Assessment of the performance of traditional agroforestry systems in Southwestern Cameroon

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Abstract: *Amid the diversity of farming systems developed in humid tropical zones, a large number is characterized by the combination of perennial and annual plants. The productive functioning, the agronomic and economic performance, and the sustainability of these crop associations remain poorly understood. To improve the management capacity of these complex agroforestry systems, adequate indicators must be developed and integrated in assessment systems. These may then be used to assist farmers in their decision making regarding management practices, as well as used to evaluate the contributions of these farming systems to sustainability. This study focused on 38 farmers in the Southwestern Province of Cameroon, whose agroforestry systems were surveyed using indicators which were then integrated into a Traditional Agroforestry Performance Indicators System (TAPIS). Analyses of the relationships between indicators in TAPIS allowed an improved understanding of agro-ecological and agro-economic performances in the studied parcels, and may contribute for the sustainability assessment of agroforestry systems.*

Keywords: *agroforestry systems, sustainability assessment, integrated indicators, traditional agriculture.*

Introduction

Although highly varied, typical traditional farming systems in Humid Tropical Zones (HTZ) are most commonly diversified, plurispecific and multi-layered associations of perennial and annual plants, coexisting in long-lasting, complex and ever evolving cropping stands. Even if usually managed with low levels of inputs and technology application, these farming systems tend to reach acceptable productive and economic performance, while being less susceptible to climatic risks, and meeting excellent social acceptability. Although confronted with low land availability and low soil fertility, shortening of fallow periods, and market insertion difficulties, such Agroforestry Systems (AFS) continue to ensure the livelihood of large portions of rural populations in HTZ. Given the current value placed on preserving the ways of life of traditional peoples, these AFS represent much more than a simple subsistence alternative, but a contribution to conservation of biodiversity and to sustainability.

The continued contribution of traditional AFS to these aforementioned objectives depends upon a better understanding of their agro-ecological and socio-economical performances (Nair, 2001; Schroth & Sinclair, 2003). However, methods and indicators usually enlisted for the performance evaluation of conventional (intensive, mono-cropping) farming systems are inappropriate for these AFS, given the essential role played by issues such as family income and food security, productivity of work, harvest diversification, input independence, judicious use of natural resources, and management of beneficial and adventitious plants.

The present study focused on the performance assessment of AFS in Southwestern Cameroon, aiming at (1) proposing an integrated indicator system that may aid farmers in their management decisions and (2) assisting in assessing the sustainability of traditional farming systems and agroforestry landholdings.

Methods

Field observations were carried out on 38 agroforestry parcels distributed between the Kumba and the Bombe-Malende zones in the Southwestern Province of Cameroon, within the rainforest domain (2500+ mm/yr), under marked (Mars to October) humid season, and 23°C mean annual temperatures. Soils are ferruginous with patches of very fertile volcanic areas, with altitudes varying towards the North from 60 to 400m. Quite varied types of agricultural exploitations are present, from industrial plantations for export (oil palm, rubber trees, banana, tea), to small farmsteads practicing agroforestry (typically characterized as home gardens) integrating oil palm, rubber trees and cocoa as main perennials and food crops such as yams, cassava, corn, banana and plantain, among several others. The collected field survey data were integrated into a 'Traditional Agroforestry Performance Indicators System' (TAPIS). Indicators were designed as a proportional performance index (0 to 1.0), ranking all farmers under the two dimensional axes related to agro-economic and agro-ecological performances. The agro-economic indicators were: (1) Income, (2) Input expenses, (3) Pesticide independence, (4) Workforce independence, (5) Family workforce engagement, (6) Total workforce efficiency, (7) Internal gross added value, and (8) Total gross added value. The agro-ecological indicators were: (1) Harvest, (2) Area equivalence index, (3) Soil resource use index, (4) Productive diversity, (5) Diversity of associated arboreal species, (6) Adventitious plants diversity, (7) Beneficial adventitious plants, and (8) Adventitious plants infestation.

Results and discussion

General results show that all farmers ranked in the lower quartile of agro-ecological performance, except for one farmer. Only the Adventitious plants infestation indicator reached a mean value above 0.5 (0.61), indicating a certain equitability among the local farmers, which can be interpreted as a tendency for adequate management situation for this indicator. The Area equivalence index followed (value = 0.47), related to a very high level of crop association. Quite expectedly, the farmer holder of such a high level of crop association showed one of the highest Productive diversity indices (0.71), but lowest Soil resources use index (0.22), and lowest Harvest (0.08), given the clear situation of immature crop stand for the perennials.

On the other hand, eight out of the 38 farmers showed agro-economic mean performance indices above the 0.5 level, with the best results related to Pesticide independence (mean = 0.80, measured according to expenses, hence an agro-economic indicator), Total workforce efficiency (mean = 0.78), and Workforce independence (mean = 0.66). The fact that no one farmer appeared ranked within the higher performance quartile when both dimensions are taken into consideration indicates a tradeoff between crop stand intensification and income generation (given the initial stage of development for the most densely packed plots). Also, it implies that excelling in one set of indicators usually implies a certain level of failure in the concurrent set, such as workforce and input intensification being counterbalanced by elevation of expenses and hence decreased Total added value.

With this kind of interactive analysis and interpretation of indicators, TAPIS offers farmers, extension agents, and researchers a tool for decision making regarding management and resources allocation strategies, as well as an approach for better understanding tradeoffs in traditional agroforestry systems. In order to favor farmers' capacity to adapt their practices as the cultivated plots develop and mature, the aggregation and expression of indicators in TAPIS facilitate clear visualization of performance levels among sets of indicators. The expression of the assessment results as proportional performance indices simplifies comparison among different indicators, without need for weighing importance factors, thereby facilitating integration and analysis in clearly understandable graphics. Such analyses may be instrumental for pointing out appropriate management practices and resources application strategies for the farmers. One open line in the TAPIS spreadsheets allows for eventual entry of a new dataset, for the evaluation of a new farm, or re-evaluation of plots at a later time, in relation with the database currently included in the system.

References

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