by Tiwari (1983) in the Indian context as "the science and art of growing trees and/or other vegetation on all land - available for the purpose, in and outside traditional forest areas and managing the existing forest with intimate involvement of the people and more or less integrated with other operations, resulting in balanced and complementary land use with a view to provide a wide range of goods and services to the individuals as well as to the society".

Social forestry for urban areas may have some different objectives. Here the main emphasis is on the aesthetic development of the landscape and beautification of compounds, roads, parks and vacant lands in or near the town and cities for creating tree reserves for maintenance of environment. Social forestry for rural masses has a still higher objective for meeting the needs of the poorest of the poor in the countryside by providing them with employment and making available firewood and other tree products and to improve their agricultural production, if they are not landless.

Social forestry is a concept, a programme and a mission which aims at ensuring/providing ecological, economic and social security to the people particularly to the rural masses, more so to those who live below the poverty line, particularly by involving the beneficiaries right from the planning stage to the harvesting stage but not only as wage earners (Tiwari, 1983). It envisages use of community lands, individual holdings and other public lands, denuded/degraded land for producing what the dependent communities need and for environmental purposes. It aims at mixed production systems of wood, fibre, fodder, grasses, fruits and other raw material for self-consumption and cottage industry and if surplus for sale. Here Government control is minimal though financial and technical support is assured. The profits that accrue after meeting the local demands are to be shared between Government and the people.

Burley and Wood (1983) comment that several terms now in common use to describe community type of forestry are sometimes used synonymously but they are by no means equivalent, since some describe concepts and objectives while others comprise land management systems.

Social forestry can legitimately be applied to almost any type of forestry since some social benefits (employment, export earning, etc.) may be obtained from even the most commercialized and industrialized production system. It is more generally applied, however, to enterprises conducted on a smaller scale, in which industrial timber production is usually not the sole objective and in which the benefits to the community are more tangible than such shadow-priced values (Burley, et al, 1983).

Social forestry includes community forestry in which the planning, establishment, management, harvesting and marketing of forests, trees and their products are carried out either by the rural community members themselves or by a state Forestry Service on their behalf, with the proceeds going to benefit the community rather than individuals.

It also includes farm forestry in which individual land owners (encouraged by training, extension programme, demonstrations and incentives) plant trees in farm woodlots, contour or boundary lines, or intermixed with agricultural crops (Burley, et al, 1983). Farm forestry has been defined by Manandhar (1980) as the practice of forestry on farm lands, it may or may not be integrated with other farm operations. It includes the growing of scattered trees on the margins of cultivated land and also small patches of forest in waste lands generally for agricultural crops. Shelterbelts and windbreaks also come within the domain of farm forestry. The definition of farm forestry is relatively broad in order to encompass the wide spectrum of forestry practised by small farmers in different countries of the developing world.

Strip planting (referred to in India as extension forestry) is also included in social forestry and refers most commonly to the planting of trees on the sides of roads, railways and canals (Burley, et al, 1983).

Recreation and amenity forestry refers to the creation and maintenance of trees and forests for specialized recreational use or improvement of local amenity. Their value is difficult to quantify and they are more common in more developed economies where they have clear social benefits (Burley, et al, 1983).

Rehabilitation forestry concerns degraded forests and soils and it may have both direct productive benefits and indirect social benefits (e.g. releasing more land for agriculture, renewing supplies for local industry, improving dry season grazing, reducing soil loss, etc.) (Burley, et at, 1983).

Compensatory plantations may improve conservation of natural forests with benefits for gene conservation, supplies of medicines, protection, etc. (Burley, et al, 1983).

All of these eight terms may be collectively called social forestry. Agroforestry, embracing agrisilviculture and perhaps better called "land husbandry" is a collective term for systems of land management and technologies that incorporate mixtures of annual and perennial crops and animals (which may range from insects to mammals) in either space or time for sustained production with management practices that are compatible with local culture (Burley et al, 1983).

Burley, et al (1983) comment that in many countries the term has been taken to be synonymous with either social forestry or farm forestry. Agroforestry is only one set of land management systems; parallel with pure agricultural or pure silvicultural systems according to whether it is appropriate or inappropriate to local environmental and social conditions and it may or may not be used in social forestry.

To facilitate the understanding of the distinction between agroforestry and social and community forestry a classification of land management systems with possible application in various types of productive and social forestry is given in Table 1 below (Burley, 1983):

Table 1 Land Management systems applicable to various types of social and commercial forestry.

Management system	Objectives							
	production(commercial) forestry			: Social forestry				
	Govt	Indus-trial	Private	:Commu-: nity	Farm	Exten-sion	Recre-ation	Rehabili-tation
Natural forest.								
Exploitative	x	x	x	x				
Natural re-generation	x	x	x	x			x	
Enrichment	x	x					x	x
Artificial forest.								
Dense planting	x	x	x	x	x			x
Line planting	x	x			x	x	x	x
Agroforestry mixture				x	x			x

2 NEED AND POTENTIAL OF AGROFORESTRY

Need

For those developing countries not possessing significant oil or mineral wealth upon which to base their economic development, the output from the use of their land resources must, for the foreseeable future, form the basis for their economies. Not only must the land produce the basic needs (food, water, wood, animal protein etc.) of a rapidly increasing population, but also the surplus required to initiate and maintain the social and economic development processes.

i. Energy Crisis

Over the past two decades, most countries have had to come to grips with an "energy crisis" - a crisis based on the changing price of oil, the search for acceptable and practical alternative source of energy, and the environmental effects of a continuing dependence on fossil fuels. But the vast majority of people in developing countries, particularly the poor, face a different kind of energy crisis altogether: a massive dependence on rapidly dwindling supplies of fuelwood and charcoal.

More than two-thirds of people in developing countries depend mainly on wood for their household energy needs. In rural areas, the forest as a source of fuelwood is fundamental to every day life. More than 80 percent of the wood harvested in developing countries is burned to cook meals, heat homes and sustain rural industries.

Population growth and the continuing dependence on fuelwood has led supply to fall too far behind demand. Two out of every three developing countries now suffer severe fuelwood shortages. Half the countries with fuelwood shortages have no proven oil or gas reserves. Alternative sources of energy are either too costly or not available (Hafeez, 1988).

As fuelwood supplies are depleted, families turn to whatever substitutes they can find. These include crop residues and animal dung. Burning these as fuel uses up valuable sources of livestock feed and robs the soil of badly needed organic matter and nutrients, leading in turn to reduced crop yields. In areas where fuelwood is scarce, an estimated 400 million tonnes of dung are burned each year to cook meals. This has reduced food-grain harvests by more than 14 million tonnes - nearly twice the amount of food-grains annually provided to developing countries.

