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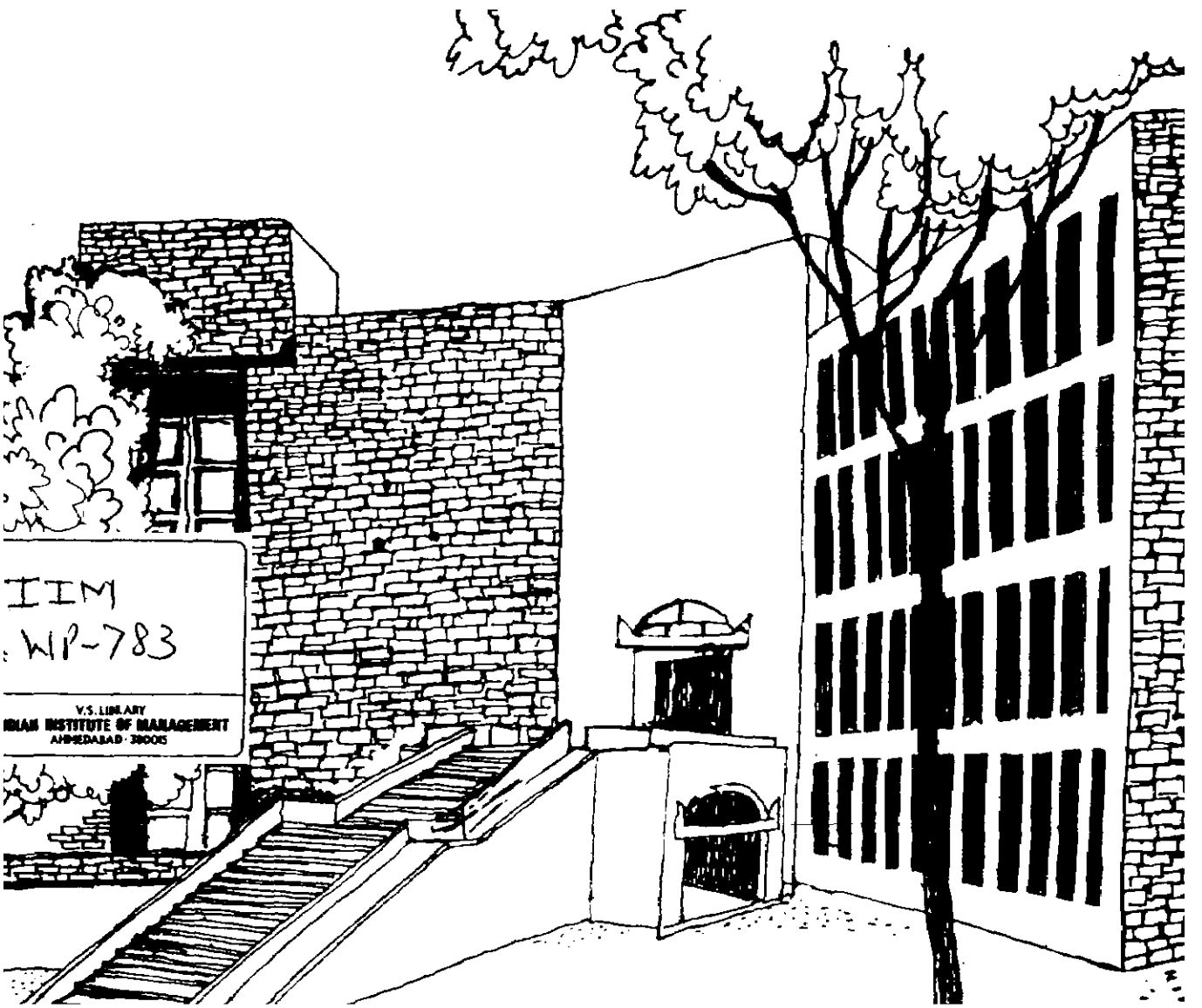

POTENTIAL IMPACTS OF AGROFORESTRY SYSTEMS ON RURAL COMMUNITIES AND REGIONS IN INDIA : METHODOLOGICAL AND GENERAL ISSUES

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POTENTIAL IMPACTS OF AGROFORESTRY SYSTEMS ON RURAL COMMUNITIES AND REGIONS IN INDIA : METHODOLOGICAL AND GENERAL ISSUES

