ALTERNATIVES, INDICATORS, TRADE-OFFS AND SYNERGIES IN SMALL SCALE FARMING SYSTEMS IN LATIN AMERICA. ANALYZING FIFTEEN MESMIS CASE STUDIES.

S. López-Ridaura [1]; M. Astier [2,3]; E.N.Speelman [3] and O. Masera [4]
[1] INRA, UMR Innovation, 2 place Pierre Viala, 34060 Montpellier Cedex 2, France; [2] Centro de Investigación en Geografía Ambiental (CIGA), Universidad Nacional Autónoma de México (UNAM), Morelia, Michoacán, Mexico; [3] Grupo Interdisciplinario de Tecnología Rural Apropiada A.C. (GIRA A.C.), Michoacán, Mexico; [4] Centro de Investigaciones en Ecosistemas (CIECO), Universidad Nacional Autónoma de México (UNAM), Morelia, Michoacán, México.
ridaura@supagro.inra.fr

INTRODUCTION

Evaluating the sustainability of current and alternative farming systems is an indispensable step in the process of innovation towards more sustainable agriculture. MESMIS is a methodological framework for sustainability evaluation of agricultural systems by means of indicators (Lopez-Ridaura et al., 2002). It was first published ten years ago and, since then, a large number of institutions and organization in Latin America have applied the framework to an equally great diversity of farming systems.

Today, we are aware of at least 50 case studies were MESMIS has been used for the evaluation of alternative agricultural or natural resource management systems. The objective of this paper is to show some preliminary results of a meta-analysis of case studies applying MESMIS. The first objective of the meta-analysis is to shed light on the kind of teams developing and evaluating alternative farming systems, the type of alternatives proposed and the indicators used to evaluate them. The second objective of the meta-analysis is to identify general tradeoffs and synergies on the performance of alternative agricultural systems.

METHODOLOGY

Fifteen case studies using MESMIS for the evaluation of alternatives in Latin America were analysed. These case were chosen because thorough documentation on the use of MESMIS and results obtained were. Most of the fifteen case studies were reported and documented during three earlier projects by Masera and Lopez-Ridaura (2000), Gianella and Chaves (2003) and Astier and Holland (2007). The analysis presented here is based on secondary data gathered from these resources.

First, the composition of the evaluation teams was analysed in relation to the institutional background separating them in academic, NGOs and farmers' organisations. Then, the agroecosystems evaluated were analysed in relation to their production objective (subsistence or commercial) and the type of agroecosystems evaluated in terms of the components taken into account (eg. crop, livestock, forest).

Most common indicators used in the 15 case studies were identified as well the attributes of sustainable systems they were used to indicate. For some of the most common indicators, an analysis of their values in the different case studies was made comparing the performance between current and alternative systems and correlating the relative change of different indicators to identify possible trade offs and synergies.

RESULTS

The majority of case studies compared two contrasting agroecosystems; one being the system common to the local area or the reference system and the other representing an alternative management system aiming to increase sustainability. In the fifteen case studies using MESMIS, a wide range of agroecosystems were evaluated (Fig 1-A). Mixed systems predominate which shows the

acceptability of MESMIS for the analysis of complex agroecosystems were different components are in close interaction. All evaluations were carried out in the context of small scale farming systems with the production of food for self-consumption as the main objective however, half of the case studies had a system's component destined marketed production (e.g. coffee, cotton, vegetables, wood).

All evaluations were made in a participative manner and farmers were involved and/or consulted along the different phases of the evaluation cycle. The evaluation teams were mainly of interdisciplinary nature coordinated by academic or research institutes, NGOs and farmers' organisations; also mixed teams between these institutions were set up for the evaluation (Figure 1-B).

