TAPIS: AN INTEGRATED INDICATORS SYSTEM FOR PERFORMANCE ASSESSMENT OF TRADITIONAL AGRO-FORESTRY IN SOUTH WEST CAMEROON

Geraldo Stachetti Rodrigues[1] ; Inácio de Barros[2] ; Eugène E Ehabe[3] ; Patrick S Lang[4] ; Frank Enjalric[5]
[1] Embrapa Labex Europe / Unité Performance des systèmes de culture de plantes pérennes (CIRAD PerSyst) ; [2] INRA, Unité de Recherche Agropédoclimatique da la Zone Caraïbe. Domaine Duclos, 97170 Petit-Bourg (Guadeloupe), France (indebarros@antilles.inra.fr); [3] Latex Programme, Institute of Agricultural Research for Development (IRAD); [4] CARBAP (Centre Africain de Recherche sur la Banane et le Plantain) ; [5] Unité Mixte de Recherche Système, CIRAD Cultures Pérennes

INTRODUCTION

Farming Systems developed in Humid Tropical Zones are frequently characterized by a combination of perennial and annual plants, intermixed in complex tree-crop associations. The productive functioning, the agronomic and economic performances, and the sustainability of these Agroforestry Systems (AFS) remain poorly understood, although they continue to ensure the livelihood of large portions of rural populations in the tropics. To improve the management capacity of these complex AFS, adequate indicators must be developed and integrated in assessment systems that harness a very diverse set of biophysical, economic and social data, and organize them into synthetic, understandable recommendations. These may then be used to account for and elucidate the relationships and tradeoffs among concurrent indicators in order to aid farmers, assisted by their extension agents, in making decisions regarding management practices (Rodrigues et al. 2009).

The present study focused on the performance assessment of AFS in the South West Region of Cameroon, aiming at (1) proposing an integrated indicator system directed at aiding farmers in their decision making on management practices and (2) contributing toward sustainability evaluations of traditional agroforestry systems.

MATERIALS AND METHODS

The present study focused on the agroforestry systems developed by 38 farmers in the South West Region of Cameroon (Kumba and Bombe-Malende zones), which were surveyed for a large set of variables, aiming at formulating a 'Traditional Agroforestry Performance Indicators System' (TAPIS). This region falls within the rainforest area, has a marked rainy season, and high mean annual temperatures. Soils are ferrallitic with patches of fertile volcanic areas, and altitudes varying from 25 to 400 m toward the North. The exploitations existing in the area are permanently occupied (no fallow) small areas integrating main perennials (cocoa, oil palm and rubber trees), food crops (plantain, manioc, yams, maize, banana, etc.), native trees, ornamentals and medicinal plants (not considered in the surveys).

Two sustainability dimensions, agro-economic and agro-ecological were defined for parcel performance ranking, each comprised by a set of eight meaningful indicators, as follows:

Agro-economic dimension indicators: (1) Income; (2) Input expenses; (3) Pesticide independence; (4) Hired workforce independence; (5) Family workforce engagement; (6) Total workforce independence; (7) Internal gross added value, and (8) Total gross added value.

Agro-ecological dimension indicators: (1) Harvest; (2) Area equivalence index; (3) Soil resource use index; (4) Productive diversity; (5) Diversity of associated arboreal species; (6) Adventitious plants controllability; (7) Beneficial adventitious plants and (8) Adventitious plants infestation control.

The composition of these locally meaningful indicators ensued from (i) a regression significance analysis of the broad set of field variables surveyed, (ii) the experience attained by contact with the farmers and the local reality, and (iii) a review of integrated indicators systems for environmental farm (and AFS) management (for details see Rodrigues et al., 2009). Accordingly, agro-economic indicators were devised to appraise attributes of cash flow, work dedication, expenses and profitability. Agro-ecological indicators were, on their part, devised to cover the essential biophysical efficiency attributes of productivity, land use, productive diversity and weed competition.

RESULTS AND DISCUSSION

With sizes ranging from just 1,000 m^2 up to 4.0 ha, all studied plots were densely packed with a diversity of annuals and seedlings of perennial crops in the implantation phases, progressing to still dense plant stands even when main crops reached production; with the exception of rubber tree-dominated plots, which tended to almost exclude annuals after onset of latex extraction.

The aggregated results for the mean performance indices in TAPIS across all plots showed that no farmer obtained combined agro-economic and agro-ecological indices to be ranked within the upper performance quartile for the two dimensions considered in the indicator system. This result implies, on the one hand, performance unevenness among farmers within each of the indicators; and on the other, important tradeoffs among indicators for all plots.

Observation of the distribution of main crops and their development stages showed that there were no evident clusters determining performance trends. This means that the variety of crop combinations, associated production stages, and practices adopted in the different plots were more important in determining performance, as indicated by TAPIS indicators, than the main crop alone, while a significant relationship still existed between the sets of agroeconomic and agroecological indicators.

One-fifth of the plots gave agro-economic mean performance indices above the 0.5 level, with the best performance indices being related to Pesticide independence (measured according to expenses, hence an agro-economic indicator), Total workforce independence, and Hired workforce independence, indicating that low expenditures were directed toward pesticide inputs and hired worker recruitment. These indicators were inversely and significantly correlated with the level of Income and Added value, which in turn were directly correlated among themselves, meaning that those who obtained better incomes tended to rely on higher investments.

Regarding the agro-ecological indicators, and with only one exception, all plots ranked in the lower performance quartile. Only the Adventitious plants infestation control indicator reached a mean value above 0.5, which is interpreted as a tendency for an adequate management situation, as suggested by a significant positive correlation between this indicator and the Adventitious plants controllability. This latter indicator, itself related to a low diversity of weeds, was significantly but inversely correlated with the presence of Beneficial adventitious plants. This strategy seems logical as weeding is a major time consuming practice and usually a constraint for farmers. The Area equivalence index was the second highest agro-ecological performance indicator, being related to a high level of crop association.

Confirming the performance results and the tradeoffs observed for the agro-economic indicators for the whole group of plots, with mean Income and Added value indicators being low, the total Harvest indicator showed the lowest mean agro-ecological performance index, implying that the majority of the plots had dense plant stands (high AEI) consisting mostly of still immature crops, resulting in a low mean Soil resource use index (0.31). In fact, only 15 of the 38 plots already had the main perennial crop in production stage. A modest Diversity of associated arboreal species (0.33) indicated a relatively low importance of non-crop, spontaneous tree species conserved in the plots.

With this kind of interactive indicator analysis and interpretation, TAPIS offers farmers, extension agents and researchers a tool for interpreting and deciding on management options and resource allocation strategies, as well as an approach for better understanding tradeoffs in traditional agroforestry systems.

REFERENCES

Rodrigues, G.S.; de Barros, I.; Ehabe, E.E.; Lang, P.S.; Enjalric, F. 2009. Integrated indicators for performance assessment of traditional agroforestry systems in South West Cameroon. *Agroforest Syst*. Published on-line 13 june 2009 (Online First).

Presented at

Farming Systems Design 2009

an international symposium on

Methodologies for Integrated Analysis of Farm Production Systems

August 23-26 2009 - Monterey, CA

www.iemss.org/farmsys09