Agroforestry Series: Volume II

AGROFORESTRY

ECOLOGICAL, SOCIO-ECONOMIC AND INSTITUTIONAL ASPECTS

By

Sahibzada Mohammad Hafeez

Punjab Forestry Research Institute
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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 ECOLOGICAL ASPECTS OF AGROFORESTRY

Positive Aspects

The ecological premises on which the concept of agroforestry is based are explained by King (1980). Forests generally have a beneficient effect on the soil. The roots of the forest trees take up nutrients from the soil, convert and utilize them for the production of plant material, and then return them to the forest floor in the form of leaves, twigs, branches, fruit, etc. This litter is transformed into humus, and later incorporated into the soil. It is this cycle of uptake, deposition and uptake again that accounts for the presence of forests on soils that are inherently low in nutrients; soils that are often incapable of sustaining annual agricultural crops, the harvesting of which removes most of the organic matter that has been manufactured by the plant. Because a well managed forest is to a large extent a closed system and can be maintained that way.

The relatively efficient nutrient cycle is only one of the ways in which the forests minimize the leakage of nutrients from the system. Trees are generally deeper rooting than other types of crops, and are often able to trap and utilize nutrients that have been leached from the upper layers of the soil. In addition, it is often claimed that some tree species have the capacity of "pumping" nutrients from layers that are not normally trapped by the other forms of plant life. This nutrient pumping attribute implies, of course, that the natural nutrient input side of the equation in a forest is greater than that in an agricultural field.

Moreover, the physiognomy of a forest is such that it provides a many-layered defence against precipitation. The crowns in the canopy, and those in the intermediate strata of the forests, progressively reduce the potential impact of rain on the soil below. In addition, the litter and humic layers on the soil surface act as a further cushion. The net effect is that the compacting effects of falling rain on the soil are reduced, there is little or no erosion on the forest floor, and another possible source of leakage of nutrients from the system is at least partially plugged.

There are other attributes. The most important properties of the earth's surface that influence climate, and that human activity can influence, are reflectivity, heat capacity and conductivity, availability of water and dust, aerodynamic roughness, emissivity in the infrared band, and heat released to the ground (Wilson, 1970).

In all these aspects the forests are important. The reflectivity of the forests is low because of the high radiant absorptive capacity of their green leaves when converting radial energy to chemical energy. Indeed, it is well established that densely built-up areas, and deserts as well as grassland, have a higher albedo than forests, and that a unit increase in the earth's albedo will cause a decrease in average surface temperature of 1.8o F (U.S.A. Congress, 1970). Recently, in an interesting experiment two integrations of a global general circulation model, differing only in the prescribed surface albedo in the Sahara, showed that an increase in albedo resulting from a decrease in plant cover causes a decrease in rainfall. Thus, any tendency for plant cover to decrease would be

reinforced by a decrease in rainfall, and could initiate or perpetuate a drought (Charney et al., 1975).

Moreover, because large amounts of latent heat are fixed during the evapotranspiration process, the capacity of the forests to absorb heat is high. In contrast, forests have a low heat conductivity, because their thick and complex structure prevents rapid cooling or heating, and regulates the heat released to the ground (FAO, 1972).

In addition, forests, by acting as windbreaks, create aerodynamic roughness and assist in arresting dust particles. Their emissivity in the infrared band is also very high. It is evident, therefore, that the forests play roles that affect all the important factors that influence climate.

Main Ecological Benefits

The main ecological benefits and opportunities of agroforestry are summarized and enumerated below:

(1) Efficient recycling of nutrients and consequent minimization of the leakage of nutrients from the system.

(2) Trees provide a many layered defence against precipitation and reduce the potential impact of rain on the soil below.

(3) The litter and humic layers on the soil surface act as a further cushion and the compacting effects of falling rain on the soil are reduced. Consequently the erosion is very much reduced.

(4) The trees play roles that affect all the important factors that influence climate.

