Farming Systems and Poverty: Making a Difference

18th Symposium and Global Learning Opportunity

Rome, Italy

12-16 September 2005

International Farming Systems Association (IFSA)

with FAO and IFAD

Risk assessment, market uncertainties and diversification strategies for rubber farmers: comparison between Indonesia and Cambodia using farming systems modelling.

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Theme 4 -- Development Strategies, Pathways and Synergies

Summary

Prospective analysis using farming systems modelling (FSM) helps explore farmers' strategies and create scenarios in different contexts such as pioneer zones, rehabilitation areas or traditional tree-crop belts in the humid tropics and in a new context of globalisation, decentralisation and market uncertainty. Combined with social and historical analysis, economic modelling contributes to building better and more suitable alternatives in terms of decision-making processes in partnership with both farmers and developers. This approach helps farmers to make the right decision at the right time concerning their future investments, in particular when tree-crops are involved. CIRAD/INRA/IAMM developed a software called « Olympe » that enables modelling of farming systems as well as farming groups. Use of this software aims to improve farmers' understanding of their own situation and of their actual socio-economic context and also provides orientations for agricultural and development policies for institutions or donors.

Prospective analysis enables the creation of scenarios of potential farm pathways that can be used in the definition of agricultural policies, recommendations and to measure the likely impacts of such policies so they can be adapted to the real situation faced by farmers. In this paper, a comparison between the situations of rubber farmers in Indonesia and Cambodia illustrates this approach.

Risk assessment, market uncertainties and diversification strategies for rubber farmers: a comparison between Indonesia and Cambodia using farming systems modelling.

1 Introduction: Olympe software used as a modelling tool.

Detailed knowledge of local farming systems and farmers' strategies in a range of different contexts such as pioneer zones, rehabilitation areas or traditional tree-crop belts, contributes to building better and more suitable alternative solutions and proposals to help farmers make the right decision at the right time concerning their future investments. INRA[1], CIRAD and IAMM) developed a farming systems modelling software called « Olympe » (Penot, 2003) that provides an economic evaluation of farming activities (all types of livestock and cropping systems) and income generation over a period of 10 years. In addition to functioning at the scale of individual farms, the software also enables analysis at the scale of groups of farms for example at the scale of a watershed, a small region or an agrarian system. Positive or negative externalities can be integrated, for example to take into account Carbon sequestration values from tree crops or pollution effects. A "hazard" module enables testing of all changes in prices (input and outputs) and in production in order to test different hypotheses in the framework of a prospective analysis.

The aim of using "Olympe" is to improve farmers' understanding of their own situation, of their socio-economic context and its impact on their decisions in addition to providing orientations for policy makers by testing scenarios of future change. Olympe can be used in a variety of situations and with different methodological approaches: comparison of cropping systems, farming system economics and resources management ("advice on farm management"[2]), prospective analysis, regional approach and even as a "role playing game"[3] (Penot et al., 2003).

Why model farming systems?
A model has two main roles: a figurative role of representation of systems (the functioning) and a demonstrative role (possibilities and strategies). Combining these two roles provides an explanatory model whose function is to represent specific phenomena deriving from general phenomena (management, accountancy etc.) as a function of the local conditions that characterise farming systems. (Nouvel, 2002). The need to understand farming systems as a "productive system" and the logic behind technical choices recalls the systemic approach (Badouin, 1985).The overall objectives of using Olympe are i) to identify smallholders' constraints and opportunities in a rapidly changing environment to enable the adoption of new cropping systems or any other organisational innovation, ii) to understand farmers' strategies, their capacity for innovation and their ability to adapt to a changing economy, to price crises and technological change, iii) to provide a tool to understand the farmers' decision making, to examine farming systems in their social and economic context (through a regional approach) and iv) to undertake prospective analysis and build scenarios based climatic risks, major climatic events such as "el Niño years" and the volatility of commodity prices. Building scenarios enables us to review the situation from a prospective standpoint and to analyse the robustness or resilience of the system that is being proposed.

