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Traditional Agroforestry for Sustainable Development in Jamaica: Exploratory Observations

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Introduction

Despite a lack of data on the magnitude of the problem, land degradation and soil erosion, in particular, are considered to be ubiquitous on agricultural land in Jamaica (McGregor 1995). Land degradation is particularly severe on steep upland slopes where there is intense moderate to high rainfall. These marginal upland areas are generally occupied by small-scale farmers, who presently contribute the majority of domestic food production (Barker 1993). Agricultural production could be threatened as net soil erosion continues. McGregor (1995) illustrates a positive feedback model in which topsoil loss and the gradual exposure of the less fertile subsoil leads to reductions in agricultural output and an eventual systems collapse. This scenario is already evident in other parts of the Caribbean. For example in parts of southwest Haiti, 60 percent of the soils are truncated to the 'B' horizon and 20 percent are truncated to the 'C' horizon. In some areas soil is eroded to unconsolidated parent material and yields are so low that progressive land abandonment is resulting (Pasket & Philoctete 1990).

The Government of Jamaica has attempted to implement several conservation techniques to ameliorate the problem. These have had very limited success, primarily due to poor diffusion of the techniques amongst the farming community and short-sighted strategic planning (Baxter 1975; Barker & McGregor 1988; Edwards 1995). There is an urgent need, therefore, to present a solution to the problem of land degradation, which while geomorphologically sound, will also prove acceptable to farmers both economically and socially.

Following the suggestion of Sheng (1972) that forms of agroforestry would be the most salient form of cultivation on these marginal lands in Jamaica, McGregor and Barker (1991) have advocated a traditional form of agroforestry, multistorey tree gardens (locally known as food forests and backyard gardens), as a potential solution to the problem. However, although there are indications that this form of agroforestry could be sustainable, the empirical evidence for Jamaica is minimal.

This chapter examines the utility of multistorey tree gardens as a conservation measure on marginal lands in Jamaica. However, given the limited success of the measures already implemented, the adoption of a holistic framework of analysis is needed to comprehensively evaluate their applicability in the Jamaican case.

Sustainability

The framework adopted here is that of sustainability as defined by the Committee on Agricultural Sustainability in Developing Countries. It describes sustainability of an agrosystem as: "its ability to meet evolving human needs without destroying, and if possible improving the natural resource base on which it depends" (Torquebiau 1992: 190).

A number of physical and socioeconomic indicators can be identified which agrosystems should fulfil in order to be sustainable (based on Soemarwoto 1987; and Torquebiau 1992). The agrosystem should, on the 'physical' side: maintain and improve soils; minimize soil erosion; maintain high biomass yields by efficient use of solar radiation; and preserve biodiversity, thus reducing the risk of crop failure through pests and disease.

On the socioeconomic side, the agrosystem should provide an adequate income; have few cash inputs; provide adequate nutrition; provide fuels and fuel wood; require little labour; provide useful plants and animals; ensure cultural integrity; provide social and practical functions and encourage community relations.

Multistorey Tree Gardens

In Jamaica, two types of traditional agroforestry have predominated since colonial times. These may be broadly classified as tree home gardens (locally known as backyard gardens) and forest tree gardens which generally comprise separate plots away from the homestead. Both systems utilize a multistoried vegetative assemblage with a wide variety of woody and herbaceous crops grown together in a dense pattern. These forms of agroforestry may be broadly described under the term multistorey tree gardens, which are defined here as "non-rotational agroforestry systems in which a diversity of woody perennials and herbaceous plants (totalling at least four species) are deliberately grown together in a spatially mixed, dense and multitiered configuration, possibly with livestock, on at least 50 percent of the same land management unit" (McCoubrey 1995).

This definition is compatible with the concept of agroforestry as defined by Lundgren and Nair (1985) and Young (1989), and a review of the literature establishes a strong rationale for them to be viewed as a highly sustainable rural production system (Soemarwoto 1987; Torquebiau 1992; McCoubrey 1995). The remainder of this chapter is therefore devoted to assessing the physical and socioeconomic sustainability of multistorey tree gardens based on data collected around two villages in Hanover, Jamaica.

Hanover Parish, Jamaica

The parish of Hanover is situated on the northwestern flank of Jamaica. Two areas (totalling 32 km^2) in the proximity of the villages of Middlesex and Cascade, Hanover, were chosen to study multistorey tree gardens (Figure 16.1). The two areas are typical of other upland regions in Jamaica, many slopes being over 25 , with soils of low natural fertility (see McGregor 1988). Farms were mainly small-scale operations, again representing upland farmers elsewhere in Jamaica (see Barker 1993).