(5) Extensive cutting of the tree cover may contribute to the increased level of carbon dioxide in the atmosphere. The accompanying increase in global temperature could directly affect agricultural production. Maintenance of tree cover is of utmost importance for ecological and economical sustainability of food production systems.

(6) A typical agroforestry system allows symbiotic economic and ecological interactions between the woody and non-woody components to increase, sustain and diversify the total farm output.

(7) Trees dominate over weeds and result in weed reduction.

(8) Trees improve soil structure and fertility.

(9) Pruned foliage decomposes in the alleys and the nutrients released increase grain yields of interplant crops.

(10) Multi-level plantations and home garden systems increase food production.

(11) Tree windbreaks increase grain yield of agricultural crops and moisture availability in soil by reducing surface run-off and evaporation.

(12) Tree components in land use in arid areas help to combat drought and desertification through improved biological productivity and plant bio-mass; to increase carrying capacity for livestock; to boost crop yields from soil conservation; to reduce wind erosion; to fix sand dunes; to ameliorate micro climates; and to protect human habitats and infrastructure.

(13) Agroforestry has a key aspect of protecting the soil in the upper parts of a catchment area and of limiting down stream damage.

(14) It helps for moderating and regulating stream.

(15) Areas affected by salinity, alkalinity, acidity and water-logging can often be reclaimed by agroforestry while providing poor farmers with some income.

(16) Farm systems that incorporate perennial trees and shrubs have the advantage of producing fuelwood, food, fodder, and other products alongwith annual crops.

(17) Multipurpose, woody, leguminous trees and shrubs in low input farm systems are capable of providing the food, fodder, fertilizer and fuel needs of local population.

(18) If sufficient fuelwood can be produced to meet the needs of farm family, animal dung need not be used for fuel and becomes available as additional organic manure.

This list of the influence of the forests on the micro-climate, and thus of the "forest environment's capacity for positively influencing the growth of other plant types associated with it, is not exhaustive. However, it is sufficiently long and wide ranging to indicate that trees grown in mixture with agricultural crops, or agroforestry systems, might a priority, especially in brittle ecosystems, be a productive form of landuse (King, 1980).

Ecological constraints

There are of course possible constraints; problems of competition for water and nutrients, and problems with respect to competition between the trees and the agricultural crops for solar energy, which are discussed in the following paragraphs (King, 1980)

Agroforestry is system of land management in which tree crops are grown together with agricultural crops, one objective being to optimize and sustain the joint yields of the combined crops. we have already examined, albeit sketchily, those characteristics of forest stands that contribute to the reduction in nutrient leakages from the soil, the

recycling of nutrients, the increase in nutrient levels in the soil, and the amelioration of the micro-climate in the forest area. These, it has been submitted, would positively contribute to the optimization and suspension of the joint yields of the combined crops, provided that that the influence of the tree crops on the agricultural crops and vice versa do not adversely contrast the positive influences of the forest ecosystem. In other words, provided that competition among the different components of the system is not great enough to affect the total productivity of the system in an adverse manner.

Clements et al , (1929) have described competition as a purely physical process. The authors go on to say that with few exceptions, such as the crowding of tuberous plants when grown too closely, an actual struggle between competing plants never occurs. Competition arises from the reaction of one plant upon the physical factors upon its competitors. In the exact sense, two plants, no matter how close, do not compete with each other so long as the water content, the nutrient material, the light and the heat are in excess of the needs of both When immediate supply of a single necessary factor falls below the combined demands of the plants, competition begins".

Donald(1963) has expressed the same principle in another way: competition occurs when each of the two or more organisms seeks the measure it wants of any particular factor or thing and when the immediate supply of the factor or thing is below the combined demand of the organisms.

Both Clements (1929)and Donald(1963) have stressed that competition for space is exceptional. and that what are really important are water, nutrients, light,, oxygen and carbon-dioxide. In the reproductive phase, the agents of pollination and dispersal are of course important. Temperature and humidity which also affect growth, are not commodities in finite supply and, therefore, are not the subject of competition.