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[1] INRA = Institut National de la Recherche Agronomique, IAMM = Institut Agronomique Montpellier Méditerranée. The original and main designer of the software is J.M. Attonaty, from INRA-ESR.
[2] "Conseil de gestion" in French.
[3] The 2003 CIRAD seminar held in Montpellier on the methodological uses of Olympe revealed a wide range of possibilities from which we selected prospective analysis as the subject of this paper

Data for analysis with Olympe should be discussed in partnership with the farmers concerned in order to validate scenarios and guarantee a high level of representativity. For instance, a network of selected representative farms can be monitored for several years to diagnose constraints and opportunities and to measure the impacts of technical change.
One of the main outputs of such an approach is the assessment of the impact of technical alternatives or choices at the farming systems level from both an economic and environmental point of view. Olympe is fed with data from appropriate farming systems surveys and provides key information in terms of diagnosis and, later, in terms of prospective analysis.

Agricultural sustainability is a major concern. The main issues concerning "ecological sustainability" are linked to the problem of degraded environment and fragile soils and, as a consequence, to fertility, biodiversity, and the protection of watersheds. Several cropping systems offer potential solutions to these problems: agroforestry practices and cropping systems with permanent vegetal cover, among others. Crop diversification and rapid technical change characterise the evolution of existing farming systems. The history of these innovations and innovation processes are key elements to analyse and understand and thus be in a position to make viable recommendations for development. The notion of “economic sustainability”, focuses on the profitability of specific technical choices: (margins analysis, income generation, return to labour and capital as a function of a specific activity, analysis of constraints-opportunities, etc.) from the point of view of farming systems, at the regional level and the “community level” where there are serious constraints with respect to land availability, as well as to access to capital and information. Analysis of farming systems and knowledge about smallholders’ strategies in the different contexts are thus key elements that should be taken into account.

Perennial crops in particular are subject to significant and sometimes very rapid changes in plantation/re-plantation strategies in pioneer and post-pioneer areas and these changes characterise farmers’ strategies through phases of investment, capital building, capital conservation, re-investment and possibly intensification or diversification or both. To ensure the adoption and appropriation of technology by smallholders is efficient, further research is required on innovation processes and technical change in general using socio-economic tools. Negotiations between stakeholders and a better knowledge of the relations between the State and farmers is essential if the effectiveness of future projects and development actions is to be ensured.

One expected output is the identification of the conditions required to ensure future projects are more viable at the decision-making level. Another is valorisation of the ability of such a collaborative approach to anticipate problems (e.g. recurring negative phases of booms, drops in fertility/productivity due to over-exploitation, negative externalities, etc.), to propose viable alternatives (technical pathways or new organisational innovations, etc.) and to provide better support for technical choices made by decision makers with respect to agricultural policy.

Olympe can be used at different scales, i.e. the local community, regional, national or international scale, depending on which stakeholders and which commodity is involved. Emphasis is placed on the farmer and on the other people directly involved in the farmers’ environment, including the government (development policies at the national level). The ‘Participatory approach’ and ‘Action–Research’ are essential components of the approach proposed by CIRAD partners. In addition to the Participatory or partnership approach and on-farm experimentation, tools for decision-making aid such as SIG, System multi-agents (SMA) and farming system modelling (Olympe) allow possible answers to be identified to important agricultural questions.

2 Risk and hazard assessment through prospective analysis

Faced with market uncertainties, price volatility and climatic hazards, most tree-crop farmers have developed diversification strategies. They may also have integrated local opportunities for specific crops, such as oil palm thanks to development schemes provided by private Estates providing.

