ECONOMIC AND ENVIRONMENTAL ANALYSIS OF CITRUS BASED INTERCROPPING SYSTEMS IN COSTAL TABLELANDS

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INTRODUCTION

Modern cultivation practices of fruit have shown that there is a need for improvements towards increasing biodiversity in production systems. The incorporation of more crops and plant species within the orchards may favor better biological balances and consequently decreasing the growing problems with pests and diseases observed in sole crop fields. A biodiversity based farming system makes better use of ecosystems services, therefore reducing the dependency on external inputs of the farm (DURU et al., 2015). The require, however, a systemic view of the agricultural activity and sets up to oppose to monocrops that induces the decline in biodiversity and reduction of ecosystems services, like nutrient cycling, climate mitigation, and water quality (GABA et al., 2015).

Intercropping fosters the intensification of environmental processes and functions in perennial cropping systems through diversification of productive design, and favors the expression of the beneficial effects of biodiversity in the production systems (ALTIERI, 1999). The possibility to explore the environment with agricultural activities, together with biodiversity, is based upon a diversified arrangement of crops, within both time and space scales, in replacement to mono-cropping.

Although intercropping is being increasingly adopted by growers, the cultivation of cash and staple food crops together with citrus is basically carried on by small and medium farmers of the North coast of Bahia and South of Sergipe States. By means of intercropping they aim at making better use the limited availability in land, inputs, machinery and labor necessary for manuring; weed, pest and disease control; irrigation; among others (MARTINS et al., 2014).

The objective of this study is to evaluate citrus based intercropping systems through indicators of economic and environmental performances aiming at identifying the best combinations for the Coastal Tablelands region.

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MATERIAL AND METHODS

A field survey was carried out in 19 fruit farms that adopt intercropping in their orchards in the Coastal Tablelands area of South Sergipe and North of Bahia. All needed information were collected with the help of a previously prepared questionnaire and the data organized into an Excel ™ template based "Matrix of indicators of economic and environmental performances of citrus based intercropping systems" developed specially for this study.

The matrix of economic and environmental performance indicators was built as an Excel ™ template and is based on 4 main premises: I) Profitability – represented by the indicators: Profit (LC); Profit evenness (ER) and Seasonality (S); II) Production efficiency – represented by the indicators: Area Equivalent Index (IEA), Efficiency in the use of water (EH), Efficiency in the use of N (EM), Efficiency in the use of P (EP), Efficiency in the use of K (EK), Return on investment in fossil fuel energy (RIEF), Return on investment in labor (RIT); III) Conservation of productive capacity – represented by the indicators: Soil Organic Matter (OM), (pH), Phosphorus (P), Potassium (K), Calcium plus Magnesium (Ca + Mg), Cation Exchange Capacity (CTC), Sum of Basis (SB) and Basis Saturation (V); and IV) Biological regulation – represented by the indicators: Plant health control impact level (NICF) and Productive diversity (PD).

RESULTS AND DISCUSSION

The economic-environmental performances of citrus monocrop (cases 1 and 2) and intercropping (cases 3 to 19) in the cases studies in the Coastal Tablelands of Sergipe and Bahia are shown in Figure 1. According to the results of the surveys, monocrop orchards have lower economic-environmental performances compared to intercropping. The average index of all intercropping farms is above 0.5 and the best results were observed almost exclusively in farms where cassava or maize (for grain or sweet corncobs) as intercrop in the citrus orchards.

Among the intercrop farms with low performance index are those that used okra, cowpea, cucumber, papaya and passionfruit. The average index for monocrop orchards was 0.19, lower than any result with intercropping case study. Individual analysis of each fruit farm reveals the indicators that contributed most for the economic-environmental performance of the best grading farms (above index 0.63), as it is shown in Figure 2 for case study number 6 where cassava, beans and corn were used as intercrop.