Water, nutrients and light are the factors most commonly in short supply, and it is these that will be borne in mind in the discussion that follows. However, it is perhaps apposite at this stage, before referring specifically to the agroforestry requirements, to emphasize the following (King, 1980):

(1) "Most of the factors for which there is competition are found as a pool of material from which competitors draw their supplies. If the pool is of limited volume or if it is subject to intermittent depletion by the competing plants, then the successful competitor is the plant which draws most rapidly from the pool or which can continue to withdraw from the pool when it is at low ebb or when its contents can no longer be tapped by other plants. If all the plants in the community are nearly equal in competitive ability -they will tend to share equally in its supply until it is exhausted, and then, simultaneously, to suffer the effect of depletion of the pool". The foregoing applies chiefly to water.

(2) With respect of nutrients, "the capacity to draw from the pool is in varying degree an expression of the differing ability of plants to make use of the nutrient in different chemical and physical forms".

(3) The concept of a "pool" is not applicable, is not valid, when competition for light is considered. "There is no store of light energy in the immediate environs of the plant. Light is available as a passing stream which must be intercepted by the leaves if it is not to be permanently lost to the plant. A dense canopy will intercept all light, but the young crop characteristically covers only a small proportion of the soil surface and most of the energy is absorbed or reflected by the soil" (Donald, 1963).

Various ecological constraints are summarized below:

(1) Competition for water and nutrients and for solar energy.

(2) Immediate survey of existing agroforestry systems to determine inter-action between component species, to classify the trees used, and then to refine the systems in view of soil, climate, socio-economic limitations is needed.

(3) Future agroforestry systems will have to overcome physiological (canopy structure), biological (pests and disease), ecological(sustainability and environment protection) constraints besides being economically sound.

(4) Diversity in agroforestry systems is very important for their ecological sustainability. It is necessary to identify and describe more nitrogen fixing tree species suitable for agroforestry systems.

(5) Lack of germplasm can delay future research and development efforts in agroforestry.

(6) Pest and disease control through agroforestry should be studied.
(7) There is also a need to resolve silvicultural problems.
(8) Allelopathic effects of various tree species need to be studied.
(9) Methods should be developed to reduce time taken to develop agroforestry systems.

2 ECONOMIC ASPECTS OF AGROFORESTRY

Positive Aspects

From the economic point of view, agroforestry appears as an interesting contribution to solve the food crisis as well as the energy crisis. The latter has been underestimated and it seems that the shortage will soon attain an even more critical level in the Third World than the shortage of aliments. The production of fuelwood outside the forests is, therefore, a useful and necessary diversification, able to produce additional incomes for the farmers. Agroforestry plays the role of a long term investment, and once the market for woody products exists the farmer will take great care of his trees (Combe, 1982).

Plantation costs are very low compared with other methods used to improve the stability and fertility of agricultural soils. In arid regions the production of fuelwood is of highest priority, while the production of trees for timber in wooded areas may decrease the devastation of the natural forests, seriously affected by abusive exploitations. The additional income provided by the sale of fuelwood and timber does more than compensate for the loss of crop production, caused by the forest shade.

A wide-spread beneficial impact of trees of economic value to the farmer is in increasing the total output from the land by adding a tree crop to one or more lower layers of crops. In a wide variety of such vertically structured multiple crop combinations the intercropped tree and crop species make supplementary or complementary use both of different layers of the soil and of the space exposed to sunlight above the surface. It is quite normal that species which require full exposure produce lower harvests under shade. This applies especially to many coffee varieties, recommended for intensive monoculture management. But the total annual income per unit area of a coffee (*Coffea arabica*) plantation under *Cordia alliodora* has been 10 to 30 % higher than the value of coffee produced under the same conditions in a monoculture(Combe, 1982). In this case the agroforestry combination used a secondary forest species of commercial value.

