What is the multifunctionalityof the mango orchards in Senegal?

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1 Introduction

Since forty years, the Senegal mango production has been developed to supply both the national and international markets. Around100,000 tons are yearly produced from quite diverse orchards. Some functions of the mango orchards dedicated to the fruit production marketing, are analyzed. The subject is the mango orchard rooted in a territory (Rapey *et al.*, 2004). The functions are defined with respect to user expectations. Various users exist: farmers, breeders, walkers, inhabitants, local representatives, territory administrator. The functions that are defined at the orchard level, involve different stakeholders. They go beyond the fruit production functions. The objective is to compare the functions of four types of orchards, resulting from a survey on orchards design and management.

2 Materials and Methods

The choice of the functions. A typology based on agronomic data (42 variables) classified 64 mango-based orchards in Niayes area. Four categories were obtained: (1) No-input mango diversified orchards ;(2) Low-input mango orchards; (3) Medium-input citrus predominant orchards; (4) Medium-input large mango or citrus predominant orchards (Grechi *et al.*, 2013).

The functions identified from literature and expert opinion are in three types:

-Productive functions: creating income from fruit production, maintaining employment in the area, land markers, increasing assets, other economic production within the perimeter of the orchard (hedges, grazing, market gardening).

-Social functions: wooded savannah landscape, tourism, maintaining employment on farms on a human scale, use of local variety.

-Environmental functions: storage of carbon in the soil (soil cover by trees, hedge, fertilization), plant biodiversity and fauna, cultivated biodiversity (other crops, plant diversity in hedges), pesticides pollution of water and soil, water depletion, creation of humid zones.

These functions can be negative or positive in relation to the stakeholders and the duration that are concerned.

The selected indicators. For each of the functions, we have selected some variables coming from the survey already done. They are used as indicators of the different functions and sub-functions. 13 indicators have been chosen, based on the author's experiences.

Productive functions: There was no yield data in that survey. We assumed that all the orchards have a fruit production. Four indicators characterize four sub-functions of productions other than fruits in the orchards: "pasture" that means that the orchard is used for pasture during some part of the year; "other crop": there are some crops grown between the line of the fruit trees; "hedge": the trees and shrubs in the hedges produced some fruits, leaves for medicinal uses and food, as well as wood for fire or building. An indicator "concrete block wall" is related to the land property, and consequently to the financial land valorization.

Social functions: three indicators are identified in relation with three sub-functions of the orchards; the landscape indicator is the ratio "hedges/acreage": the higher is the ratio, the higher is the percentage of hedges in the landscape with esthetic and walk values; "acreage" of the orchards in relation with the fact that the orchards should remain at a human scale; percentage of local mango varieties in the orchard "local varieties" in contrast to export varieties.

Agro-environmental functions: Six indicators have been chosen in relation with three sub-functions: the capacities of the orchards to maintain biodiversity, the soil protection and the water protection. The diversities in the "hedges species" around the orchard and the diversity of the fruit trees "species" in the orchards will provide some trends for the biodiversity. The soil protection is characterized by "fertilization" based on the hypothesis that fertilization will improve the storage of carbon in the soil. No difference has been done in this indicator between mineral fertilizers and animal manure. The second indicator is the "cover" of the soil by the canopy. The higher is the "cover", the higher is

the protection of the soil. The relations with the water protection will be estimated by two indicators: the "irrigation" describing mainly the level of the irrigation in the orchards and the "pesticides" indicating also the level of pesticides use in the orchards. High irrigation and high pesticides application cause a low protection of the water.

The individual values from the previous survey are transformed by arithmetic operations and then added together to give "synthetic indicators" of same order.

3 Results – Discussion

Synthetic indicators of the productive, social and agro-environmental functions are gathered for the four types of orchards in the table 1.

Table 1. Synthetic indicators of functions for the 4 types of orchards in Niayes areas

Functions	Productive	Social	Agro-environmental
(1)No-input mango diversified orchards	9,4	6,1	15,1
(2)Low-input mangoorchards	11,0	5,9	13,0
(3)Medium-input citrus-predominant orchards	13,0	7,8	12,1
(4)Medium-input large mango or citrus predominant orchards	10,2	5,3	8,4

The table 1 puts in evidence that the functions of the different types of orchards seem intuitively in accordance with the expected results for social and agro-environmental functions, although a low number of indicators are used compared to the 42 indicators of the IDEA method (Villain *et al.* 2008). Agro-environmental functions are lower in the large orchards mainly focus on export production. But the type (3) orchard provides more productive and social functions that the types (1), (2), (4). The results of the productive functions raise the questions about the measurements of the yields and other productive sub-functions in spite of the lack of yields.

4 Conclusions

It seems possible to re-analyze an agronomic survey in a multifunctional approach which allows to better characterize the asset of orchards in a rural area.

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