INTRODUCTION

Roslyn Tamara Prinsley
Project Officer, Agricultural Sciences, Commonwealth Science Council
Commonwealth Secretariat, Marlborough House, Pall Mall, London SW1Y 5HX

A large development project burns down all the trees in its domain, kills off all the wildlife, pollutes the air with smoke and clogs up the rivers with silt. Does the country thus become poorer? Yes, says common sense. No, say conventional economics.

If a country's man-made assets (factories, machinery) depreciate faster than they are being replaced, it is clearly living beyond its means, and economic growth is not sustainable (Repetto et al 1989). In conventional economics no such concept applies to the depletion of natural resources. As they are used up, no decline in value is registered to reflect the fall in future potential production.

However in the same sense that a machine depreciates, soils depreciate as their fertility is diminished since they can produce only at higher costs or lower yields (Repetto et al 1989). In particular for developing countries which are more dependent on natural resources for income , jobs, livelihood and exports, the danger of treating natural resources as valueless is even greater. Natural resources which are not accounted for are such countries' main assets ignored.

This view that natural resources are "free gifts of nature" is held from the national level of economist and policy maker to more localised cost - benefit analysis of development projects down to the household level of the peasant farmer who cannot see the need to plant indigenous trees as they are given freely by God in the communal woodland (which is all but cleared).

'An asset which is undervalued will inevitably be misused' (Repetto, 1988)

There is a clear need for the valuation of natural resources, and for estimates of the costs and benefits of investment in their conservation and use. Cost Benefit Analysis is an approach to this type of problem. It can be used to assess the net benefit or loss to the economy as a whole, as well as to the private users of natural resources.

Trees are a particular example of a natural resource that has been traditionally undervalued. Deforestation has resulted in land degradation and wood shortages. Now, agroforestry is being promoted by scientists as a contributory solution. **Could Cost Benefit Analysis and other methods of economic assessment be used to assess the net benefits of agroforestry enterprises in terms of sustainable development?**

Although much of the loss of woodland and forest can be attributed to pressures from growing population, clearance for arable land and use for fuelwood, construction wood and forage - government policies lie behind the wastage of forest resources in many countries (Repetto, 1988). In many cases, various incentives have been given to land users to cut down trees rather than to conserve or plant them (Abel et al 1989). **What appropriate incentives could be given to farmers to plant trees?**

These are among the issues which the Commonwealth Science Council addressed at a workshop held in Swaziland on April 21-25, 1989 entitled 'Agroforestry for Sustainable Development - Economic Implications'. This volume represents the collection of papers presented at the workshop.

Part I is a discussion paper of the key issues involved in financial and economic analysis of agroforestry. This paper was prepared by Mike Stocking, Jan Bojö and Nick Abel as a background paper for the workshop. As it contains its own introduction, very little more will be said about it here, except that it combines an economic perspective with a study of natural resources in the setting of agroforestry enterprises for poor farmers. It addresses the question 'How can rational decisions be made on whether to invest in or support agroforestry?'

Part II comprises the other papers presented at the workshop.

Clearly the subject of this volume has far reaching implications (see Table I). We started off by discussing at the national level but we have also mentioned the peasant farmer. It is thus clear that the social and spatial scale in such a discussion can vary greatly. Social and economic aspects have been mentioned - however methods for assessing the value of natural resources must also be developed. In Table I these are denoted 'technical issues'. The spatial scale of these can also range from household/farm level to catchment to national level. Both the effects of trees on erosion with respect to the crop productivity of the individual farm as well as in relation to the problems of flooding, river flow and dam siltation which may affect a whole district or nation are relevant. To further complicate the calculation, technical, financial, economic and social issues need to be considered in both the short and long terms. In Table I these issues are clarified. Although most of the issues shown in Table I are discussed in this volume, it has been necessary to focus on certain aspects (which are discussed in the following text).