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Agronomic research has shown that, under several edaphic and climatic environments, judicious simultaneous and/or sequential combinations of seasonal crops and trees could lead to greater efficiency in resource use due to complementarities amongst the activities. Agroforestry could, thus, not only be an important means for diversifying conventional agriculture and enhancing biomass output per unit of cultivated land, but could also, among others, i) reduce the risk of crop failures due to uncertainties in weather as trees are more drought resistant; ii) enhance the small and marginal farmers' opportunities to benefit from the high seasonal demand for their family labour and yet use their owned land effectively as they may spread the tree planting and culturing operations on portions of their land; iii) enhance the choice between income flows and capital assets as many of the tree species are less sensitive to soil quality and are renewable enterprises; iv) arrest declining productivity of land through reduced erosion of top soils and enhanced rain water percolation; and v) check deterioration of canal irrigated developed land as farm trees can be biological pumps for rising water tables.

Mixed cropping has been conventionally practised in most of India's semi-arid tropical (SAT) regions but such practices could possibly not be expected to generate the type and size of benefits visualized from agroforestry. Tree crops are a necessary component of the agroforestry systems and the choice,

placement and rotation of the tree species should be such that complementarities amongst them and seasonal crops are maximized and competition minimized through efficient recycling of nutrients, reduction in nutrient leaching, reduction in top soil erosion, improvement in micro-climates, etc.

In that sense, agroforestry systems should emerge from deliberate choices of sustainable land use which, in turn, should be based on optimal or near optimal combination of adequately identified and accessible site specific technologies, management practices, and socio-ecological needs of the local people.

It should then be easy to see that the following can not come under agroforestry : i) subsistence rearing of unevently scattered and sparse natural trees in farmers' fields, a common site in India's SAT, as they do not make a noticeable contribution to local income (1/); ii) sole cropped farm forestry systems which compete with food/seasonal crops and could adversely affect the demand for casual labour, as observed in many parts of India starting late 1970s; iii) the Taungya system where the farmers/paid labourers cleared land and raised tree plantations along with food crops in the initial few years with the main objective of higher productivity from forest land at a lower cost; iv) swinden or shifting cultivation whereby people

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1. Scattered trees have often been highly competitive with seasonal crops, but it has been intuitively believed that their expected outputs more than compensate for field crop losses.

It has also been said that if any adverse effects were observed, planting and retention of trees could not have continued on the observed scale [FAO, 1981]. But, this did not distinguish between economic and socio-ecological variables in decision making.

find fuel, fibre, building materials, etc. from natural forests which are also alternately cut and burnt to find space for seasonal crops without attempts to improve the land productivity.

Agroforestry systems could, of course, take various forms to include:

- parts of farms comprising rocky, steep, poor soil areas used for raising short rotation fuelwood, or small timber/pole, or fodder, trees while better quality land could be used for seasonal crops;
- parts of a farm sequentially used for tree and for seasonal crops to enhance total outputs and variety of goods, and to minimize climate related risks;
- farm corners/bunds/irrigation channels used for tree crops to meet family needs for fuelwood, fodder, small timber, etc.
- agrisilvi systems in situations with strong pastoral base but restrictions on open grazing.

Potential Impacts of Agroforestry Systems

In the recent past, agroforestry has attracted considerable interest of academicians, administrators and policy makers. A large body of literature has been generated and a number of research projects have been initiated : all emanating from considerations of potentially positive economic impacts. A few of these could be described even at the cost of some repetition.

Agroforestry systems are expected to enhance the choices amongst viable and sustainable uses of the productive resources. That, in turn, should enhance productivity of the resources to benefit the land owners and the society. It could also enhance off season employment opportunities for the rural labourers.

More importantly, agroforestry practices are expected to reduce seasonal vulnerability by i) enhanced and continuous flow of timber, poles, firewood, fodders, and other non-wood products of tree origin which directly and indirectly enhance food supplies; and ii) enhanced stock of assets in the form of trees which could be encashed to meet contingencies and/or be mortgaged to obtain institutional credit. The second of these could have relatively greater value where markets for tree products have expanded and their prices have risen, and where costs of conventional means of meeting contingencies have risen [Chambers and Leach, 1987].