Associated with this benefit is the advantage obtained by diversifying the range of outputs from the farm, by including a number of products of tree species, in order to reduce the risk to subsistence or income due to the failure of individual crops, and to provide usable or saleable produce over a wide seasonal time span than would be possible with only one or a few crops (Arnold, 1983).

Another category of economic benefit is that of raising incomes by employing tree crops which provide higher returns from the land than alternative crops. Recent studies have shown, for example, that eucalyptus grown on irrigated land in Gujrat, India, to produce poles and firewood for sale (Gupta, 1979), and *Albizia falcataria* grown on agricultural land in Mindanao, Philippines, for sale as pulp wood, produced higher returns

to the farmers than the agricultural cash crops they displaced. In some situations tree crops can increase incomes by using idle resources of land or of labour, etc.

Tree products can equally contribute to reductions in costs. Materials needed to meet essential local needs, such as fuel, forage and building materials, might be provided at lower cost by growing trees than from alternative market sources of supply of these products. Trees can also provide a capital reserve to be harvested to provide income in an emergency or to meet exceptional cash outlays. Trees are widely grown for this purpose by farmers. As they do not have to be harvested at a particular time, and usually accrue in vale over time, they have unique value in this respect.

The socio-economic factors on which the potential value of agroforestry is premised are perhaps more straightforward (King, 1980).

First, forests are being felled in all the developing continents of the world by farmers who require the land to produce food for their very existence. Often, the areas that are so felled are basically unsuited to arable agriculture, either because of the inherent infertility of the soil, or because the sites are prone to accelerate erosion if not under forest cover, or because of combination of these factors.

The people who clear the forests to produce food are often not unaware of the possibly deleterious effects of their practices upon the ecosystem: in terms of erosion hazards, the possibility of droughts and floods, and the possibility of soil fertility decline. Yet, despite their knowledge of these adverse consequences, they persist, because to them there are no other courses of action. They are positive that to survive they must destroy and degrade.

Secondly, the consequences of ill-advised landuse are often experienced not only in the areas in which such practices are perpetrated, but also in others that are either adjacent or far removed from the originally damaged sites. Rivers flood valuable arable land and crops, reservoirs are silted, droughts occur and crops fail; there is famine, there is loss of life, and the total effects on the general economy are burdensome and debilitating.

Third, the failure to develop the marginal lands often leads to a retardation of the rate of development of the general economy. The soil and economic arguments that are frequently adduced in support of these advocating rural development in general, can be applied with even greater force to the brittle and marginal ecosystems of the tropics. The point is that the development and technological options are fewer in marginal than in most other ecosystems.

Accordingly, if in-equities that are based on the accidents of geography are not to be perpetuated, if the economics of the developing countries are not to remain skewed in favour of urban areas and of those rural areas that can be farmed in the conventional way, and if the creation of tropical urban slums through the failure of infrastructural development to keep pace with rural migration to the town is to be avoided, then special

efforts should be made to develop a technological package that might be used in marginal ecosystems.

In most of the situations, farmers lacked access to capital and consequently were unable to increase their land or labour resources by renting or purchasing. In many instances, farmer decisions were clearly also influenced by considerations of risk management. In such conditions of limited resources and high susceptibility to risk, five over-lapping farmer strategies involving adoption of agroforestry practices can be discerned.

(1) To maintain productivity of land in situations of scarce capital in which the presence of these can help substitute for purchased inputs of fertilizer and herbicide and for investments in soil and crop production.

(2) To make productive use of land in situations of scarce capital and labour where trees, as low-input low-management crops, constitute the most effective use of these resources.

(3) To increase useable biomass outputs per unit of land area in situations where land and capital are limited and tree/crop/livestock combinations permit fuller use of available labour than alternative uses of the land.

(4) To increase income-earning opportunities from use of farm resources as size of land holding and/or site productivity fall below the level at which the household's basic needs can be met from on-farm production.

(5) To strengthen risk management through diversification of outputs, wider seasonal spread of inputs and outputs, and built up of tree stocks which can be sold in order to meet periodic or unforeseen needs for capital.