The farmers' main objectives in diversifying are the following :

- securing income (guaranteed minimum income, not a decrease in income)
- improving living standards,
- limiting risks (e.g. climatic risks) on production, food security, self-sufficiency and of economic hazards on commodity prices,
- obtaining better distribution of income throughout the year,
- profiting from potential opportunities (or not missing them, which is another way of looking at it!),
- being less dependant on a single commodity in a world of globalisation,
- acquiring property (patrimony),
- valorising land that was not previously cropped,
- increasing knowledge and acquiring technical information to be in a better position to innovate
- increasing the sustainability of agricultural production in the medium or long term (see figure 1).

Prospective analysis can be used for different purposes: i) to test the impact of a commodity or of volatile prices of inputs , ii) to test the robustness of technical choices, iii) to define a financial or economical threshold beyond which profitability is too low or risks too high and to measure capital and credit requirement to change pathways, iv) to measure flows of inputs and outputs and v) to assess the impact of any decision on profitability, return to labour and return to investment. Historical records, data on prices, and agrarian history help identify possible scenarios.

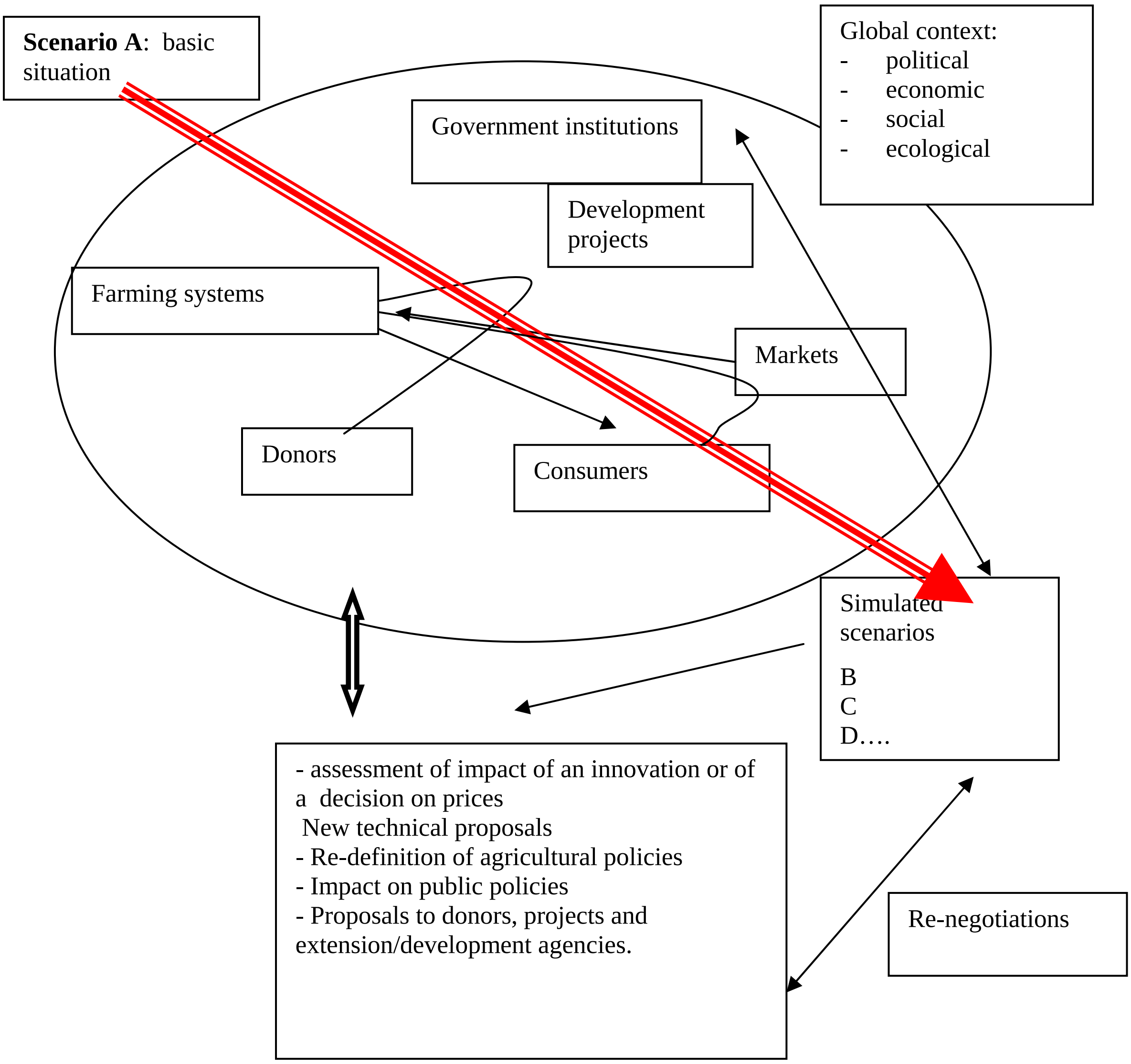
Some instances are explored through the case of rubber farmers in Indonesia and Cambodia.