The fuelwood crisis is more than just an energy issue; it is an ecological issue too. Where regular fuelwood supplies to not keep up with demand, trees are cut down at random, leading to deforestation. The stability of the environment is compromised and the potential for food production is impaired.

The fuelwood crisis is a social issue. Where fuelwood supplies are already short, consumption by the people most dependent on them is driven well below subsistence requirements. As fuelwood supplies become increasingly scarce, people must walk farther and farther ton find new supplies. Gathering fuelwood increasingly dominates the daily lives of millions of rural people, most of them women. This affects family life, and shortens the time available for tending crops, preparing food and fulfilling other domestic needs.

The fuelwood crisis is also an economic issue. Lack of purchasing power on the part of rural people discourages private investment to meet rural needs. The rural poor must either find low cost wood or do without. In urban areas, households must buy fuelwood or charcoal at market prices. Shortages (and the distances over which fuelwood must be transported) have caused prices to rise so sharply in recent years that the wood used for cooking often costs more than the food cooked.

The economic effects of fuelwood scarcity are felt beyond the home. In many developing countries, a number of agriculture based industries such as fish- smoking, tea and tobacco-curing and beer-brewing, as well as other industries such as brick making and pottery, depend heavily on fuelwood. Shortages of fuelwood directly affect these industries and the level of employment and income generated by them.

The fuelwood crisis is a nutritional issue too. In some countries, malnutrition may be caused as much by the lack of fuelwood as by the lack of food. Where fuelwood is in short supply, families may not be able to boil their water and may be compelled to eat less nutritious, quick-cooking foods - or even uncooked meals. Their health - especially that of the children - may be seriously impaired as a result.

Without radical changes in attitudes and fuelwood policies, more than 2800 million people will be short of fuelwood by the end of the century. They will be caught in a destructive cycle of deforestation, fuelwood scarcity, poverty and malnutrition.

Situation in Pakistan

Pakistan's forest resources are limited. Presently, about five percent of the country's land is under forest cover. It is becoming increasingly difficult to meet the demands of the growing populace for fuelwood, fodder, agricultural implements, and raw materials required for wood based industries.

More than 60 percent of the land in Pakistan is either already affected or likely to be affected by desertification. The suspended sediment load per km of drainage basin is one of the highest in the region. More than 1.2 million ha of land has already been affected by soil erosion, 4.2 million ha have been rendered unproductive by salinity, and another 2 million ha have become unarable due to water logging. Inspite of reclamation efforts, large areas remain plagued by these problems.

Although the official figure for the country' forested land is 5 percent, actual productive forest area comprises less than 2 percent. Consequently, available timber per

capita is only 0.013 m^3 as compared with per capita consumption of 0.024 m^3. Imports which narrow the gap between supply and demand, have swollen to Rs. 1.7 billion per annum. Most likely, rising demand and declining supply will follow in the wake of increasing population and per capita income growth on the one hand, and shrinking forests on the other. It has been estimated that the present (year 1987) annual timber requirement of two million m^3 will double by the year 2000, and that firewood consumption will increase from 16 million m^3 to 30 million m^3 within the same time span.

Due to the widening gap between wood supply and fuelwood demand, the bulk of our domestic energy requirements are being met by kerosene oil, natural gas, electricity, cow-dung, and agricultural wastes. All of these commodities could be used more profitably for industrial and crop production rather than for fuel consumption. Imports total 13000 m^3 annually, costing more than Rs. 95 million. With pulp, paper, and other wood products, the foreign exchange bill has risen to Rs. 1.7 billion per year.

ii. Food Emergencies

Forests and trees are intimately linked to agriculture. They play vital role in sustaining crop yields by helping to maintain the soil and water base. They ensure environmental stability by mitigating the effects of climatic irregularities, storms and winds. They reduce soil erosion and moderate stream flows. They restore soil fertility in shifting agriculture. By slowing the wind and increasing soil moisture, they increase farm yields in arid and semi arid areas. Finally, they provide a significant proportion of livestock feed.

Sustainable agriculture, including crop and livestock production, is the corner-stone of national development in most tropical countries including Pakistan. But the constant struggle for additional cropland has become the largest single cause of forest destruction. Inequitable land tenure, loss of available arable land to large scale, non-agricultural projects, and low agricultural productivity, combined with rising rural populations are accelerating the conversion of more and more forest lands to non-sustainable uses.

Unwise landuse policies that lead to environmental degradation are a primary cause of the food emergencies that occur with tragic regularity in many developing countries.

Upland watersheds should benefit both upland and lowland communities. Skillful land use that maintains the environmental stability of such areas protects downstream hydropower reservoirs and irrigation system from silt. In return, the hill populations can benefit from the wealth generated by lowland communities for the provision of roads and other services. As population grows and arable land becomes increasingly scarce, many farmers are forced to clear steep upland areas. The removal of upland forests increases the incidence of lowland flooding and the silting up of rivers and major reservoirs.

Agriculture nearly everywhere has traditionally been concentrated on fertile plains and valley floors. Population growth, inadequate agricultural practices, and poorly defined

and inequitable ownership rights and land tenure, and increasing scarcity of arable land have forced farmers to clear steep upland areas.

The removal of upland forests increases lowland flooding and the silting up of rivers and reservoirs. On the lowland plains of Pakistan, India and Bangladesh, for example, the welfare of more than 400 million people depends largely on how 46 million hill-dwellers manage their land.

Deforestation can set off a chain reaction leading to desertification - the reduction of semi arid land to unproductive desert. The process begins when vegetation is removed, reducing the benefits of rainfall by decreasing the amount of water that percolates into the ground. Run-off increases, erosion accelerates, the water table is lowered, and springs and wells dry up.

Dry lands are particularly susceptible because of the erratic patterns of rainfall and the fragility of their soils. In the developing world as a whole some 1300 million hectares of land, where more than 300 million people live, are in various stages of desertifications.

iii. Fragile Ecosystems

The arid and semi arid zones of the world, arid savannas of the tropics, the slopes of the mountains of the tropics and sub-tropics and forest areas of the developing world under shifting cultivation have been described by King (1979 a) as ' Fragile Ecosystems' because their equilibrium appears to be easily upset and because they become ecologically degraded if certain forms of land use, particularly sedentary agriculture, are practised in them. They have also been described, from another point of view, as Wasted Lands (King and Chandler, 1978) because they represent areas in which natural resources are currently being wasted either through over-exploitation, under utilization and mismanagement, or through sheer neglect.