In terms of the alternatives being developed and evaluated, the strategies used to increase sustainability in small scale farming systems were mainly based on agro-ecological principles. Their main objectives were directed towards strengthening the functioning of the system itself (productivity and stability) and its response to changes in economic or biophysical environment (reliability, resilience, adaptability and self-reliance). The most frequently defined strategies in the alternative agroecosystems were: (i) The diversification of the agroecosystem through the (re)introduction of crop species including different varieties of maize, some legumes such as velvet bean (*Mucuna pruriens*), common bean (*Phaseolus vulgaris*), and pea (*Pisum sativum*); forage species such as sorghum and improved grass species in prairies (*Lolium perenne; L. multiflorum* and *Trifolium repens),* in addition to forest and horticultural trees and livestock species. (ii) The protection and improvement of soil fertility were implemented in one third of the alternative systems including soil conservation measures (terraces and tree plantation); adding organic matter in the form of cattle or green manure; practicing zero or minimal tillage; implementing crop rotation and improving fertilization. (iii) The reduction of external inputs and the intensive use of local resources. Practices such as the use of green manure, and the collection and use of cattle manure in fields, as well as the use of local crop species and practices of reciprocity among peasant families (including trading of inputs, products and labour) were therefore defined.

Each case study selected and calculated between 10 and 27 indicators (with a median value of 19) covering the environmental, economic and social dimensions of sustainability. Most case studies included indicators related to (i) the yield of specific products of the agroecosystems, (ii) the economic performance of the system (iii) their independence to external inputs (iv) the systems' agrodiversity, (v) the existing of regulation mechanisms, (vi) the organisational levels and capacity building of farmers and (vii) the distribution of benefits from the agroecosystems and (viii) the conservation of the resource base.

Most alternative systems resulted in higher productivity, meaning higher yields and and higher agrodiversity in comparison with the reference system; for the indicators income and independence to external inputs this tendency is not as clear. In a trade-off analysis based on the relative change of these four indicators in the different case studies, it is showed that synergies between agro-diversity and productivity are not uncommon in the generation of alternatives for small scale farming systems in Latin-America. Figure 2 shows the correlation between the relative change in the standardised value of indicators related to yield and that of indicators related to agrodiversity. In most cases yields was increased as well as agrodiversity, the latter being obvious taking into account that several alternatives were precisely based in the diversification of the agroecosystem. Only in two cases, a trade off between agrodiversity and productivity was seen, one where a decreased agrodiversity increased productivity and another one in the opposite sense.

DISCUSSION AND CONCLUSIONS

Rather than a standardised method for sustainability evaluation, MESMIS was conceived as a flexible methodological framework, adaptable to the specific agroecological conditions and institutional contexts where evaluation takes place. This flexibility of MESMIS poses certain challenges for a meta-analysis: e.g.: (i) its application to different agroecosystems will forcedly imply

different alternatives evaluated and different indicators used for their evaluation and (ii) different evaluation teams, with their specific disciplinary and institutional background as well as different time and economic resources engaged for the evaluation, will implement different methods and techniques for indicator selection and qualification.

Common among almost all case studies is the design and evaluation of alternatives for complex small scale farmers. These complex agroecosystems, generally integrating different activities (eg. Crop, livestock, forest, off-farm work, handcraft), provide several goods and services for both, self consumption (eg. grains, milk, firewood, traction) and for the market (eg. grains, cotton, coffee, milk, wood). Such common feature among case studies acknowledges MESMIS capabilities to apprehend, in an integrated way, the sustainability of such complex agroecosystems. It may also explain its wide acceptance among researchers and practitioners trying to understand and strengthen the sustainability of small scale farming systems.

Most alternatives were oriented towards increase productivity and stability of current agroecosystems as well as their independence to external inputs. Mainly based on agroecological principles, these alternatives often implied the diversification and integration of agroecosystems and the intensification in the use of local resources.

For the evaluation of these alternatives, a great number and diversity of quantitative and qualitative indicators were used. In this first analysis, and because of the nature of alternatives, we focussed in only few indicators related to the productivity, diversity and independence of external inputs. Unless not a clear success in the alternative systems to generate income and increase the independence to external inputs, a synergy between primary production (yield) of agroecosystems and their agrodiversity was found.