Such an interpretation of the economic role of agroforestry activities suggests a number of propositions about agroforestry of possible relevance to project and policy analysis and design.

Principal Economic Features

The principal positive economic features and the underlying hypotheses about agroforestry are summarized below:

(1) Maintains or increases site productivity through nutrient recycling and soil protection, at low capital and labour costs.

(2) Increases the value of output on a given area of land through spatial or inter temporal intercropping of tree and other species.

(3) Diversifies the range of outputs from a given area, in order to (a) increase self-sufficiency, or/and (b) reduce the risk to income from adverse climatic, biological or market impacts on particular crops.

(4) Spreads the needs for labour inputs more evenly seasonally so reducing the effects of sharp peaks and thorough in-activity characteristic of tropical agriculture.

(5) Provides productive applications for under-utilized land, labour or capital.

(6) Creates capital stocks available to meet intermittent costs or unforeseen contingencies.

(7) provides additional income for the farmers.

(8) Reduces cost of fuel, forage and building material due to growing of trees on farms.

(9) Provides useful or saleable produce over a wide seasonal time span.

Economic Constraints

Arnold (1983) focuses his attention on the economic considerations affecting the farmer's decision about the inclusion or removal of trees-what costs he faces which discourage or prevent him from incorporating trees, and what returns and other benefits could be obtained from them and from their presence on the land he farms. Many of the costs and benefits to a poor farmer, living partly or wholly within a subsistence system, take forms other than cash outlays and incomings. For example, prominent among his implicit calculations is usually consideration of risk; the need, when living at the very margins of existence, to avoid any change which, though it might improve his situation if it does not. An assessment of the relevant economic considerations must, therefore, reflect these and other realities which shape the farmer's economic decision, and not be confined simply to monetary assessments of costs and profitability.

Projects supporting agroforestry often introduce additional considerations. The interests of governments in encouraging agroforestry often include stabilizing land use, diminishing environmental and resource damage, and developing forest resources at low cost. These benefits spread much more widely than just to the farmers concerned, but are usually achieved only by imposing additional costs upon them, and, therefore, affect their economic decisions. The implications of these external economic objectives and impacts upon the farmer should also be considered.

Population growth also endangers existing agroforestry through the resultant growing pressure on the tree resource raising the value of the latter to the point at which economic pressures to cut and use it exceed its value as a continuing part of the agricultural system. With the other locally available organic fuel from agricultural wastes already fully used, the tree resource provides the only reserve from which to accommodate the rising fuel needs of growing population. At the same time large

populations require more housing in the village areas, so constraining the area available for the tree resource.

A powerful component in the increase in economic pressures to cut and use existing tree resources is the growth in urban and industrial demands for wood in particular for fuelwood and charcoal. However, it is necessary to recognize that rising values for tree products also provide a major economic incentive to investment in husbanding and growing trees. Shifting in the values and costs of other uses of the land can also have impacts on trees and agroforestry systems. Market pressures have encouraged farmers to introduce crops which directly or indirectly lead to the removal of trees. "Modernization" of tropical agriculture, and the economies of scale, support services and marketing opportunities it attracts, favour monocultures which replace the traditional multiple cropping systems of tropical agriculture in which trees often featured. Similarly, trees are also usually incompatible with current forms of mechanization, creating impediments to the use of heavy machinery, and are, therefore, removed. All such economic pressures discourage the retention of trees in existing systems.

Another economic constraint encountered by farmers in trying to introduce tees into their production system is usually stated to be competition for use of land with crops or pasture. The reality in most agroforestry situations is evidently more complex and varied. In many situations trees can be integrated with an agroforestry in ways which result in supplementary or complementary increases in yields and/or returns. In many more situations crops or pasture can continue to be grown under trees even though the latter depress crop/pasture yields, because the resultant reductions in returns from the crops are more than offset by returns from the tree outputs (Raintree, 1983 a).