It has been estimated (King, 1979 a) that 4,900 million hectares, or 65% of the land in the tropical world may be classified as being "wasted" or as occupying fragile ecosystems. These lands are found in the poorest countries in the developing world. The number of people who depend upon these areas for their food and livelihood is 630 million or 35% of the total population of the developing countries (King, 1978 a). The people who live in these areas are, on average, poorer than those who live in other parts of their already poor countries. They are thus the poorest of the world's poor.

They cannot afford to purchase food from other less brittle and fragile ecological zones. Accordingly, if they must eat they must either be given "food aid" or be made to settle in areas that are better suited to permanent arable agriculture, or be given alternative occupations so that they might earn money to buy food, or produce food for their sustenance in these fragile ecosystems.

Although food aid is not to be rejected out of hand, it must be regarded as essentially an emergency measure. A nation or part of a nation should not be forced to

depend upon such assistance for one of the basic necessities of life. The resettlement of large populations is not only costly, it is bedeviled by a number of social problems that have led to the failure of most of the land settlement schemes that have been attempted in the Third World. The developing countries find it increasingly difficult to create job opportunities for their citizens. Indeed, the average rate of unemployment in the developing world is over 25 percent.

The consequence of this failure to offer alternative sources of income or food is that most of the inhabitants of fragile ecosystems must perforce, now and in the foreseeable future, themselves provide their own food. However, studies of the arid and semi arid zones reveal a history of degradation of vegetation and soils, and a reduced productivity of both natural and "managed" ecosystems. The situation in the arid savannas, which are to be found mainly in South America, is no less reprehensible. Here again, an extensive resource is not only under-utilized, it is also being degraded.

Forests in tropical and sub-tropical mountain ecosystems are being raised to the ground at alarming rates to provide wood for fuel and shelter to rapidly growing populations, and to yield land for farming for food for the inhabitants of these areas. The improper land use of upland areas obviously affects the development of those who live there. What is perhaps more important, is that malpractices in the utilization of the slopes of these hills and mountains often lead to erosion, increased run-off, siltation of the rivers, flooding and droughts. Agricultural productivity in the often more fertile and higher yielding valleys is, therefore, adversely affected; irrigation works are rendered ineffective and the rate of both agricultural and industrial development is reduced. The ravages of the forests in mountain ecosystems are to be observed mainly on the foothills of the Himalayas, and it is perhaps no coincidence that the highest incidence of recurring floods and droughts are to be found in the Indian subcontinent. Shifting cultivation is practised on every continent that is occupied by developing countries. As a result, soils have become degraded, indeed often to the point of making the land incapable of supporting further crops. The practice of shifting cultivation has destroyed thousands of hectares of forests, valuable timber resources have been depleted and the protective cover removed from vast watershed areas.

It is evident in all these areas (which have been described as being "fragile ecosystem", the necessity for food has forced the occupants to employ land-utilization practices that have led to the degradation of the ecosystems.

No alternative energy source will provide a viable substitute for fuelwood in the near future. In places where a surplus of wood for energy exists or could be created, wood-based energy can contribute to rural and industrial development, as well as to self-reliance in energy at the national level. Similarly food deficit continues in our country and food has to be produced to feed the ever-increasing population.

Several factors that make today's 'land use crisis' a global issue of greatest concern are:

The magnitude of the problem in terms of people and areas affected, which is unprecedented in history.

The accelerating nature of the processes involved and the increasing irreversibility of their results. It is often very elucidating to consider what is happening in the Sahel, the Himalayas, the Amazon and other places, by employing a time scale of decades rather than years. The distressing and alarming trends become clearer when we are not fooling ourselves with looking at year-to-year variations caused by differences in rainfall, short term political decisions or economic measures which may very temporarily alleviate a local problem.

The lack of success (for socio-economic, cultural or ecological reasons) of most agricultural technologies from temperate regions to solve land-productivity problems over large areas of the tropics and the sub-tropics, and the grossly inadequate resources set aside, nationally and internationally, for research and development of suitable land use technologies and systems for these areas.

It is now time to design a strategy not only to overcome the present deficit, but also to meet the increasing demands placed on public and private forests and farmers.

Strategy for action

i. Agroforestry

It is difficult to increase the forested area because suitable publicly owned lands are not available. Forestry competes with agriculture for inadequate quantities of water, and natural conditions for forest growth are constrained by the problems of arid and semi arid conditions coupled with increased population pressure and uncontrolled grazing.

Present demand for food and agricultural products in developing countries is expected to double by the year 2000. Therefore, there is no doubting the huge benefits of both restoring degraded agricultural land to productive use and ensuring that no more land is put out of production.

The priority is to improve and intensify agricultural production on land suited to agriculture, thereby lessening the need to clear new land and taking the pressure off forest lands. This must go hand in hand with controlling deforestation, regenerating vegetative cover and adapting farming practices to suit local needs and ecological conditions.

It is time that we devote greater attention to economically and ecologically sustainable agricultural production systems where present economic progress and prospects for survival will not be in conflict. Fortunately, agroforestry systems are characterized by this happy blend and help us to exploit in a sustainable manner cubic volumes of soil and air and thereby give farmers the maximum return from the available soil, water, nutrient, and sunlight. Agroforestry (combining forestry with crop or livestock

production) and landuse practices that combine agriculture, forestry and pastoralism offer important opportunities for improving productivity while maintaining environmental stability.

Agroforestry is generally taken to be synonymous with either social forestry or farm forestry. Agroforestry is only one set of land management systems; parallel with pure agricultural or pure silvicultural systems according to whether it is appropriate or inappropriate to local environmental and social conditions and it may or may not be used in social forestry. It is one of the means to achieve the objective of Social Forestry. "Agroforestry is a collective term for system of land management and technologies, where woody perennials are deliberately used on the same land management unit as agriculture crops and/or animals, either in some form of spatial arrangement or temporal sequence. In agroforestry systems there are both ecological and economical interactions between the different components".

A strictly scientific definition of agroforestry should stress two characteristics common to all forms of agroforestry and separating them from other forms of landuse namely; (i) the deliberate growing of woody perennials on the same unit of land as agricultural crop and/or animals, either in some form of spatial mixture or in sequence; (ii) there must be a significant interaction (positive and/or negative) between the woody and non-woody components of the system, either ecological and/or economical.