3 The example of Indonesian rubber farmers diversifying with oil palm

Smallholders have based their strategies on both intensification: moving from traditional jungle rubber to monoculture of improved agroforestry systems in Indonesia,, and on sustainability (risk limitation) and diversification (integration of new crops such as oil palm, pepper, etc.) [Penot, 2003 #1171].

Several hypotheses were based on the following main hypotheses (Penot et Hébraud, 2003):
1. Rubber and oil palm prices volatility: rubber prices varied between 0.5 and 2 US$/kg (a variation of 200 % between 1995 and 1998) while oil palm varied only by 100 %.
2. Effect of a commodity windfall thanks to a period of very good prices which has an impact on household expenses, financial return and investment capabilities; improvement in living conditions is the priority with an increase of 30 % in household expenditure, and the balance of available cash flow may then be invested in tree crops.

Figure 1: Definition of prospective scenarios:



3 Global negative or positive effect on investment, replanting and diversification.
4 Effect of climatic events: one or two “el Niño” years in a 10-year period for instance: to measure risks and the robustness of technical choices

Figure 2 shows fluctuations in farmers’ annual net income as a function of different diversification strategies. Oil palm rapidly provides a significant improvement when rubber prices are low (2002). Such a trend would be far less significant when rubber prices recover in 2003.