Among other economic constraints, one of the most important is the relatively long production period of most tree species. Poor farmers can seldom divert resources from producing to meet immediate needs for food and income to a tree product which will start production returns at best a few years into the future. Hence the widespread preference in agroforestry for fruit trees and the other species which yield outputs of value early in their production cycle, and for fast growing species, and for coppicing, 'vertical pollarding' (branch harvesting). The length of the production period imposes another economic constraint; it increases the level of risk for those, such as tenant farmers or farmers practising shifting cultivation on state land, who do not have security of tenure of the land they cultivate. Few will invest in a long term crop such as trees if they fear that they will not be present to harvest the returns in the future. This is a fundamental constraint to agroforestry, which may in some situations need changes in basic legislation affecting control of the land to rectify (Poulsen, 1981).

Although, as has been pointed out earlier, agroforestry activities may sometimes enable economic use to be made of available labour in other instances shortage of labour may prove to be a serious constraint. There can also be more fundamental economic pressures preventing or discouraging farmers from introducing trees into their agricultural practices.

The main costs and constraints of agroforestry are summarized below

(1) Reduces output of staple food crops, where trees compete for use of arable land and or depress crop yields, through shade, root competition or allelopathic interactions

(2) Incompatibility of trees with agricultural practices such as free grazing, burning, common fields, etc which make it difficult to protect trees

(3) Trees can impede cultivation of monocrops and introduction of mechanization, and increase labour costs in situations where the latter is appropriate and or inhibit advances in farming practices

(4) Where the planting season is very restricted, e.g. in arid and semi-arid conditions, demands on available labour for crop establishment may prevent tree planting.

(5) The relatively long production period of trees delays returns beyond what may be tenable for poor farmers, and increase the risks to them associated with insecurity of tenure

(6) One prominent implicit calculation of the farmers is usually consideration of risk, which might improve his situation if it functions as expected but could leave him even worse off than he is now if it does not.

(7) Population growth also endangers existing agroforestry by increasing pressure on the tree resource raising the value of tree to the point at which economic pressure to cut and use it exceed its value as a continuing part of the agricultural system. Similarly large populations require more housing in the village areas, so constraining the area available for the tree resource.

(8) Some Government agroforestry projects meant for overall development of the region are usually implemented by imposing additional costs upon the farmers and, therefore, affect their economic decisions.

3 SOCIAL AND INSTITUTIONAL ASPECTS OF AGROFORESTRY

Positive Aspects

From the social point of view, the introduction of a forest component into the rural world helps to create new employment, without changing local traditions and without inducing further deterioration of the agricultural soils. In many countries of the Third World, even in the more advanced among them, more than 80% of the active population is occupied in the agricultural sector. The demographic pressure induces the colonization of new lands, often of very low fertility. According to an estimation made by the ILO (International Labour Office), it will be necessary to offer 800 million new jobs in the tropical and subtropical countries until the year 2000 (Combe, 1982). The rural world can contribute to this effort by a better crop diversification and especially by the production of timber outside the forests, hence developing new possibilities for trade and small business. Since trees do not depend on a specific harvesting season, timber production can easily occupy local labour, which may be temporarily underused in seasonal crops.

Although shifting cultivation can reach a durable equilibrium under ideal conditions, it is obvious that huge surfaces have been deteriorated by migrating farmers, unable to maintain the fallow long enough. Their annual crops give them the possibility to move to other places and to colonize new lands, according to their needs. Agroforestry, which introduces perennial plants into their production, may contribute to the social integration of these populations and will maintain them on lands which produce both: food for subsistence and cash crops. More than 200 million people actually live as nomades on roughly 300 million hectares of forest and t becomes increasingly urgent to show them more stable cultivation methods (FAO, 1978).

It is one of the demands of this document that when the biological influences and services of forests are considered alongwith the specific socio-economic problems of those who exist in marginal areas, together with the general development problems of national economies, this technological package should include agroforestry systems.