Incentives for Agroforestry

Agroforestry in developing countries is targetted at the peasant farmer. In the final analysis, it is the peasant farmer who will have to adopt such conservation schemes. Peasants differ from capitalist farm enterprises because non-market interactions figure in their access to resources, in the farming systems they adopt, and in the social principles to which they conform (Ellis 1988). Agricultural economics as a discipline usually makes no such distinctions with respect to social organisation of farm production (Ellis 1988). However, analysis of these social relations along with financial analysis done from the farmer's perspective, are extremely useful in determining how to design and implement incentive schemes such as those involving compensation and subsidies. Incentives for farmers to adopt agroforestry are discussed in Part I, and more extensively in Part II by Scoones, Pretty, Bradley, Falconer, Gumbo, Mukamuri and Muzondo. All authors demonstrate clearly that there is great variation between different peasant households, groups, villages

TABLE I: CLASSIFICATION OF AGROFORESTRY SOCIO-ECONOMIC AND TECHNICAL ISSUES BY TIME, SPATIAL AND ECONOMIC SCALES

SOCIAL & SPATIAL SCALE	SHORT TERM		LONG TERM	
	A. TECHNICAL	B. FINANCIAL/SOCIAL	C. TECHNICAL	D. FINANCIAL/SOCIAL
HOUSEHOLD/ FARM/ SITE	A1 Quantification of direct outputs - fruits, wood, fibre, fuel, posts, poles, shade, mulch, fodder, etc A2 Quantification of indirect positive & negative effects - shade, micro climate, nutrients organic matter, allelopaths, inter-ception of rain, etc A3 Possible use of householders estimates of A1 & A2 in absence of measurements	B1 Valuation of out-puts by households in use & exchange B2 Labour allocation to enterprises B3 Costs of inputs B4 Reliability of supply of inputs & markets for products B5 Risk of change in prices & costs B6 Social relations of production, especially autonomy of household in decision-making & labour-sharing B7 Categorisation of households by production strategy and access to means of production	C1 Environmental trends, eg deforestation, changes in scarcities of land and tree products C2 Perceptions of wind, drought, pests, diseases & other hazards -> private discount rate C3 Modelling the hazards in C2 C4 Modelling environmental trends, especially land degradation & productivity decline	D1 Household life-cycle considerations D2 Risk of change in prices -> private discount rate D3 Security of tree & land tenure -> private discount rate D4 Perceived income decline without conservation. Conservation as loss-reduction. Modelled estimates of declines

	E. TECHNICAL	F. ECONOMIC/SOCIAL	G. TECHNICAL	H. ECONOMIC/SOCIAL
CATCHMENT/ LANDSCAPE/ REGION/ NATION	E1 Land cover under agroforestry & alternatives ie: How do the land cover changes on myriad farms in aggregate affect the cover, hydrology and erosion rates of a catchment?	F1 Shadow prices of products F2 Foreign exchange component of various approaches to conservation, including agro-forestry F3 Research & extension requirements of agroforestry vs alternative approaches	G1 Catchment effects of land use change if agro-forestry introduced - sediment loads & net soil losses, flooding/ river flow, dam siltation G2 Flood hazard assessment G3 Landscape effects of land degradation - some sites may be gaining productivity through deposition	H1 Costs of flooding (= Benefits of control) H2 Costs of sedimentation (= Benefits of control)

(After Nick Abel & Roslyn Prinsley, unpublished 1989) and regions in their likelihood to adopt a technical change such as agroforestry. Bradley, for example, compares two small areas in the Kakamega district in Kenya, and two individual farms to demonstrate this. It is made clear that it is difficult to generalise about peasant economic decisions. Scoones and Pretty emphasise that in order to develop appropriate policy and development strategies, investigations from the national to the local level need to be integrated. Information gathering and analytical techniques that can provide an understanding of local complexity as part of the development process are provided by Scoones and Pretty and by Gumbo et al with reference to case studies in Sudan and Zimbabwe. These include semi-structured interviewing, maps, transects, seasonal calendars, historical profiles, preference rankings, direct matrix rankings, wealth rankings, Venn diagrams, matrices and key informant interviews.

Falconer adopts a different approach, and assesses agroforestry in the light of household food security on the assumption that food security is often a major production goal of the peasant farmer.

Technical Issues

Economists rely upon accurate technical data to calculate benefits and costs. The data required for natural resource and conservation aspects of agroforestry are lacking. For instance, although soil erosion is recognised as an economic cost to society because it often leads to a serious decline in primary productivity, there is a lack of quantitative models for relating soil erosion to loss of crop yield.

Indeed, at the project level - where cost benefit analysis is customarily used to look at such parameters as productivity of crops and timber production from trees against costs of land preparation, planting and labour - the issues of soil productivity and sustainability are not often considered. These issues are explored in Parts I and II of this volume.