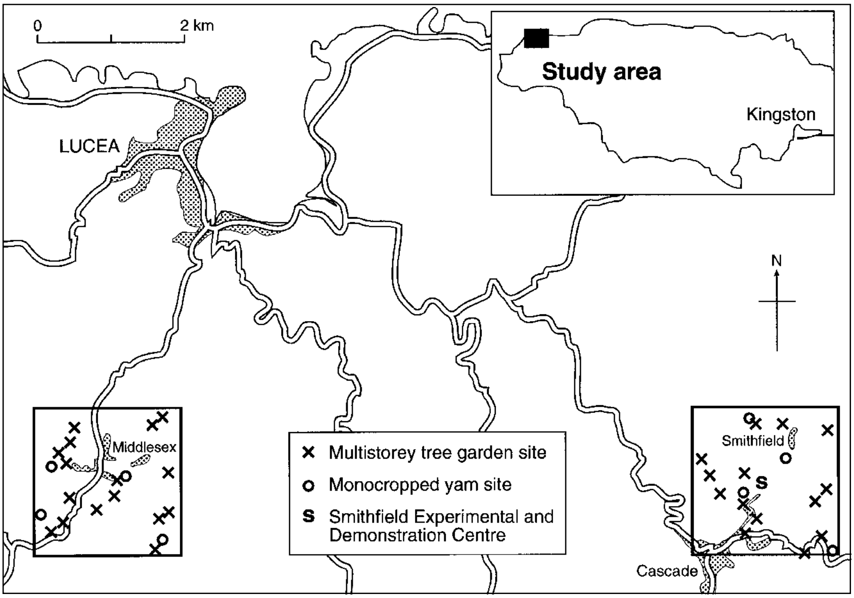

Figure 16.1 Research Areas and Plot Sites, Hanover, Jamaica

Climate

Temperatures are high and equitable throughout the year (Figure 16.2). Total annual rainfall was between 2,793 mm (112 inches) from January   December 1994, measured at the Smithfield Experimental and Demonstration Centre, Hanover, which is within one of the field sites. This figure is slightly less than the thirty-year average between 1942 and 1972 which was 3,247 mm (130 inches) (data supplied by the Experimental and Demonstration Centre). Figure 16.2 illustrates the seasonality of the rainfall that can be expected. This seasonality can cause problems. The dryer period between October and January coupled with relatively high evaporation may cause periodic moisture deficit situations.

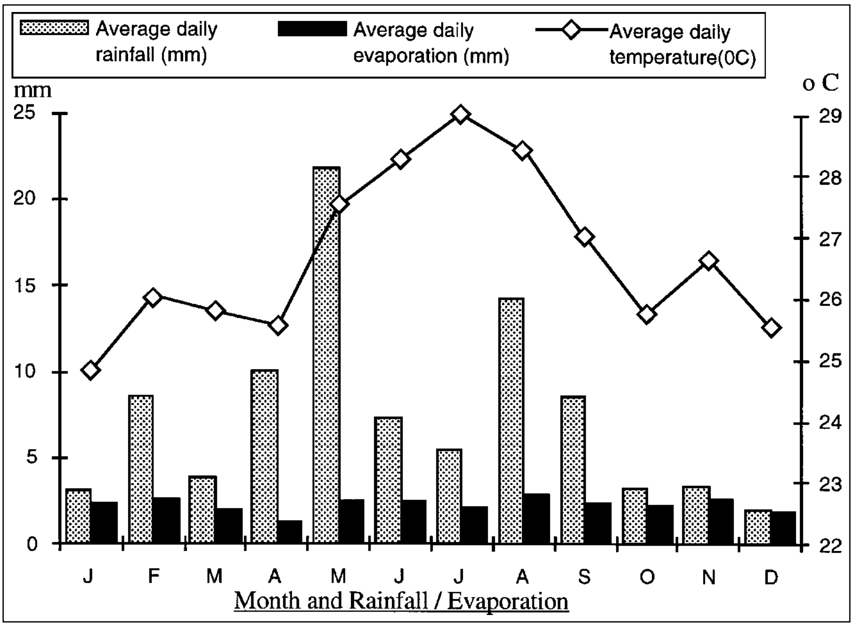

Figure 16.2 Average Daily Rainfall, Evaporation and Temperatures by Month for 1994 as Measured at the Smithfield Experimental and Demonstration Centre, Smithfield, Hanover Parish, Jamaica.