Enhanced planting and care of trees on private land is also expected to generate multiple tangible and intangible, and direct and indirect benefits which could include : i) enhanced motivation to choose better management of naturally growing and planted trees on the common property lands including forests; ii) reduced use of animal dung for fuel which can substantially enhance farm productivity (2/); iii) enhanced and stable incomes for millions of farmers which could mean higher on and off-farm investments, higher demand for industrial goods, reduced dependence on governmental programmes, enhanced appreciation for population control, etc.

Methodology for Impact Assessments

A systematic appraisal of the impacts of agroforestry would require comparisons of with and without situations of

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2. An estimated 75 million tonnes dry cowdung, equivalent to 30 million tonnes coal, was burnt annually. If that was used in cultivation, an additional 45 million tonnes food could be produced [FAO, 1981].

combinations of seasonal and tree crops. Data on the with and without situations could be used to arrive at a generally understood criterion called the net present value (NPV) of the future returns or enterprise income after deducting all annual expenses including an imputed value for family labour, and discounting the net incremental future returns at an appropriately chosen interest rate. This has been expressed as:

$$NPV = \sum_{i=1}^{n} \frac{R_i - C_i}{(1+r)^i}$$

Where:

Ri = returns in the ith year of the agroforestry cycle
Ci = costs in the ith year of the agroforestry cycle
n = life of the agroforestry cycle in years, and
r = the chosen discount/interest rate.

Since the period of analysis would vary amongst crop combinations or farming models, their returns could be better compared in terms of annuities which represent constant annual equivalents of NPVs. The annuity values can be expressed as :

$$A = \frac{P}{\sum_{i=1}^{n} \frac{1}{(1+r)^i}}$$

Where:

A = annuity value
P = the present value of net annual returns
r = the chosen discount/interest rate, and
n = life of the agroforestry cycle in years.

The arithmatic is simple, but the data required to demonstrate its use are not available even for situations where emphasis on agroforestry was placed as early as the 1930s (3/).

On the same pattern, a relatively simple and composite measure of the impacts of agroforestry could be the changes in wage rates along with the changes in i) total farm employment, and ii) seasonal employment patterns (4/). Once again, the required data are not available.

This discussion must, however, be useful for an understanding of the concepts and, more importantly, for reaching multi-disciplinary undestanding on the need, the methodology and mechanisms for collecting the required data.

It must also be noted that these measures generally do not consider many intangible and even tangile dimensions : improvements in land quality, value of leisure etc (5/). Nevertheless, these could be valid overall indicators of techno-socio-economic impacts of agroforestry, particularly at the family and village levels; and should be important as general

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3. A programme to create small farm woodlots in the denuded gangetic plain in Uttar Pradesh was started in 1938. In 1945, a large organization, the Land Management Circle, was created to encourage that work on a bigger scale. However, the emphasis gradually shifted to afforesting ravines and other publically owned waste lands [FAO, 1981].

4. In cases of substantial spread in employment opportunities, experience based judgements may be used to assign higher weights to the returns per labour day with agroforestry.

5. Some of the indirect benefits such as appreciation in land quality/productivity could be assessed by constructing an index of net changes in land prices within the with and without framework.

socio-economic well-being has been the single most pertinent objective of human activities, and of planned changes in them.

Assessments of potential economic impacts at the regional and national levels could be made through the accepted, but not so familiar, concepts like the income-investment multiplier. Data requirements would be substantial whereas very little data are available. Separating the impacts of agroforestry vis-a-vis other changes in farming systems and the economy could also be extremely difficult.

Alternatively, indicators of the impacts of agroforestry systems can be developed both in 'financial' and 'benefit-cost' terms. The distinction between financial and benefit-cost analyses is simple but subtle. Their mechanics are also similar except that the benefit-cost analysis would require some additional data and experience, if not expertise (Annexure 1 for those not familiar with the professional economics jargon).

This discussion may be concluded with the observations that systematic assessments of impacts of the emerging agroforestry systems in India remain to be done. The task necessitates that all concerned must generate and share the basic data. In the mean time, we may also make a few general observations.