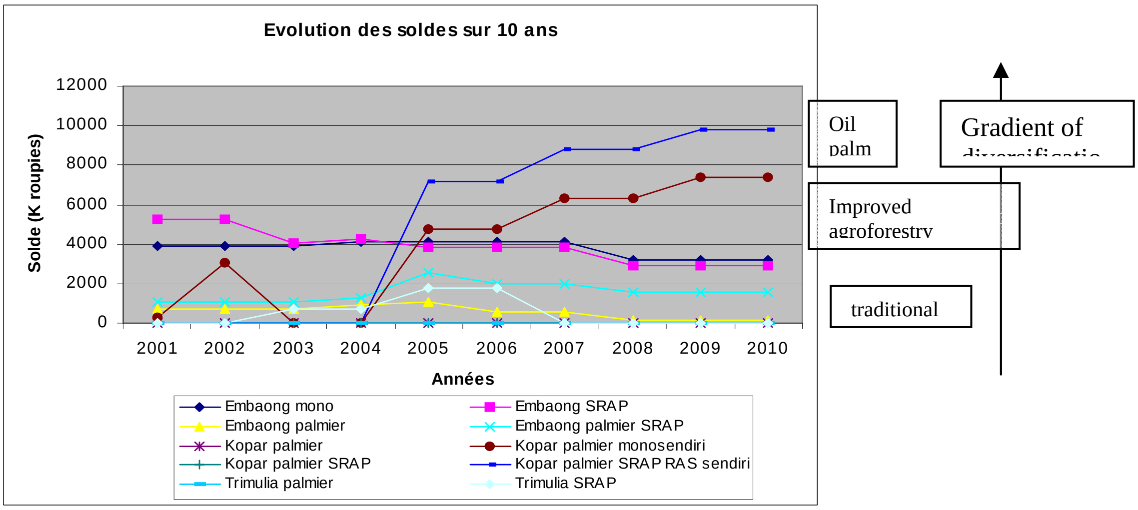
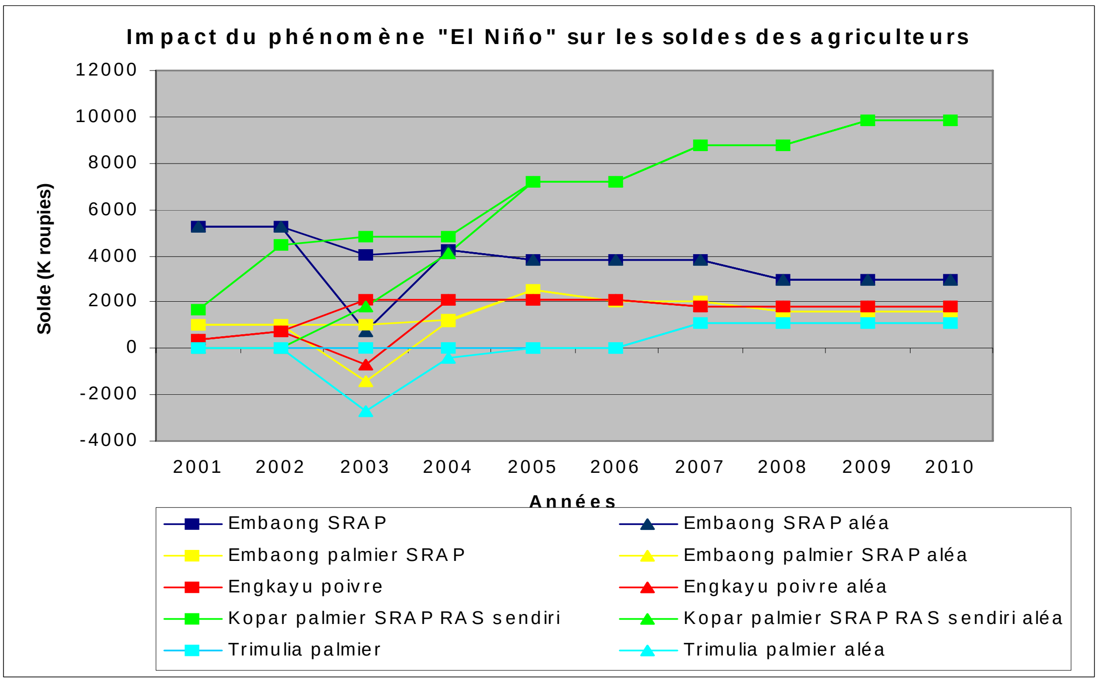


Figure 2: Fluctuations/variations in farmers’ income for 10 different types of farms with differing degrees of intensification (rubber) and diversification (oil palm).

Figure 3 shows the effect on income of an average “el Niño” year in 2003 and how different types of farms recover differently depending on their degree of diversification. In this case, the impact of “El Niño” on yield is minus 30 % on annual crops, minus 10 % on rubber and oil palm with a secondary effect of minus 5 % in the second year for oil palm (recorded or observed in Sumatra).

Figure 3: Impact of an “el Niño year “ in 2003 on net annual income over a 10-year period.



4 the case of Cambodian farmers

The results presented here are taken from the report on a regional assessment of agriculture in Mimot district made in 2004 (L Feintrenie, 2004). The methodology was based on a survey of farm households. The exploratory survey enabled a typology to be constructed and representative farms were then selected. Further surveys allowed farming systems to be defined and analysed after modelling which was based on discussions with local farmers' groups.