Geology and Geomorphology

The surface geology of the field area comprises clastic material (grey shales) of the Hanover Formation representing an inlier of Cretaceous age (Government of Jamaica & Ralph M. Field Associates 1987; Porter et al. 1982). Geomorphologically, the area is characterized by a dissected terrain. Erosion rates are perceived to be particularly high where vegetation cover has been removed. Chemical weathering rates are high due to high rainfall and temperatures. The area is classified as having high land slip potential (Government of Jamaica & Ralph M. Field Associates 1987) which will lower slope angles and add to the effects of slower mass movement and wash erosion (McGregor 1988).

Soils

Sheng and Michaelson (1973) and the Government of Jamaica and Ralph M. Field Associates (1987) note that the soils of the region are well drained, moderately deep, brown to reddish brown clayey soils in places with a 10 30 cm (4 12 inches) thick loamy surface, and are strongly acid with low chemical fertility. They can be described as orthic luvisols and eutric cambisols (Government of Jamaica & Ralph M. Field Associates 1987) which classes their erodability as moderate to high (based on FAO 1979 in Young 1989).

Socioeconomic Patterns

Barker (1993) proposes a dualistic model of Jamaica's rural spatial economy, in which the flat fertile lands are dominated by large export orientated farms, while upland areas are characterized by fragmented small-scale farming systems which support the domestic market. The areas around Cascade and Middlesex follow this model to a limited extent being dominated by small farms, growing goods mainly for subsistence needs or for sale on the domestic market. However, one or two larger private farms are evident and certain crops such as yam are grown on small-scale farms for export. Yam is the major crop in both field areas and is usually monocropped on fields away from the homestead, although it is not uncommon for yam to be grown within multistorey tree gardens, or in combination with bananas. Most farmers sell their produce on the domestic market by an intermediary (higgler), personally direct to supermarkets, or to produce exporters or on road sides (Meikle 1992).

Land tenure differs between the two field sites. Around the village of Cascade, much of the land is government owned and thus some of the farmers are long-term squatters, who have developed their farms over many years, adding to them when necessary. Around the Middlesex village most farmers own their land. No data on the size of holdings, farmer age or number of farms can be found in the literature. It was observed by the author that the majority of farmers were men, although there did not seem to be a predominance toward any particular age group within the farm community.

Methodology

The sustainability of multistorey tree gardens was investigated from two perspectives. Firstly, a land degradation index and other observations were used to assess physical sustainability; and secondly, semi-structured interviews were undertaken with farmers to augment the physical data and to assess the socioeconomic aspects of sustainability.

Thirty-two multistorey tree garden plots were chosen with eight control plots of monocropped yam for comparison. Plots were chosen within the two study areas by random number table and grid squares on the Government of Jamaica, Department of Surveys map (Sheet 1) at a scale of 1:50,000 (Figure 16.1). A total area of 32 km^2 was sampled in a stratified way by locating four multistorey tree garden sites and one control plot in each grid square. The gardens were identified using the working definition above; the 50 percent coverage threshold being estimated visually.

Within each sampled plot, eight sampling points, each 2 m^2 were chosen by a random walk method (after Chapman 1976). The method involved pacing from the most northern, western, southern and eastern points in the garden or plot on a random bearing for a random number of paces to locate four of the sampling sites. The remainder were chosen by taking a second random bearing from these points and pacing a random number of steps.

A rigorous analysis of the physical indicators of sustainability (soil erosion, soil nutrient analysis, biomass yields) was not possible due to temporal constraints on the field work. A degradation analysis (after Stidwell 1993) was undertaken which served as a comparative tool for the assessment of the susceptibility to, or the amount of land degradation under, multistorey tree gardens and monocropped land.

The *degradation index* (DI) is a rating system derived by means of rapid field assessment techniques. The individual land, vegetation and soil management characteristics are assessed individually and then arithmetically combined. The DI is composed of five factors: soil factors; topographic factors; vegetation factors; management factors; and erosion characteristics (Table 16.1). Within each factor the various individual characteristics were ranked on a scale of 1 5, 1 3 or 1 2, depending on the number of divisions appropriate. The system is designed in such a way that the lower the factorial score the lower the level of land degradation/lower the susceptibility to land degradation.

Although some of these characteristics are visually assessed, and thus open to criticism on the grounds of subjectivity, the method is not without precedence. Stidwell (1993) used the index in an investigation of land degradation in an upland tropical watershed in Jamaica, while Chokor and Odermerho (1994) used a similar approach to assess land degradation in Nigeria.