Agroforestry is a socially, culturally and ecologically acceptable, integrated form of landuse involving trees that improves or does not degrade the soil and permits increased and sustained production of plant and animal produce including wood. It is a promising approach to reconcile the production of more food, and the prevention of economic degradation. It aims directly at social development in rural areas, applying self-help strategies.

The aim of most agroforestry systems are to optimize the positive interactions in order to obtain a higher total, a more diversified and/or a more sustainable production from the available resources than is possible with other forms of land use under prevailing ecological, technological and socio-economic conditions.

It combines the protection characteristics of forestry with the production attitudes of both forestry and agriculture. It conserves and produces.

Agroforestry appears as an interesting contribution to solve the food crisis as well as the energy crisis. It creates employment and occupy local under-used labour.

Before deciding the use of agroforestry land use system in any particular situation, it is first necessary to identify where there is a role for agroforestry; considering arid, semi-arid and humid areas separately. A need for agroforestry system will exist whenever the following situations occur (Cannell & Pickersgill, 1983):

A. The land use or farming system is perceived to be non-self-sustaining because of:

(i) depletion of soil nutrients (especially nitrogen and phosphorous);

(ii) soil degradation due to absence of soil cover at certain times;

(iii) inadequate fuel and food supplies.

B. Tree might lessen the risk of hardship because of crop failure (because of the inherently well-buffered ecosystem in agroforestry), and whenever trees will allow farmers to accumulate capital or cash.

C. Trees will help to spread production activities throughout the year, by staggering the harvests, providing products in dry seasons, or spreading the labour load.

ii. Social Forestry

The strategy for action to overcome energy crisis involves a two-pronged approach: increasing fuelwood supply, and reducing demand through improved efficiency in wood-fuel use and substitution.

Social forestry, in which the benefits of tree planting and improved management are shared equally within the local community, must be the focus of efforts to meet fuelwood needs.

Social forestry refers to all professional forestry activities that aim specifically at the participation of local people in forest management and at the fulfillment of the forest-related needs and aspirations of these people.

Potential

The most apparent ecological potential for an agroforestry approach to land use exists in areas where soil fertility is low and mainly depend on the soil organic matter fraction, where erosion potential is high, and where the incidence of surface soil desiccation is high. On such 'marginal lands', which cover by far the largest land surfaces in the tropical and sub-tropical world, the deliberate use of the woody perennials may, if properly integrated in the land use systems, enhance both productivity and sustainability. The less capital and technology that are available the more motivated is the use of trees and shrubs to enhance organic matter production, to maintain soil fertility, to reduce erosion and to create a more even micro-climate.

The potential for agroforestry is, however, by no means confined to 'marginal' lands. Some of the most successful small farmers' systems in the tropics are in fact found on high potential, fertile soils, where intensive agroforestry systems are highly competitive and often economically superior to other forms of land use.

A further rationale for agroforestry, equally applicable on marginal and high potential land, exists in situations where land tenure or lack of cash-economy infrastructure (roads, markets, transport, etc.) makes it vital for farmers to produce most of their basic needs (food, fuel, building material, etc.) from their piece of land (Lundgren, 1982 a).

3 HISTORICAL BACKGROUND OF AGROFORESTRY

Europe

Throughout the world, at one period or another in its history, it has been the practice to cultivate tree species and agricultural crops in intimate combination. The examples are numerous. It was the general custom in Europe, at least until the Middle Ages, to clear-fell derelict forest, burn the slash, cultivate food crops for varying periods on the cleared areas, and plant or sow tree species before, alongwith, or after the sowing of the agricultural crop. This "farming system" is, of course, no longer popular in Europe. But it was still widely followed in Finland up to the end of the last century, and was being practised in a few areas in Germany as late as the 1920s (King, 1968).

America

In tropical America, many societies have traditionally simulated forest conditions in their farms in order to obtain the beneficial effects of forest structures. Farmers in Central America, for example, have long imitated the structure and species diversity of tropical forests by planting a variety of crops with different growth habits. Plots of no more than one-tenth of a hectare contained, on average, two dozen different species of plants each with a different form, together corresponding to the layered configuration of mixed tropical forests: coconut or papaya with a lower layer of a bananas or citrus, a shrub layer of coffee or cacao, tall and low annuals such as maize, and finally a spreading ground cover of plants such as Squash (Wilken, 1977).

Asia

In Asia, the Hanunoo of the Philippines practised a complex and somewhat sophisticated type of shifting cultivation. In clearing the forest for agricultural use, they deliberately left certain selected trees which, by the end of the rice-growing season, would "provide a partial canopy of new foliage" to prevent excessive exposure to the sun "at a time when moisture is more important than sunlight for the maturing grain". Nor was this all. Trees were an indispensable part of the Hanunoo farming system and were either planted or conserved from the original forests to provide food, medicines, construction wood and cosmetics, in addition to their protective services.

Africa

The situation was little different in Africa. In southern Nigeria, yams, maize, pumpkins and beans were typically grown together under a cover of scattered trees. In Zambia, in addition to the main crop in the homestead, there were traditionally numerous subsidiary crops that were grown in mixture with tree species. Indeed, the Yoruba of

western Nigeria, who have long practised an intensive system of mixed herbaceous, shrub and tree cropping, explain that the system is a means of conserving human energy by making full use of the limited space laboriously won from the dense forest. They compare the method to a multistoreyed building in a congested area in which expansion must perforce be vertical rather than horizontal. They also claim that it is an inexpensive means of combating erosion and leaching, and of maintaining soil fertility. As they picturesquely described it, "the plants eat and drink, as it were, not from one table, but from many tables under the same sky".

Change of AF Objective with Time

These examples indicate the wide geographical coverage of the system and its early origins. What is more important perhaps, they clearly point to the fact that the earliest practitioners of what has now become known as agroforestry perceived food production as the system's raison deter. Trees were an integral part of a farming system. They were kept on established farmland to support agriculture. The ultimate objective was not tree production but food production.

By the end of the nineteenth century, however, the establishment of forest plantations had become the dominant objective wherever agroforestry was being utilized as a system of land management. This change of emphasis was not, at first, deliberate. It began fortuitously enough in a far-flung outpost of the British Empire. In 1806, U Pan Hle established a plantation of teak through the use of what he called the "taungya" method and presented it to Sir Dietrich Brandis. Brandis is alleged to have prophesied that "this, if the people can ever be brought to do it, is likely to become the most efficient way of planting teak".

The taungya system spread to other parts of Burma, Schlich recording in 1867 that he had been shown a taungya teak plantation in its second year in the Kabaung forests of the Taungoo Division.