The Olympe software was used to analyse farming systems and implement prospective analysis through the creation of potential scenarios for the next 20 years based on current trends. This study resulted in proposals for development and research actions to the donor (AFD, *Agence Francaise de Développement*).

Kampong Cham province, in the East of Cambodia, is dedicated to the rubber industry. Mimot district is characterized by its red soil plateaux that have been planted with rubber since 1925. Nowadays the economy of this depends on the primary branch. Agriculture is represented by family farms, and the average area of a farm is between one and five hectares. A programme aimed at the development of rubber production in Cambodia is presently run by the Khmer Government with financial help from the AFD and scientific support from CIRAD and GRET; it is called 'The Family rubber crop project'. The superintendent of this project is the Directorate-General of Rubber Plantations (DGRP), in partnership with the GRET for the selection of the candidate growers, and with the financial backing of the AFD (French Agency for Development). Other aims of the project are the re-establishment of old rubber zones, the establishment of new sites and agricultural diversification in rubber-production areas. Project actions target four districts of Kompong Cham province: Chamcar Loeu, Tbong Khmum, Damber and Mimot.

The main crops produced in the district of Mimot are cashew nuts, rubber, black pepper and fruits like durian-civet fruit and rambutan. The district environment is quite heterogeneous. Three kind of agrarian systems are observed at village level that depend pn relief and soil characteristics, access to market and the level of specialization of the farming system concerned. Within these groups, farming systems can be characterised by their particular combination of production units.

Figure 4s and 5 show the results of modelling (of different types of farming systems. Fig 4 shows differences in farmers' income for 10 different types of farming systems under different crops for a period of 20 years. Periods of capitalisation and/or de-capitalisation occur highlighting periods when the farmer family cannot live only on its farming income which pave the way for off-farm activities. Figure 5 shows cumulated income for a period of 20 years for the same farming systems, and highlights capitalisation and debts processes which lead to a concentration of land tenure that favours the richest farms at the district scale, and which has been a relatively rapid since the end of the 1990s. The main consequence is a multiplication of no-land farmers since 1990 and the birth of forest clearing fronts in the district. The two figures show that the more diversified the farming system is, the higher the farmer's income. But even more important than the link with crop diversification is the link with two particular crops: rubber and durian which are the most productive agricultural activities in Mimot district in terms of labour and of valorisation of the land. The results of modelling show that the development of rubber or planting durian should help build up a strong family agriculture in Mimot district on condition diversified activities are maintained on the farm. Meanwhile access to a rubber plantation with the current AFD project is the best way to secure long-term agricultural income.

In this regional assessment of the efficiency agricultural activity in terms of income, the Olympe software was very useful, firstly as a “formatted database tool ” enabling very rapid processing of economic data on farms, secondly for the analysis of changes in farming systems by providing a dynamic dimension to a originally static survey of farming systems with emphasis on ? *(there’s a word missing here),* and lastly, as an ideal tool for prospective studies and for testing scenarios of possible future changes in farming systems based on current trends.

