Approaches to the economic evaluation of agroforestry farming systems

DAN M. ETHERINGTON and PETER J. MATTHEWS*

Australian National University, P.O. Box 4, Canberra City, ACT 2600, Australia

Abstract. The economics of agroforestry systems can be approached in a purely analytical fashion with mathematical equations and diagrams explaining the principles of analysis. This paper argues that such an approach may be useful for teaching purposes but has little practical relevance. There is an urgent need for a practical tool with which multi-disciplinary teams can assess agroforestry systems. The simplest and most common approaches to the economic analysis of farm management problems are various forms of budgeting. Recent advances in micro-computer technology provide the means by which the principles of partial budgeting can be adapted to the needs of agroforestry taking account of its multiple component nature, seasonal variability and long life span. The paper sets out the specifications for such an approach and indicates how it might be used.

I. An analytical approach

A distinguishing feature of all agroforestry farming systems (AFS) is that they are composed of many components. Each component (crop, tree or animal) will have a number of attributes which in some way impinge on the other components because they all use or contribute to the pool of biological resources. As the number of components and the number of attributes increases, so the possible combinations of interactions increases dramatically. The basic purpose of investigating AFS is to learn about these interactions with a view to possible modifications... to get higher productivity, more economic returns, and better social benefits on a sustained basis, than are obtainable from monoculture on the same unit of land'. [24] It is then necessary, but not sufficient, that economic evaluations of AFS be undertaken. It is important that such analyses be well done because many AFS commit farmers to a selected course of action for decades rather than years.

Component interactions in intercropping have been well reviewed for annual crops by Willey [37]. The degree of 'mutual cooperation', 'inhibition' or 'compensation' is often investigated in terms of replacement series.

*Fellow (Agricultural Economist) and Consultant Programmer respectively at the Development Studies Centre. The Australian National University (ANU), Canberra. This paper is the result of collaborative research between the ANU and the International Council for Research in Agroforestry (ICRAF) and is funded by the International Development Research Centre of Canada (IDRC), the ANU and ICRAF.
The complication for AFS is that the 'woody-perennial' component that forms a necessary part of the definition of AF introduces the temporal dimension. Huxley [16] has produced a useful discussion of inter-temporal replacement series. Economists would prefer to use 'production possibility frontiers' rather than replacement series because they allow for the explicit introduction of relative prices to assist in deciding on the optimum combination of components.

Figure 1 presents a multi-period production possibility surface. The output of a woody-perennial (WP) component is drawn on the vertical axis, while the output of an annual crop is on the horizontal axis. Time is shown on the third axis. An infinite number of alternative situations could be represented in this way. This particular diagram seeks to illustrate a situation in the semi-arid tropics of a low income country where there might be a possible AFS solution to the problems of declining yields due to continuous cultivation and declining fertility. Such a situation may be forced on farmers as a result of increasing population pressure. Annual crop yields are shown to be decreasing over time. The woody-perennial is shown to be growing through time. If OD of the woody-perennial is grown at the beginning of the period, then OB of the annual crop can be grown. The annual crop forgone is BC, since OC is the maximum possible monocrop output with the given resources and technology.