From these beginnings, the practice became more and more widespread. It was introduced into South Africa as early as 1887 and was taken from Burma to the Chittagong area in India in 1890 and to Bengal in 1896.

It must not be imagined that once introduced, the system was practised continuously in India. It was abandoned both in Bengal and in the Chittagong, and was not resumed until 1908 and 1912, respectively. In the second decade of the twentieth century, however, the system became more and more popular with foresters as a relatively inexpensive method of establishing forests. In 1920 it was adopted in Kerala, in 1923 in Uttar Pradesh and in 1925 in Madhya Pradesh.

This period also saw its wider dispersal in Africa, and today it is practised in varying degrees in all the tropical regions of the world. Teak is, of course, not the only forest species which is being established by the use of this agroforestry method. Indeed, the evidence suggests that if the system is utilized for the sole purpose of establishing forest

Because nearly all the forest and forest industry development which has taken place in the under-developed world over the last decades has been externally oriented... the basic forest products needs of the peoples of the underdeveloped world are farther from being satisfied than ever...

Just because the principal preoccupation of the forest services in the underdeveloped world has been to help promote this miscalled forest and forest industry development, the much more important role which forestry could play in supporting agriculture and raising rural welfare has been either badly neglected or completely ignored.

FAO, therefore, redirected its thrust and assistance in the direction of the rural poor. Its new policies, while not abandoning the traditional areas of forestry development, emphasized the importance of forestry for rural development, the benefits which could accrue to both the farmer and the nation if greater attention was paid to the beneficial effects of trees and forests on food and agricultural production, and advised land managers in the tropics to "eschew the false dichotomy between agriculture and forestry" (King, 1979). They also stressed the necessity of devising systems which would provide food and fuel and yet conserve the environment.

As a result of this change in policy, FAO prepared a seminar paper "Forestry for Rural Development" (FAO, 1976) and, with funding from the Swedish International Development Authority (SIDA), organized a series of seminars and workshops on the subject in all the tropical regions of the world, and formulated and implemented a number of rural forestry projects throughout the developing world. In these projects, as with the World Bank's social forestry projects, agroforestry plays a pivotal role. FAO also utilized the 8th World Forestry Congress, which was held in Jakarta, Indonesia in 1978, to focus the attention of the world's leading foresters on the important topic of agroforestry. The central theme of the Congress was "Forests for People", and a special section was devoted to "Forestry for Rural Communities".

ICRAF

International Council for Research in Agroforestry "ICRAF" was established during 1977 to support, plan and coordinate, on a world wide basis, research in combined land management systems of agriculture and forestry.

This congruence of men and of concepts and of institutional change provided the material and the basis for the development of agroforestry since then. Although many individuals and institutions have made valuable contributions to the understanding and expansion of the concept of agroforestry since the 1970s, it is perhaps true to assert that ICRAF has played the leading role in collecting information, conducting research,. disseminating research results, pioneering new approaches and systems, and in general, by the presentation of hard facts, in attempting to reduce the doubts still held by a few skeptics.

Today, agroforestry is taught as a part of forestry and agriculture degree courses in many universities in both the developing and developed world; and specific degrees in agroforestry are already offered in a few. Today, instead of agroforestry being merely the handmaiden of forestry, the system is being more and more utilized as an agricultural system, particularly for small-scale farmers. Today, the potential of agroforestry for soil conservation is generally accepted. Indeed, agroforestry is fast becoming recognized as a system which is capable of yielding both wood and food and at the same time of conserving and rehabilitating ecosystems. This world-wide situation is very true for Pakistan also.

4 AGROFORESTRY/SOCIAL FORESTRY IN RURAL DEVELOPMENT

Introduction

In many of the developing countries of the region today, there is a relentless expansion of populations that could bring forth serious Malthusian questions of survival. The demand for food, shelter, fuel and fodder is rising at a geometric rate as jointly influenced by rapid population growths and increasing per capital consumption. The aggregate supply of the basic commodities, on the other hand, is not expanding as rapidly because the technology available is relatively low, much of the land under tillage has been abused as per capita arable lands continue to shrink, and newly-opened lands added to those under cultivation are from the progressively-steeper uplands that have lower productive capacity. The net effect is a worsening deficit of basic goods over time.

Signs of socio-economic deterioration are becoming progressively clearer and more difficult to ignore. In some countries at this very moment, food products for survival are critically short and have to be imported at high costs, adding more problems to the already difficult balance of payments situation. In others, the scarcity of forests and wood products have caused serious environmental degradation(erosion, soil desiccation, streams siltation, etc.), which further reduce productivity, have made livable homes unaffordable to a large segment of the populace , and have threatened the ability of many rural families to cook three square meals a day, assuming that there is enough food to cook. In almost all third world countries, the common unemployment, poor nutrition and health, low-level education, and other socio-economic situation under which many developing Asia-Pacific countries find themselves is the result of this environmental deterioration.

An array of possible measures could be instituted by governments to remedy the situation, ranging from:(1) population control to ease the heavy pressures on limited land and other productive resources; (2) initiation of new economic activities to generate new employment and to raise incomes; (3) application of appropriate technology to substantially increase productivity and aggregate production; (4) husbanding of the natural environment to enhance sustainability of production; and others. Agroforestry/Social forestry embraces the last three of these four measures, thus making it one of the strong candidates for adoption as a strategy to socio-economic development, particularly in the economically-depressed rural areas of the Third World countries.

The nature and potential roles of agroforestry/social forestry(AF/SF)

In what ways, and to what extent, can AF/SF help alleviate the acute socio-economic problems faced by many of the developing countries? How sustainable are these solutions, and how acceptable are they to the poverty-ridden farmers/ The answers could be found in a brief discussion of the nature and ecological-socio-economic roles that this system of people-oriented forestry practice can play.

1 The nature of social forestry/agroforestry

The first unique characteristic is its small scale. Since it is a forest-based undertaking by an individual or a household, or a group of households, or a community, it is by necessity limited in scope and geographic extent as dictated by the dearth of production inputs in the hands of farmers. The small scale is especially noticeable when compared with corporate forestry activities.

The second characteristic relates to the nature and end use of the products. Unlike governmental or corporate bodies, individuals, households, or rural communities have relatively short time horizons and high propensities to consume, and therefore cannot afford to raise long term forest products. To minimize their waiting periods and maximize their yields per unit time, they normally use fast-growing, early-maturing multipurpose tree species and harvest a wide array of products mostly for local consumption, such as small timber and poles for farm buildings and fencing, small tree stems for fuel wood, leaves for fodder and organic fertilizer, and flowers/fruits for human food. They extract these products using mostly in-house labour under entrepreneurial operations that could be best described as "family enterprise."