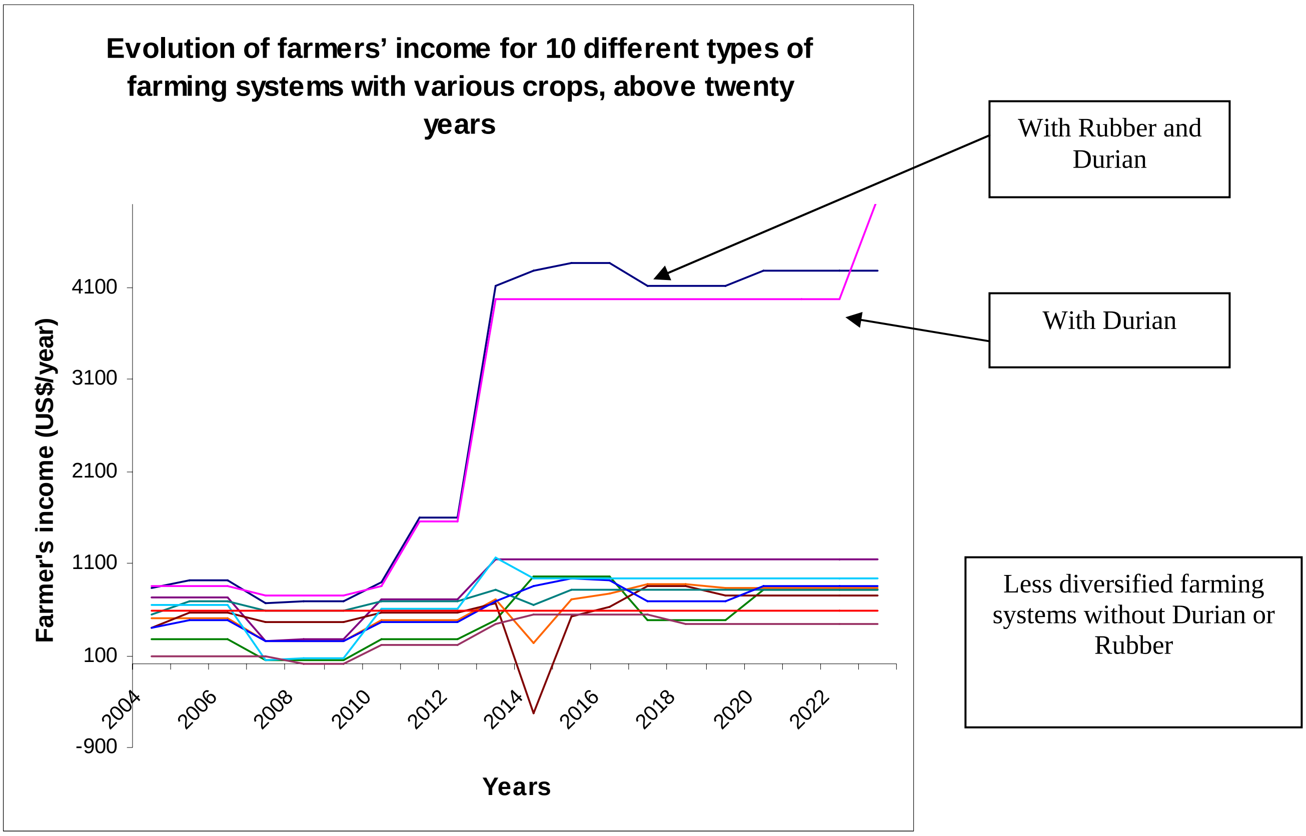


Figure 4: Differences in farmers’ income for 10 different types of farming systems with various crops for a period of 20 years