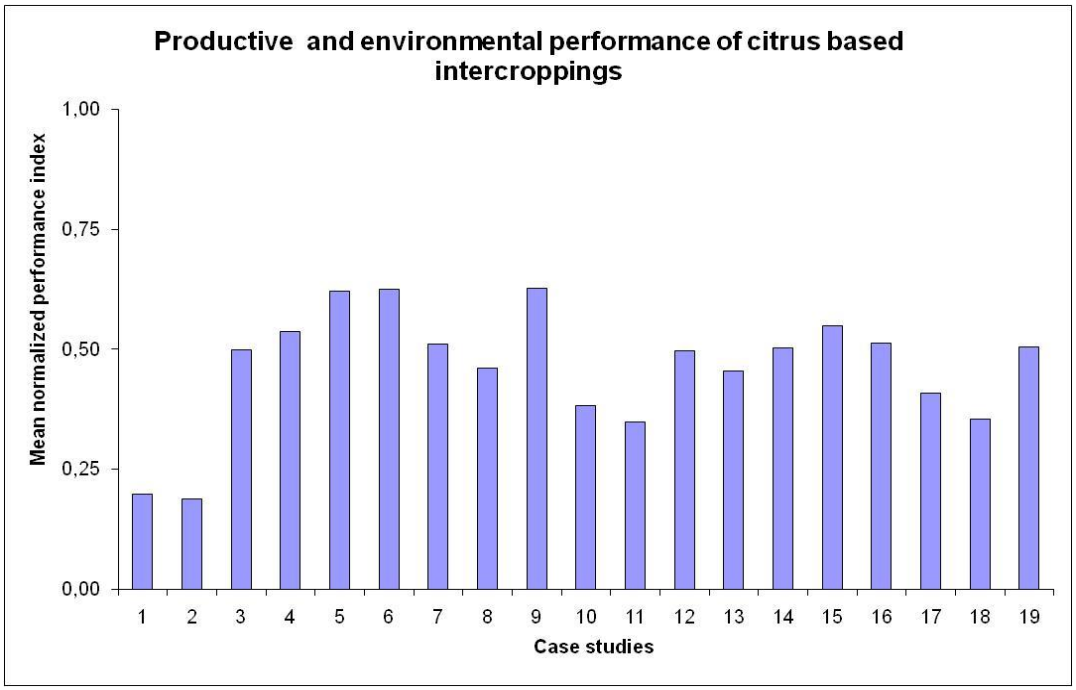

Figure 1: Economic-environmental performances of citrus monocrop (cases 1 and 2) and intercropping (cases 3 to 19) in Coastal Tablelands of Sergipe and Bahia

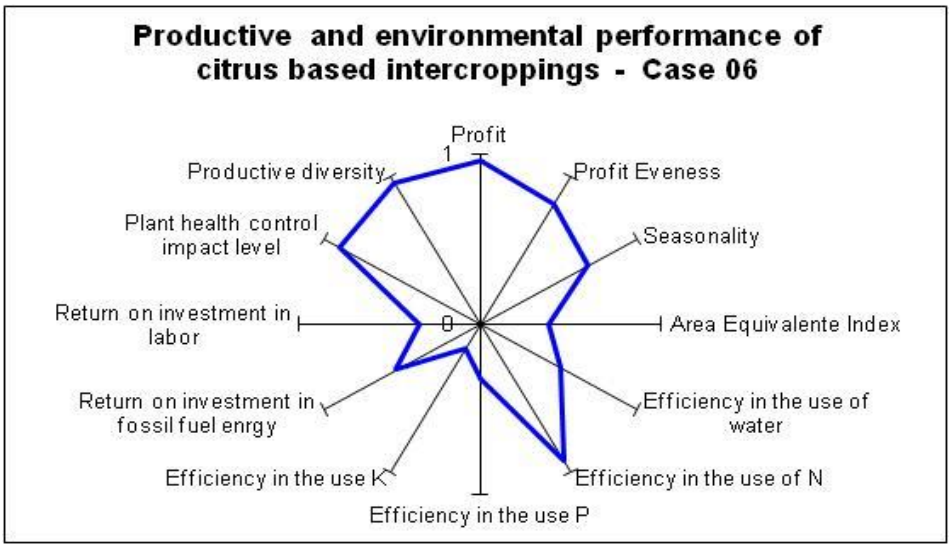

Figure 2: Economic-environmental performance of the intercropping systems with citrus, cassava, cowpea and corn in case study n° 6.

The results of the present study shows that the combination of citrus with cassava, corn, cowpea, yam, fava beans, cucumber, okra, peanuts, watermelon, papaya and passionfruit in intercrop farming systems design brigs economic and environmental benefits to fruit farms. It is important to highlight however, that the economic and environmental performance of an intercropping system depends upon how the different crops cope together for

complementarity in the use of resources (DIMA et al., 2007). Based upon the concept of niche complementarity and facilitation, intercropping systems may favor symbiosis and reduction in the dependency of external inputs (GLIESSMAN, 2001).

CONCLUSIONS

The 'Integrated Indicator System for Economic-Environmental Performance Assessment of Citrus Based Intercropping Designs in Costal Tablelands' has shown to be a suitable tool for evaluating citrus farming systems according to the principles of the Ecological Intensification. The best economic-environmental performances are obtained by combining citrus with cassava; cassava, maize and cowpea (or brown beans?); maize and cucumber. The indicators most positively influenced by the intercropping are Plant health control impact level, Productive diversity, Profit, Profit evenness, Return on investment in fossil fuel energy, Efficiency in the use of water, nitrogen and phosphorus.

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