1. Successful agroforestry activities necessitate optimal or near optimal combinations of the available alternatives. That requires scientific knowledge and location specific input-output data for <u>each</u> of the enterprises. But, satisfactory knowledge and data on potentialities of agro-forestry have been extremely limited

[Khan, 1987]. Infrastructure to educate the farmers and to efficiently exchange inputs and outputs would be another major requirement. These are stupendous tasks, particularly in the context of marginal and sub-marginal land (6/).

In such a situation, emphasis on agroforestry could induce introduction of untested or hypothetical designs wich could overshadow the farmers' traditional wisdom and not succeed in achieving the objectives.

2. Inadequately tested induced changes, even on small scale, could be highly risky as failures have been much more damaging than inaction. To counteract such situations, subsidies may be provided to induce the resource poor farmers to accept the change [FAO, 1981]. But, that could carry the risk of perpetuating the subsidies and of enhancing the dependence of the poor on governmental help.

3. Most of the lands where agroforestry systems have been contemplated are in the 'waste' category due to erosion, ravine formation, impregnation with salts, over-grazing, etc. Substantial inputs would be necessary to recapture their productivity. If the future benefits were translated to their present value at the prevalent interest rates, the activities would rarely be financially viable.

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6. It has been claimed that agroforestry should be capable of improving the productivity of even highly productive lands in the tropics which is under settled agriculture. But, management of such productive areas has been largely standardized such that innovations are difficult.

This also explains the most commn thoughts about agroforestry : small scale, simple technologies with low capital requirements, and outputs for direct local consumption rather than for organised markets or for the processing sector.

The activities have, however, been promoted or even financed by the central or state governments. This appeared to be due to social rather than on economic considerations. It has been reasoned that a welfare state should povide bare necessities to the rural poor. It has also been reasoned that no price could be placed on measures to eliminate the daily drudgery of collecting twigs, vegetable waste and stray pieces of dry dung for cooking [FAO, 1981]. The main issue, however, is whether the efforts would lead to substantial and sustained change for the better or the subsidies would be perpetuated.

4. Agroforestry systems may succeed in achieving the objectives of local subsistence as well as a strong market economy with division of labour and regional specialization [Maydell, 1982]. Assessments of comparative, as opposeed to absolute, advantages of alternative economic activities have, however, not been done. For instance, the Central Soil Salinity Research Institute has developed several techniques for reclaiming saline soils. One of the techniques is based on intensive use of chemical fertilizers, gypsum at the rate of 2 to 15 tonnes per hectare, and high yielding varieties of rice and wheat. The technology package improved the top 15 cm of the soil - just sufficient for the recommended crops. But, the danger of salts rising with water or because of capillary action persisted. More importantly, financial, economic and managemental feasibilities of using such lands for specialized cultivation of tree crops have not been carried out with the desired interest and intensity.

Moreover, at least agroforestry research has been carried out with a fixed focus irrespective of the inherent properties of the land resource under consideration. In one case, for instance, the selected site for agroforestry was a forest area full of Shorea robusta coppices and bushes, and had 10-15 per cent slope with severely eroded top soil such that the available soil was gravally with a marginally acidic pH at 6.2. With the research project, the available roots were dug and removed, the land was levelled, temporary check dams were constructed, and 12 tree species and four seasonal crops were planted during the kharif and rabi 1987-88. The tree seedlings received interculturing and plant protection measures, and were reported to have established. Performance of one of the four seasonal crops was not known, but that of the other three was reported to be unsatisfactory. The researchers attributed the poor performance to the inherent natural characteristics of the site.

5. The level of skills and entrepreneurial ability for adopting complex agroforestry systems has been low among farmers in marginal and sub-marginal agricultures. On the contrary, it has been reasoned that resource poor small farmers could have advantage in adopting the complex agroforestry systems to meet multiple objectives as they i) were used to the complexities inherent in intercropping systems, ii) had more time for farm management, and iii) relied less on hired labour per unit of land [Bentley, et. al. 1986]. This reasoning may, however, not materialize as the scope for intercropping woody perennials and annuals on poor quality soils appeared to be restricted by

competition for soil moisture and scarcity of financial resources. Limited experiences also indicated that the scales were heavily tilted towards the large farmers to be early adopters. That could have severe consequences on the seasonal demand for casual labour and, thus, on the resource poor rural households who derived substantial portion of their subsistence from wages.