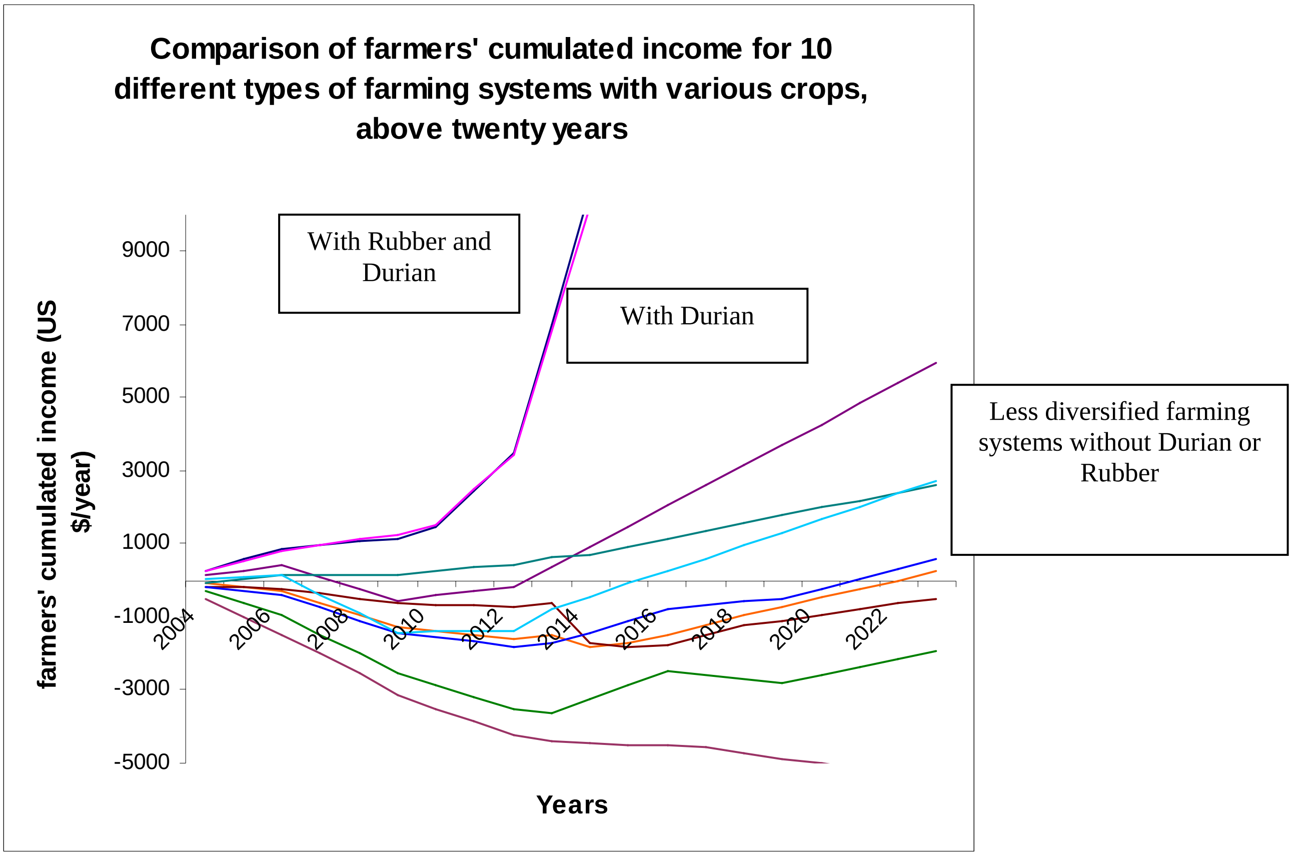


Figure 5: Comparison of the cumulated income of the same farmers

5 Conclusions

Understanding the dynamics of farming systems is a key factor in our ability to deal with changes in a very rapidly changing world and the characterization of farming systems can no longer provide only a static picture at a given date.

Innovations and technical changes leading to new farming pathways are of primary concern to development stakeholders in the context of globalization, decentralization and privatization processes which have largely contributed to the reduction or even withdrawal of Government support from the agricultural and rural sector and consequently to the abandonment of services to farmers, except those provided by private operators such as plantation Estates.

Modelling farming systems can be used (beside other uses such as role-playing or farming management counselling) as a prospective tool to build scenarios about potential farm pathways as a function of farmers' constraints, opportunities and decision-making processes. It can also contribute to the definition of agricultural policies, recommendations, to ensuring the applicability of recommendations with respect to local constraints, to measuring impacts and targeting policies to fit the real situation faced by farmers.

This economic and very pragmatic approach should be combined with a detailed socio-economic approach based in particular on understanding how rural people learn and share experiences and evaluate their actions. FSM is a comprehensive tool to bridge the gap between farmers' options and strategies and policy makers.

The use of such a tool enables stakeholders, policy makers, the private sector, plantation Estates, credit operators, and traders to explore the domain of feasibility and reduce risks for all those involved, including farmers engaged in a process of development.

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