Agroforestry research has added, and promises to add, much more to the tool bag to community- development, agriculture and forestry extension officers in the over all development effort. It helps focus agriculture on sustainable practices and on ways to make smaller parcels of land produce the range of plant and animal products required for subsistence or for market. It offers hope where land pressure has made traditional agriculture and herding practice unviable. When well designed; it can provide a more diverse production system thereby reducing risks. However, when not designed to respond to the social milieu the benefits can completely miss the poor.

The combination of social and political factors which are involved in promoting trees in traditional farming and livestock systems are unique, and as such deserve special emphasis.

Some Common Issues

Probably agroforestry awareness and training will be needed for various extension agents dealing with farmers. Some of the common issues which should be raised in order to tailor agroforestry promotion policies and the training of promoters in an effective manner include; local use and knowledge, tenure, organization, conservation, land-lessness/distance, enterprises and marketing, labour nutrition, and gender/age.

(1) Local use and knowledge: Local women, men and youth can identify not only numerous uses they make of trees and shrubs, but in some areas they have a whole system of classifying interplant relationships. Other local knowledge relates to such scientific management as biological pest control. Learning about the scientific knowledge gained from generations of informal research into making a livelihood in a selected environment can realize that they are newly facing each specific environment and its vagaries. Clearly, in agroforestry promotion there is no room for one-way communication. Listening skills are essential. The selection of the specific agroforestry innovation to be tried in a certain environment must not be decided from outside.

(2) Tenure: Tenure issues for agroforestry may be similar to those faced in promoting agricultural programmes only when land use is privatized, tenure of trees is synonymous with tenure of land, and the farm operator is the owner. But this is frequently not the case. There is a growing literature pointing to the complexity of tenure issues.

(3) Organization: Related to land tenure, farming systems, and the accessibility of tree products, is the question of local organization. Inherent in the concept that tree planting and/or protection may concretize land use, and may eliminate or vastly reduce free access of land to others, is the idea that to be successful tree planting must b accepted by the community at large, whether the activity itself is carried out by a group or by individuals.

(4) Conservation: Overlapping with tenure and organizational issues is that of conservation. Since agroforestry is frequently the proposed answer to improved long-term production prospects, conservation and management of soil and water through integration of trees must become part of the ordinary training of agricultural and other extension agents.

(5) Landlessness/distance: Closely related to conservation, organization and other agroforestry issues are those of access to tree resources for the landless and those living at a distance from forests.

(6) Enterprise/marketing: One of the essential considerations for rural populations, especially in areas of increased pressure on basic productive resources, is additional off-farm income provided through processing and/or sale. The issue of

harvesting and marketing wood products can offer another challenge, based on weight and bulk, and the resulting difficulty and costs of extraction and transport on the scale of the artisan or small farmer.

(7) Labour: Almost all agroforestry innovations demand change in labour inputs, and the labour requirement is one item in the package of circumstances which rural people weigh before deciding whether or not to adopt a new agroforestry practice.

(8) Nutrition: Agroforestry offers the possibility of improving food security by more effectively managing soil and water resources for the sustained production of animals. It also offers a potential for overcoming many problems of seasonality of food availability by greatly extending the season when green fodder and food supplies are available. Trees and other perennials in the production system can help tide people over drought and pest attacks, etc. when annuals cannot survive.

(9) Gender/Age: A number of issues previously referred to, such as local use and knowledge, tenure, organization, landlessness/distance, marketing and labour have gender specific components. Under each of these elements information must be obtained and kept dis-aggregated by gender. Age-group issues are also frequently relevant.

(10) Introduction of forest component into the rural world helps to create new employment.

(11) By a better crop diversification and especially by the production of timber outside the forests new possibilities for trade and small business are developed.

(12) Agroforestry contributes to the social integration of those populations which are engaged in shifting cultivation, and maintains them on lands which produce both food for subsistence and cash crops.