A third feature has top do with the system of land use. Where conventional forestry plantation is often monoculture tree cropping for a single end use(say, lumber) social forestry may range from monocropping with multiple-use goals(example: forest plantations with fast-growing species for fuelwood, poles and fodder), on one end, to multiple or integrated cropping systems for a multiplicity of uses(example: trees integrated with food crops for wood, food, fodder and green manure production), on the other.

The fourth characteristic refers to the degree of participation and involvement of the local people. In classical forestry, local people often only serve as hired workers of corporate bodies which plan, implement and manage the project. In social forestry/agroforestry on the other hand, the farmers take the prime initiative of planning and managing their projects. Consequently they bear all the costs, take all the risks, but also reap all the benefits for themselves.

In summary, then social forestry is a small scale land use operation ranging from pure forestry to integrated agroforestry, and planned and implemented by individual farmers or communities to yield products and services for their primary use and benefits.

The land used for social forestry/agroforestry projects could be sole-owned, community or clan owned, or government controlled but made accessible to farmers

2 The potential roles of agroforestry/social forestry

Agroforestry/Social forestry could become highly attractive and readily acceptable to farmers and could be highly favoured by government because of the wide array of roles that it can play which yield direct and immediate micro-level benefits to resource poor and economically disadvantaged rural dwellers, as well as bring forth long term, macro-level, resource-conservation type advantages that government agencies try all the time to achieve. Examples of the impact of agroforestry/social forestry in the areas of ecology, sociology and economics follow.

i. Ecological impacts: site protection, maintenance and rehabilitation

To be productive, land-based production systems, including social forestry, should be sited on the best lands available. In actual land allocation, however the best and most accessible lands are usually- and logically- allocated to food production where agroforestry could be practised. The residual areas, normally the poorest, the least accessible and the least topographically favourable to cultivation, are often the ones assigned to forestry. Thus, social forestry suffers right from the beginning by being relegated to poor sites. Ironically, it is at the same time expected to be productive in those less-desired areas and to perform the "miraculous" transformation of severely degraded sites into highly productive ones.

From available scientific evidence, tree plantations established through agroforestry/social forestry or other reforestation programmes, if allowed to grow over sufficiently extended periods, can improve and rehabilitate the area through substantial inputs of nutrients and organic matter into the soil. Depending on the species and age of the trees, the nutrients injected into the ecosystem could range from about 70 to around 245 kg per ha of Nitrogen per year while the organic matter added in the form of litterfall could be in the magnitude of 3 to 11 tons per ha per year. Besides improving the soil tilth, the accumulated organic matter improves soil porosity and increases the water retentive capacity of the soil to store sufficient moisture which nurtures the plants to ensure productivity and sustainability. Litter also serves as mulch and crowns serve as shade to minimize soil loss through evaporation. All these benefits the farmers directly in terms of higher productivity.

On a macro-scale, the environmental benefits from agroforestry/social forestry which governments want to maximize are slope stabilization and erosion control, especially on watersheds of important streams and reservoirs. Tree roots anchor, stabilize and hold together the soil on steep slopes; tree litter shields the soil surface from the erosive force of raindrops; three crowns intercept and cushion the impact of rainfall; and stems and surface runoff following heavy rains. All these impacts are not viewed by farmers as purely ecological but perceive them as economic in the sense that they positively influence productivity.

While these ecological roles are considered by government to be extremely important especially in the protection of major watershed areas, farmers normally do not fully appreciate them, especially when they are expressed in those terms that appear to have no direct bearing on their production concerns within their farms. Thus, to enlist farmers! cooperation in reforestation through social forestry or agroforestry government often has to set up attractive incentives in the form of subsidies, technical assistance, and long term(sometimes lifetime) lease of government lands for social forestry use, in addition, of course, to campaigns to make farmers aware of the economic advantages that accrue to them.

ii. Economic benefits: Income and employment

To farmers engaged, or about to become involved, in agroforestry/social forestry, the perceived and anticipated economic benefits from this land use system are the most important attraction. These local people expect to be able to produce for their own use, without having to rely on external markets, such prime products as small timber for farm construction; fuelwood for home use and for local markets in the event of surplus outputs; fodder for draft animals or for livestock that serve as source of animal protein in the farmers' diet; green manure with which to substitute for expensive chemical fertilizers in improving productivity, and for mulching to minimize moisture loss from the farms; and food products harvested from the intercrops. These various products are viewed as incomes-in-kind rather than cash incomes and are a direct economic benefit to the agroforestry/social forestry practitioners. Moreover, these incomes from the wide variety of crops become available year round rather than seasonal as in the case of monocultural annual food crops, thereby making AF/SF doubly beneficial to the economically-disadvantaged farmers. Improvement of the ecological status of the farm sites, as pointed out above, now make possible the sustained extraction of these economic benefits from the once-unproductive or low-productive land.

All these outputs and benefits incur costs, of course. Planting trees means reduction of land available to food crops. More complex integrated cropping systems require more labour inputs and reduction of leisure. Generation of outputs in excess of consumption require market outlets and marketing efforts and skill. But these costs are manageable and acceptable to the farmers. Reduced surface are for food crops are willingly accepted in exchange for sustainability of production that he presence of tree intercrops seem able to provide; increased labour inputs are welcomed rather than abhorred because they represent an expansion in gainful employment and, therefore, lead to greater incomes; surplus outputs that require marketing are viewed as an important breakthrough in upward movement from subsistence situations to a market-oriented and, therefore, more progressive existence. All these phenomena which could be triggered by AF/.SF indicate the possibility of a significant improvement in the socio-economic status of the rural populations, as well as for the whole developing nation.

iii. Social benefits: Higher quality of life

Hand in hand with the economic advantages of embarking on AF/SF projects are the anticipated sociological benefits that could accrue to the farmers. Foremost among them is the creation of continuous employment opportunities which generate year-round income that now makes it possible for the rural poor to gain access to better nutrition, higher quality clothing and homes, more stable communities, improved education, and better health.

One drawback from the sociological standpoint that may be recognized is the fact that year-round work by farmers in AF/SF farms would leave them practically no time for recreation and other pleasurable pursuits, and little or no time for the traditional social events and cultural interactions among the rural people. However, this sociological disadvantage may be overcome when the economic gains in terms of greater productivity and incomes enable farmers to improve the quality of their entire lives rather than just sections of it.