Agroforestry is commonly perceived to control erosion and to conserve soil for sustainable production. If such issues are to be taken account of in economic analysis it is necessary to quantify and value these benefits and to predict what would happen to these values in the future. Before this can be done the benefits (or otherwise) which agroforestry confers to the soil must be identified and the processes understood.

The role of trees in soil productivity is comprehensively reviewed by Julie Ingram in Part II. She emphasises the importance of defining the effects of trees on soils and for standardising units of their measurement. Together with Stocking et al in Part I, Ingram's paper makes it clear that there is very little evidence from rigorous scientific studies of the effects of trees on soil erosion and soil conservation. Significantly, Stocking et al point out that the number and range of different agroforestry systems make it very difficult to generalise the effects of agroforestry on soil productivity. They propose the use of technical models to predict the performance of an agroforestry system in relation to the soil in both the short and long terms. This quantified information could then be valued in economic terms, and used in Cost Benefit Analysis. Models such as "Soil Changes Under Agroforestry" or SCUAF (Young et al 1987) have great potential. However, their limitations, due to gaps in current understanding, are noted.

Sitaubi goes on to warn us that even biological figures which may seem obvious need careful analysis and thought before economic accounting. He illustrates his point with reference to an experiment which determines foliar nitrogen levels to use as an index for the best trees for supply of green manure. He concludes that foliar nitrogen levels alone can be misleading and that they need to be linked to foliage biomass production for an appropriate index. Mungai explains how biological management and environmental conditions can alter the pre-chosen principal economic parameters for carrying out a cost benefit analysis for the implementation of an agroforestry enterprise.

In her paper 'The technical costs and benefits of agroforestry to the catchment as a whole. Upstream-downstream relationships', Sue White explains that to reliably predict the impact of a proposed catchment management change such as agroforestry is almost impossible. This is because there has been insufficient experimentation in this field to understand the complex processes of runoff and sedimentation. Therefore, at present, it is very difficult to give economists estimates of large scale effects of agroforestry interventions. She goes on to review what is known of the technical costs and benefits of agroforestry to the catchment as a whole.

Economic Modelling of AF Systems

Thomas has developed a spreadsheet model for the economic evaluation of an agroforestry system. Although this model has been adapted for Northern European conditions, Thomas explains that other components could be incorporated to make it more suited to conditions in developing countries. However he also emphasises the need for data of high quality, and we are reminded of the difficulties of quantifying and valuing components described in the chapters on socio-economics and technical issues.

Economics for Sustainable Development

Scientists, in particular ecologists, have for some time promoted the concept of sustainable production. What do economists think of this? Barbier, an economist, explains in his paper that although economists have been reluctant to accept the ecological view of sustainability, they have increasingly recognised that the pursuit of economic efficiency does not always guarantee the sustainability of agricultural production. He goes on to operationalise this concept by assuming that sustainability is dependent on the constancy of natural capital stock. He warns us however that this is not a sufficient condition for sustainability of production and that it is necessary too for appropriate incentives to be developed to replace those which are aimed solely at the pursuit of economic efficiency.

Sekhwela is of the opinion that formal cost-benefit analysis, a rational decision making process, cannot better the informal cost-benefit analysis which farmers use to make decisions based on the real situation of their existence in terms of their physical world. He expresses concern that formal cost-benefit analysis has been developed by economists for economists and that its use by others requires appropriate adaptation, particularly where the monetary unit does not appear to capture fully the nature of sometimes unquantifiable benefits and costs.

References

NOJ Abel, Drinkwater MJ, Ingram J, Okafor J and Prinsley RT (1989) 'Guidelines for Training in Rapid Appraisal for Agroforestry Research and Extension' Commonwealth Science Council.

F Ellis (1988) Peasant economics. Farm Households and Agrarian Development: Cambridge University Press. Cambrige.

R Repetto (1986) 'The Forest for the Trees? Government Policies and the Misuse of Forest Resources' World Resources Institute, Washington.

R Repetto, Magrath W, Wells M, Beer C, Rossini F (1989) 'Wasting Assets - Natural Resources in the National Income Accounts' World Resources Institute, Washington.

A Young, Cheatle R J and Muraya P (1987). The potential of agroforestry for soil conservation. Part III. Soil changes under agroforestry (SCUAF): a predictive model. ICRAF Working Paper No 44. Nairobi.