In future work, a more in depth analysis of the evaluation process and results of a greater number of case studies will be conducted. Hopefully this will lead to more conclusive results in terms of the strengths and weaknesses of both, the alternative agroecosystems being evaluated and the evaluation process itself.

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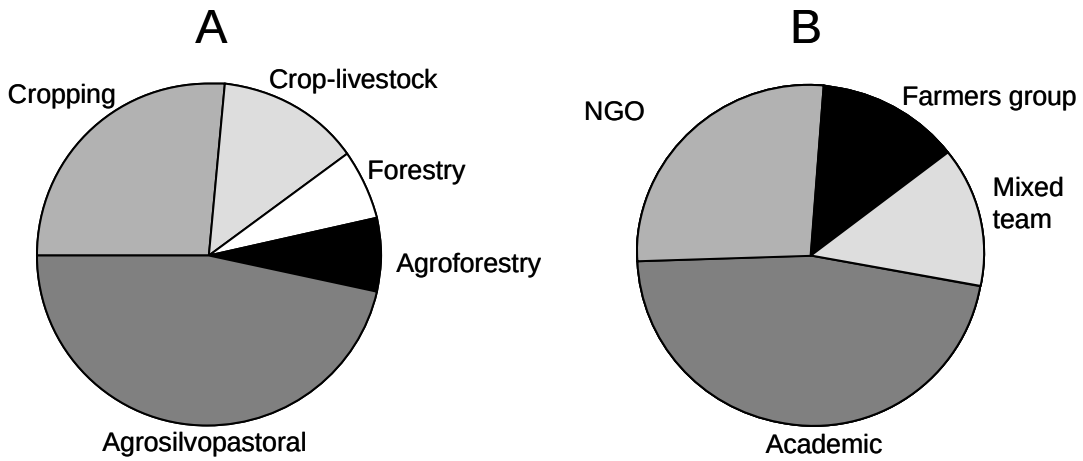

Figure 1. Distribution of 15 MESMIS case studies in terms of (A) type of agroecosystems evaluated and (B) type of evaluation team

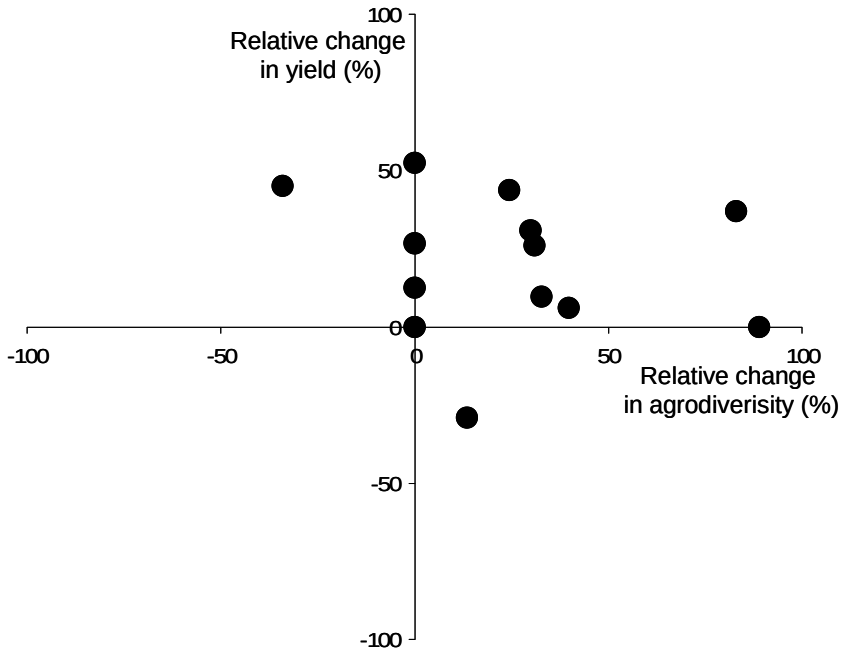

Figure 2. Correlation between the relative change in the value of yield and agrodiversity indicators in case studies using MESMIS for sustainability evaluation