Suitability of Agroforestry/Social Forestry as a Development Tool

In Asia, where around 66 percent of the population live in rural areas as tillers of the soil in subsistence or below subsistence levels, and where substantial areas of degraded lands await rehabilitation, AF/SF, with roles as described above, appears to be a promising tool for socio-economic-ecological development.

The Adoptability for Agroforestry/Social Forestry

Nothing is more frustrating to development planners than for them to design what they deem to be the best programme for lifting the rural populations from the depths of poverty only to find that such programme is rejected by the intended beneficiaries. This puzzling phenomenon has been occuring with increasing frequency, and some social forestry programmes have been turned down by farmers in this manner, indicating that the adoptability rating of the programme is very low.

There are two main issues related to the adoption/rejection of innovative land uses, including social forestry: (1) whether the innovation truly benefits the farmers/practitioners; and (2) whether the new system or technology has been introduced and/or transferred to the farmers in a manner that enhances acceptance.

With regards to benefits from new technology, farmers usually readily recognize and take advantage of perceived economic benefits. They may implicitly take cognizance of ecological and social advantages as well, but in most cases, these "intangibles" could be understood and best be handled in terms of economics. For instance, the ecological benefit arising from erosion minimization through tree planting is more deeply appreciated if it is expressed in economic terms as a reduction of nutrient loss and therefore an increase in productivity. In short, farmers may be indifferent to innovative land use system

if proposed and justified merely on basis of soil conversation, but may be wholly receptive to one that demonstrates increased yields per hectare per year.

Agroforestry/Social Forestry, as illustrated earlier, is capable of demonstrating direct economic benefits to upland farmers in the form of readily available small timber, fuelwood, food, fodder, and fertilizer where there used to be serious scarcity. Thus, notwithstanding the nature of the other impacts of the project, farmers are very likely to accept it.

The other issue concerns the method of technology transfer. This has two phases: the first one relates to efforts to alter the farmers' perception of, and regard for, the innovation being advanced. This is largely informational, and while it may not result in a final adopt/reject decision on the part of the farmer, it would at least create enough interest preparatory to the next stage, which is demonstration of an actual or "real-life" project. Working under the "seeing-is-believing" principle, pilot demonstration plots to which farmers can be brought can go a long way in clinching the final adoption of the technology or system. The system of AF/SF land use, and the physical products and benefits that they bring, lend themselves very well to pilot demonstrations. Thus, it is deemed relatively easy to induce adoption by upland farmers,

The two phases may of course be combined under one whole process called "participatory approach". Under this scheme, the target farmers are involved all the way from problem identification, through plan formulation, to implementation. Their intimate participation at the inception of the project enables them to understand what project is being planned and, more importantly, why it is being planned. When the technology comes, the farmers will have reached a high state of receptivity that will be difficult to equal. Thus operates the "bottom-up" or "participatory" approach towards a successful AF/SF project.

In a setting where there is a loud cry for new land use initiatives to promote rural development and soften the harsh effects of overpopulation, under-employment, and poverty, it is important that a development triggering system like AF/SF be well designed by planners and be fully accepted and implemented by the farmer beneficiaries in order to be successful and effective.

Research a Pre-requisite to Effective AF/SF Projects

Development programmes do not just happen. They are deliberately planned and set up. However, sound formulation and effective implementation will only be possible if there is sufficient and reliable information on which to base plans and strategies.

The first set of information required relates to needs analysis and problem identification: What primary products and services do people in rural communities need; what are the constraints and potentials that affect their production? Unless a suitable data base is first made available, plans may be formulated that are not relevant to key needs and problems of rural communities.

The second data set relates to management of the resources: What resources are available in the locality, and in what ways could and should these biophysical technological factors be manipulated and combined maximize and sustain the output of products and services that are in demand by the local people?

The third set pertains to the involvement of the human elements in the production system. What strategies could and should be established such that the local people, for whom and by whom the development programmes are implemented, would readily adopt and willingly embrace the proposed production technologies and reap the benefits?

The fourth and last one has to do with supporting policies: What policy initiatives should government develop in order to support and enhance the success of the development programme?

The act of collecting, collating, synthesizing and interpreting data in order to provide answers to the above pre-project questions is research.. It is obvious that to develop a sound and effective rural development plan requires well-designed and thoroughly undertaken pre-project research.

Management strategies: How AF/SF can be made more effective in rural development

Agroforestry/Social Forestry has contributed to rural development and should continue to contribute more effectively through a well-defined responsibility under integrated resource management schemes.

Rural development is not a simple process, nor is it a sector of national development or a matter of increasing agricultural production. It cuts across a wide spectrum of needs and requirements, therefore, it requires a multi-disciplinary approach and a comprehensive development policy.

A spirit of joint undertaking must be based on completing and supplementing each other rather than competing and monopolizing among all related disciplines; appreciation of and respect for each other's competence, with keen interest in and imagination of every possible diversification. Not a conceptual but an action oriented approach must be used as a vehicle to accomplish the task.

Both donors and receivers must be fully aware of their responsibilities and obligations because the whole development process must be based on open, continuous and constructive dialogue during which shortcomings, possibilities and contributions must be clearly identified. There should be clear common understanding that the current problems and poverty are the results of accumulated misuse and mismanagement by several past generations, but also have a direct bearing on future generations, so that the solutions are long term in nature and complex and huge in their magnitude. Effective and continuing incentives and motivations are needed to reverse the trends. However, these

should not be taken free for all, but as a starter to set the communities themselves on the road to reconstructing their own lives and environment.

Rural development cannot be achieved unless resource potentials are correctly measured, respective problems and constraints are identified and possible solutions are planned in accordance with their technical possibility, economic feasibility and social acceptability.

Technical constraints are the least difficult to overcome, while socio-economic and institutional ones are deep-rooted and require constant effort and sincere determination for their solution.

Administrative machinery must be reorganized to deal effectively with rural development, in coordination with decentralization of the responsible department(s) in order to have constant and direct contact with the people at grass roots level.

All legislation related to rural development, especially that dealing with natural resources management, credit and subsidies, should be reviewed with the aim of making necessary amendments to provide rural communities with flexibility, alternatives and financial assistance to produce their immediately essential needs in harmony with long term benefits and services,

Rural communities have to be motivated and mobilized to take part in and pursue every phase of the development, from planning to maintenance and monitoring. Their self-reliance has to be reactivated and their accumulated experience should be respected.

An appropriate technology, which blends the traditions, conventional practices, culture and aspirations with modern science, has to be developed and implemented in sincere and continuing effort to uplift the quality of their life.