Moreover, in spite of steadily growing demand and rising prices for fuelwood, the risks for the late adopters of tree crops vis-a-vis cereals and legumes have not been adequately known. At least part of the rise in fuelwood prices has been due to decline in products from the village commons. The area under the commons has reduced by as much as 50 per cent in some parts of the country, and the remaining area is not as productive as it used to be [Jodha, 1986]. But the situation could, rather should, change with the social forestry activities and with improved management of forest land. The possibilities of excess supply cannot be ruled out. That could be a welcome situation for the economy but not necessarily for the resource poor farmers who could be forced towards distress sales during normal times.

In essence, objectively chosen agroforestry systems have the potential for improved management of natural in general and cultivated land in particular. But, such merits can not be assumed. Continuous flow of data to assess the impacts at local, regional and national levels must be an absolute necessity to ensure economic and socio-ecological relevance of the new systems.

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ANNEXURE 1 : FINANCIAL VERSUS ECONOMIC ANALYSIS

Financial analysis focuses on costs of and returns from an investment relevant to farm firms or other types of business organization* with profit maximization as their main objective. Thus, only monetary returns and costs merit consideration in financial analysis. On the contrary, economic or benefit-cost analysis is concerned with the society as a whole, and attempts to measure and compare the total benefits accruing to the society or economy from the total resources used in an activity/project. The terms 'Society' and 'economy' are used interchangeably, and imply that considerations of who contributes the inputs or receives the outputs are not germane to the analysis. This may also explain an often repeated statement that benefit-cost analysis is neutral to capital ownership and income distribution. The distinction may be further explained.

Financial analysis considers only the direct monetary costs incurred on an activity and the returns received from it at their market prices. The capital costs usually include investments on land, buidlings, machinery, etc. Payments such as interest, taxes, wages and salaries form components of working costs. Similarly, returns include proceeds from sale of the outputs, subsidies received on production or on exports, salvage value of the fixed assets at the end of the useful life of the activity, etc.

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* A firm may have other objectives such as holding on to land even if other more attractive opportunities were available, maximizing sales or sales revenues, enhancing its reputation or image, enhancing the hold on the market, establishing a group or a clan of its own. Such objectives are usually not assessed.

On the contrary, not all monetary costs are accounted for in benefit-cost analysis, and some non-monetary costs excluded from financial analysis are included. Examples could be taxes and interest payments which are costs to a firm, but are transfer payments from the society's point of view. Non-monetary costs usually include air, water, and noise pollution; reduction in the value or life of a unique natural or historical spot; reduction in stream flows; increase in intensity or frequency of floods; etc. These should usually not be relevant to agroforestry systems. On the contracy, non-monetary benefits excluded from financial analysis : reduced dependence on relief measures, reduced dependence on food and fibre imports, could be included.

Besides pricing the intangibles, monetary values of certain costs or returns could be changed for benefit-cost analysis so as to account for their true or real values. The adjusted prices are termed shadow or accounting prices. For instance, the market wage rate may be Rs.15-20 per day whereas the opportunity cost of the labour may be Rs.12-15. Similarly, the true value of the foreign currencies could be substantially higher than the officially fixed exchange rates.

The essential differences between financial and economic analyses, thus, arise from i) differences in cost and return items to be included/excluded, and ii) price tags to be placed on the inputs and outputs. Once these issues are settled, the mechanics for computing financial and economic indicators are similar.

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* The techniques of shadow pricing and valuation of intangibles have not been discussed here.

Some people have termed the financial and benefit-cost analyses as 'private' and 'public', respectively. This categorization is not valid. Financial analyses may be performed on public sector projects/activities. The total investible resources at the disposal of the governments are limited as they are with private organizations. Depending on the political ideology, or economic necessity, or competition to win the allocation of limited budgetary resources; government departments may like to or may even be expected to ensure that the activities undertaken by them also meet the test of financial viability.

Similarly, benefit cost analysis on activities proposed by individual entrepreneurs could be necessary to determine their overall social desirability. There could be cases where the intangible benefits or costs constitute significant portions of the total project outputs or inputs. The former types of activities, agroforestry could be a good example, would qualify for subsidies while the latter types may necessitate differential taxes to discourage them or to force the concerned organizations to compensate the society for the 'bads'.

** Such considerations may not be relevant for activities dealing pertaining to absolute national priorities.