Constraints

There are several problems that hinder the acceptance of agroforestry concepts and their use as tools in rural development. Examples of successful agroforestry in China, Korea, Costa Rica and East Africa indicate that socio-political factors unique to these systems were responsible for their success. Failure in a number of other systems can often be attributed to the attempt to introduce technological procedures not suited to the prevailing socio-economic situations. While agroforestry enterprise may be attractive, their adaptation could be frustrated when they are contradicted by other aspects of the farming systems. Communal agroforestry plantings may be unsuccessful because they are located on misused common land which constitutes the principal resource of poorer households. Effects to introduce agroforestry should concentrate on the creation of appropriate social and administrative conditions.

Being a new subject, agroforestry requires detailed scientific study but because of its complexity, it requires combined efforts of agriculturists, foresters, livestock specialists, ecologists, sociologists, economists, policy-makers, community leaders and extension

workers. Although agroforestry activities have existed for many years, literature on the subject is limited. What exists are descriptions of practices with little critical analysis of the interaction factors. Serious, well planned research is new. In this situation, the basis for some of agroforestry's tenets and the predictions of its benefits can be questioned by critics.

Besides, there are some institutional constraints. Agroforestry and forestry for local community development contains some concepts that differ from established tenets of professional forestry practices. Agroforestry projects must make people the centre of activities, rather than government revenue. There may be a need for change from projects developed and operated by the people for their own good. These are basic changes for which forestry policy-makers and technical staff will need to reorientate themselves to ensure success of agroforestry schemes.

Virtually, all agroforestry projects are sponsored and executed by foresters with the full involvement of agriculturists still to be achieved. More often than not, the old attitude of exclusiveness and competition for land, rather than cooperation, is still prevalent. Since the national priority is usually for food production and agriculture is invariably the "big brother" in ministries of agriculture and natural resources, there will be problems if agriculturists are not fully involved in agroforestry programmes.

Political will and commitment are basic for the success of local community development programmes. From experience so far, such programmes are not rated highly in many countries. Furthermore, development has tended to concentrate in urban areas, which in turn has created problems necessitating further investment in these areas. Rural areas are consequently neglected.

While it is possible to obtain government commitment to food production programmes, the value of programmes for environmental improvement is not easily appreciated, even where they have a direct bearing on food production. It usually requires a disaster to compel implementation of such programmes, from which the rural poor benefit most.

As a country develops, the number of its institutions grows. Without a clear definition of functions, good and effective coordination, and good monitoring, it is not uncommon to find two or more government agencies tackling the same problem at the same time but in different ways. There is also the problem of institutional instability which can have unsettling effects and slow down activities and programmes.

Forestry and agricultural training are not oriented to agroforestry programmes. The complexity of the subject and the kinds of people who should be involved in it dictate the need for such training

Unlike the traditional forestry, a good extension service is necessary for the success of agroforestry programmes. Agricultural extension specialists may not have the required orientation, but this could be acquired. Alternatively, a separate service could be established. Shortage of trained staff, funds and equipment are common in most of the

developing countries. Gives that these are usually inadequate for existing programme, it is likely that new kinds of programmes will be more severely affected. The main constraints are summarized below:

(1) Introduction of technological procedures not suited to the prevailing socio-economic situations.

(2) While agroforestry enterprise may be attractive, their adaptation could be frustrated, when they are contradicted by other aspects of the farming systems.

(3) Communal agroforestry planting may be unsuccessful because they are located on misused common land which constitutes the principal resource of poorer households.

(4) Political will and commitment: The value of programmes for environment improvement is not easily appreciated.

(5) Increasing number of institutions without clear definition of functions, good and effective coordination and good monitoring etc., therefore, one or more agencies tackling the same problem at the same time but in different ways.

(6) Institutional instability.

(7) Lack of facilities for formal or informal training.

(8) Institutional constraints: Agroforestry must make people the center of activities, rather than government revenue. There may be a need for change from projects development and operated by government officials to those conceived and operated by the people for their own good. These basic changes are necessary.

(9) Shortage of trained staff, funds and equipment.

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