The motivation and incentives need to be taken in their entirely as a package covering establishment of dialogue, training, stimulation of their active participation in the process, provision of financial support in cash or in kind, legal security, community development, market promotion, infrastructure, health and education systems.

The communities need to be organized into cooperatives, associations, committees, action groups etc., to stimulate the sense of belonging, common ambition and security of the people in their own development. This is also a practical way of making their voice heard and getting respective measures taken by the Government.

Selection of incentives should and can be made according to the socio-economic conditions, resource availability, technical know-how and administrative set up. Incentives for development of forest resources on state-owned or communal land for timber production and protection of downstream interests should consist of convenient working seasons and length, attractive employment conditions, bonus for protecting these plantations against vandalism and arson; certain royalties at the age of harvest and the provision of thinning wood free or with a nominal charge could create vested interest.

To carry out development on land partly owned or utilized by individuals, under lease or use holder permits, requires a more comprehensive incentive scheme, especially if there is pressure on land and if the land would be partially or totally taken out of production for certain periods of time. Attractive subsidies and credit should be given and further supplemented with wages in food until the land can be put back to full production. Injection of immediate cash-yielding activities to give the farmer purchasing power would alleviate the burden which changes may create, especially during the period of transition.

5 IMPORTANCE OF AGROFORESTRY IN PAKISTAN

Introduction

About 4.6 million hectares forming only 5.2% of the total land area are forests. There are several reasons for this poor cover. More than 75% area falls under arid and semi arid climate. As a result of that, vegetation is sparse and the site once cleared does not respond positively to reforestation. Other reasons for poor forest over are the cutting of trees from almost all parts of the country for different end-uses; incessant grazing pressure; and encroachment on forest land for cultivation. At the time of land settlement, certain rights of the local population were admitted for timber, fuelwood, grass cutting and grazing. Since these rights have multiplied with the growth in population, they are no more compatible with the resource potential. As a matter of fact only 1.26 million ha are managed primarily for production of wood as commercial forests. The rest of the forest area i.e., 3.31 million ha are maintained and managed primarily for soil and water conservation.

Timber demand and supply

Timber supplies come from three sources: state controlled forests; farmlands and imports. The estimated timber supplies from state-controlled forests are 0.544 million m^3. About 60% of supplies comprise coniferous timber and the rest hardwoods. The estimated supplies from farmlands are 1.236 million m^3, almost entirely of hardwoods. Imports take the form of round and sawn timber, wood manufactures and wood-based panel products, including pulp and paper. The round wood equivalent of imports totals 0.890 million m^3. Thus, state controlled forests contribute 20%, farmlands 46% and imports 33%, to the current consumption of timber. If the present rate of population growth continues, timber requirements by the year 2000 would be around 3.54 million m^3.

The main end-uses are building construction, wood containers, village carpentry, furniture industry, timber in coal mines, but/truck-body building, sports goods, plywood, match boxes and boat-building industries. Building construction and wood containers alone constitute about 50% of the consumption. According to a World Bank survey report, the consumption in Pakistan is around 0.0239 m^3 per head per annum. This, going by the current population status, comes out to be 2.67 million m^3. On account of acute scarcity of timber, its consumption is much constrained in Pakistan. It is estimated that the present level of consumption is 50% below what might be expected in a country at the same level of development as Pakistan.

Wood for Domestic Energy Requirement

According to a World Bank survey, per capita domestic energy requirement in Pakistan is equal to 0.4 m^3 of firewood. 50% (0.2 m^3) of it is met from wood, the rest from commercial Fuels, Such as Gas, Kerosene oil, Coal (18%) and Agricultural waste and cow-dung (32%). On the basis of a population of about 112 millions, total current consumption works out to be 22.4 million m^3 of firewood.

Wood has a significant role to play in meeting the domestic energy requirements. Wood fuels must replace commercial fuels to save the scarce foreign exchange and release natural gas for better and more productive utilization. It should also replace crop residues for ploughing them back into the soil to improve its nutrient status. Animal waste can first be converted into bio-gas and then used as manure.

Assuming that the domestic energy requirements of the additional population will be met entirely from firewood, the total wood demand by the year 2000 would be about 60 million m^3 i.e. an additional quantity of 37.6 million m^3 would be required for a population of about 150 million people. In case only 50% demand is met from firewood, as is the case now, approximately 30 million m^3 of firewood would be required against the present consumption of 22.4 million m^3. It may be of interest to record that presently only 10% of the requirements are met by the state forests and 90% firewood comes from the farmlands. The average retail price of firewood has increased from US $ 2.5/quintal in 1975 to US $ 5.0 in 1986-87.

Although wood shortages lack the striking visibility of famine, it seems irrational to worry about producing more food without raising strategies for producing fuel to cook it, and indeed short-sighted to invest in expensive engineering projects if uncontrolled deforestation by firewood gatherers silts up the dams, irrigation channels and exposes the mountain roads to the ravagers of drifting earth. The collective effect of overuse and misuse of the forest resources in the uplands is reflected in widespread degradation and denudation of the hillside with adverse effect on the local hill population as well as those living in the plains. Both the devegetated and overgrazed arid mountainous tract and the arid Indus plain are exposed to wind erosion.

The rising population and increasing number of people wanting forest produce, and the fact that with the rising standard of living the per capita demand increases, show that, given the small forest land base (5.2% of the total land area), wood production must be given a national approach. While farmers cannot comprehend the concept of untouchable forest reserves, or the values of outdoor recreations, they are familiar with the value of trees as a source of fuelwood, the silent energy crisis of the poor

Thus the need for a more sustainable production of food, and fuel for cooking it and wood for the construction of farm buildings, cannot be examined in isolation from each other. State controlled forests produce only 20% timber and 105 (recorded) fuelwood of the total country's consumption. It is, therefore, evident that the Forest Services of

Pakistan cannot guarantee supplies of all types of wood products from the meager state forests inspite of highly intensive management. Neither Government can afford to divert much more land, water and other resources from agriculture to pure forestry. Increasing supplies of wood for fuel, building, etc. must be produced in farm land holdings, like a farm crop with minimal government intervention.

Agroforestry (which is a collective name for land-use systems in which woody perennials are deliberately grown on the same piece of land as agricultural crops and/or animals, either in some form of spatial arrangement or in sequence)is probably the best land use system in hilly areas under cultivation, some of which will be required to be withdrawn entirely from cultivation and put under trees. Besides, vast Indus plain offers vast opportunities for various forms of agroforestry.

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