

Is it possible to be sustainable in the agricultural production for Maranhão State in Brazil?

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Introduction

The weaknesses of the agricultural production systems in Brazilian Maranhão State, which are based on traditional technological procedures, are indicators of how much rice, beans, cassava and corn crops are vulnerable to the climatic instability that prevails in many of the areas where these crops are practiced in the state. As a result, farmers have a low level of income and limited capacity to search alternative means of survival due to the low level of investment in technologies adapted to the different ecosystems at one of the major states of Brazilian Federation, which is reflected in the oscillations in the area harvested, in the yields for hectare of these crops.^{1,2}

Moreover, the instability of agricultural prices, defined outside the scope of farmers' interference in an uncertainty situation, also become uncertain their monetary income. Thus, it can be speculated, in addition to the technological backwardness in which agriculture is practiced in the state, that the non-predictability of rainfall, as well as the oscillations of agricultural prices, constitute some of the most relevant factors that explain the irregular evolution of agricultural production in the state of Maranhão over the years.

In agriculture, the concept of sustainability is treated as the ability to guarantee the permanence of productivity, preserving environmental quality and maintaining natural resources.³ This definition became of great importance when one perceived many harmful effects caused by the productivity technological model that was practically imposed on farmers in the 1960s / 1970s, which was based on principles of productivity increase through the use of chemical inputs, intensive mechanization and high yield cultivars.³⁻⁵ However, this implemented model, when done improperly had as a side effect a strong pressure on natural resources, causing deforestation and soil deterioration.⁶

Due to the agricultural frontier that still prevails in Maranhão, the agricultural practices of food crops (rice, beans, manioc and maize) have always been carried out using the traditional technology that consists of the deforestation of new areas or the withdrawal of secondary forest known as "capoeira" that was recovering. The material resulting from this clearing is burned. This is the way of cleaning that farmers have to leave the land ready for planting. The burning of this material resulting from the elimination of "undesirable" vegetation is the way to achieve, in the first year, to add macro and micronutrients to the soil through the ash.⁷

According to Bartelmus,⁸ the economic aspect of sustainability is related to the maintenance of natural capital, an essential requirement so that there is no economic weakening. It refers to the capacity that an economic system has in generating income, wealth and occupation in a continuous and indefinite way in time for the population, through the most efficient combination of resources.

Rocha⁹ evaluated the economic sustainability to produce food crops in ten regions of Maranhão State in the period 1980/2018. It was designed two research groups; experimental (EXP) and control group (CON). It was constructed the sustainability index (ISUS) used

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to evaluate economic sustainability in both groups. This was possible because it has same indicators and weights. Then the estimated ISUS for the EXP are confronted with the estimated ISUS for the CON in each of the regions. It was used statistically tests in order to evaluate if this two groups were equal (the null hypothesis). Thus, if the ISUS values were statistically different and have positive value, suggest that the two groups were different. The sustainability test used was to estimate the instantaneous general tax of geometrical growth (TGG). The results showed that EXP group have average statistically higher than the CON group. The study also showed that the TGG of EXP group is statistically positive over the years. This indicate that we don't have statistical reason to reject the hypothesis that EXP groups have economic sustainable growth over the studied years in that search.¹⁰

Sustainability should be considered economical because farmers would achieve the same physical output and production value in a smaller area, in lower areas. In this case we should consider that Sustainability would be technological because the same production of these crops in lower areas was possible because the yields per hectare were increased. For this results really happen in the ten studied regions, would be necessary the introduction of genetically increased cultivars of rice, bean cassava and corn, and change the actual way agriculture is placed in those areas.

We should consider that the search showed that we could achieve environmental sustainability by using new technologies, which increase productivity of those crops. It was feasible because the exceeded areas should be used to make reforestation or to produce fruits or leave those area free to regenerate their original composition. All these options would positively impact the environments of the regions and can be considered sustainable, as defined in this research.

The overall conclusion of the study is that the proposed objectives were achieved, as well as the hypothesis that the average sustainability indexes estimated for the experimental groups are all significantly higher than those observed in the control groups. In addition, the results showed that in all ten studied regions it is possible to produce rice, beans, cassava and corn in a sustainable way according economic, technological and environmental point of view without

expansion areas above a certain level. It should be possible if farmers have access to technologies that enable higher levels of productivity than that ones actually observed in those regions.

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Conflicts of interest

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