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ANALYSIS OF THE ECONOMIC, SOCIAL AND ENVIRONMENTAL IMPACTS OF URT/ILPF - CORN AND SORGHUN IN THE CENTRAL REGION OF MINAS GERAIS.

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ABSTRACT
The objective of this work is to make an analysis of the environmental, social and economic impacts of the ILPF Strategy for agriculture in the central region of Minas Gerais and neighboring areas. The method of analysis of information was based on secondary data. The data were provided by Santos (2020) and by Noce (2017), from two different research for doctoral theses. All the analysis of this work was based on the experience of the project of installation of a URT of the ILPF System in the farm of Embrapa in Sete Lagoas - Brazil. The results analyzed showed that the economic, social and environmental impacts of the Systems implemented in the Central Region of Minas Gerais were positive resulting in farmers seeking to increase their areas with the ILPF system and adding new producers, in a spillover effect of the technology.
Key words: Impacts; economics; small farmer

INTRODUCTION

Embrapa Maize and Sorghum, located in the Municipality of Sete Lagoas, implanted a Technical Reference Unit in Integration of Crop and Livestock (ILPF), seeking to represent a rural property in the region. According to Alvarenga et al. (2015) and Balbino et al. (2011) a technological reference unit (URT) is a physical model of a production system, implanted in areas of farms to serve as a reference, aiming at the validation, demonstration and transfer of the technologies strategies generated, adapted and / or recommended for implantation and development of ILPF system.

Cattle farming predominates in the region, with grain production mostly directed to animal feed, with the surplus sold on the market (by-product of livestock). Each year, in the spring / summer, crops are grown on three 5.5-hectare plots, and a fourth plot of the same size is used for grazing, following the order: soy => corn + Urochloa => forage sorghum + Megathyrsus = > pasture, using the cultivars of grass: Piatã (*Urochloa*) and Mombaça (*Megathyrsus*). This spatial design aims at sustainable production by integrating grains and silage with the rearing and finishing of cattle (GONTIJO NETO et al., 2018).

In addition to the ILPF URT area implemented by Embrapa, the work of presenting the ILPF system to producers in the region was carried out by 3 institutions and had a very positive return in terms of using the system. Two doctoral theses analyzed the technology transfer process that was carried out over the years using the URT ILPF installed at Embrapa as a base. Santos (2020) analyzes the process as a whole and provides information on economic, social and environmental impacts of the use of the ILPF system on properties, while Noce (2018) evaluates the SEAPA-MG Program to strengthen the expansion of the use of the ILPF system also in the central region of Minas Gerais, also presenting some impacts of the use of the ILPF system.

The objective of this work is to make an analysis of the environmental, social and economic impacts of the ILPF Strategy for agriculture in the central region of Minas Gerais and neighboring areas. For this purpose, we intend to present some concepts to be able to bring to light some results, related to efficiency and sustainability, arising from the use of ILPF strategies in the Region, which were made possible by Embrapa's performance in partnership with EPAMIG and EMATER -MG.

MATERIAL AND METHODS

The concept of efficiency in production used in the economic evaluation takes into account the two aspects of efficiency, Technical Efficiency and Economic Efficiency. Many of the research results made available to be disseminated to users do not go through one of these sieves or even both.

Technical Efficiency is the result of engineering that shows that the new one works and gives technical results. We can understand technical efficiency as the maximum possible production, given levels of labor, capital and technology, resulting from the use of a technical relationship between the physical quantity of factors of production and the physical quantity of the product in a given period. time (MANKIW, 1999).

But this analysis must not be based only on pure economic concepts, established by economic theory, but also taking into account the social and environmental aspects that are affected by the new productive system. Attention is drawn to the analysis of the sustainability of the process, which should be assessed without ideological bias, but in a practical way, if possible, with tools that have some metrics.

Thus, sustainability involves in its analysis the three aspects of the desired sustainable development, where it is presented that the productive actions must be economically viable and profitable, socially fair and environmentally friendly. This productive process must take into account how its current externalities will impact our legacy for future generations.

Based on the concepts explained above, the method of analysis of information based on secondary data was used. The data were provided by Santos (2020) and by Noce (2017). It is data from two researches for doctoral theses at two different Universities that dealt with the process of technology transfer and Public Policy for the adoption of technology.

The data were compiled, organized, and analyzed using concepts focused on the impact of ILPF strategies for the sustainable development of agroforestry production in the region. The farmers' responses were considered as indicators of each of the proposed concepts. The responses of 8 rural producers were considered in the data from Santos (2020) and 35 rural producers in the data from Noce (2017).

RESULTS AND DISCUSSIONS

ILPF has already proven to be technically efficient. Although it is almost unanimous in terms of technical recognition, much has been said in its sustainability with agricultural, livestock and forestry production strategy. Questions are raised about the applicability of this system in family farming, about what is actually delivered in terms of environmental benefit, among other questions (CORTNER et al., 2019).

Santos (2020), in her research conducted with producers to evaluate the process of transferring ILPF technology in the Central Region of the State of Minas Gerais, addressed the issue of applicability of the ILPF system to small producers, showing that there was positive involvement of family agriculture in the use of technology. In the sample of producers who had the influence of Embrapa, Epamig (Minas Gerais Agricultural Research Company) and Emater-MG (Minas Gerais Technical Assistance and Rural Extension Company) in the dissemination of the ILPF System in the Central

Region of Minas Gerais, assisted by Emater-MG in all their needs, one can observe that they are small properties with small areas used with the ILPF System also. Half of these areas have 3 ha or less applying the technologies recommended by the system. These small areas have been in the areas for more than 8 years with results that show the sustainability of the system in different sizes of properties, including economic viability.

Environmental Impact

Tables 1 and 2 show information collected in Santos' research (2020) and reported in his Doctoral Thesis. Information collected by the author is reported with the properties participating in her research. It is observed in table 1 that the perception of the agents who acted in the implementation and conduction of ILPF Systems in properties (Producers, extensionists of EMATER-MG, researchers from EPAMIG and Embrapa) is positive for environmental and social improvement.

According to the producers' reports, the indicators that were positive, without the use of any metrics, but only as an observation of the evolution of the results experienced by them, were:

- Improvement of soil quality.
- Abandonment of harmful practices to the soil and the environment (e.g. burning, clearing of riparian forests, etc.)
- Recovery of degraded pasture
- Improvement of the rural landscape.
- Reduction of animal stresses by offering shades;
- Rotation of crops.

In the evaluation carried out by the producers, the environmental quality in their properties was increased. According to their reports, they were able to control erosion by keeping the soil always covered, also contributing to a sense of well-being, because the rural landscape became more beautiful. They were able to ensure more moisture for the soil, with the use of no-tillage, adding to the previously reported effect. The planting of trees brought the possibility of improving the ambience for the animals that grazed under their canopy, which resulted in an increase in the quantity and quality of the milk produced by them.

Social Impacts

Some social benefits were also identified in relation to the use of ILPF systems. In this sense, these producers were able to enjoy social benefits more because they were the ones who were at the forefront of the use of innovation in the region.

One of the great benefits of ILPF is related to the training of farmers and all who are part of the production process for questions about technical, administrative, environmental and social relationship (cooperation) development. These trainings underwent a spillover process where those who were trained passed their knowledge to their community and all benefited.

In addition to the training, Table 1 presents the social benefits of the Implementation of the ILPF System in the analysis by Santos (2020). This information was reported by the producers themselves who came to have ILPF as a promoter of welfare on their property. They considered that the activity improved the quality of the work they developed and reduced the amount of time spent with the tasks, which provided them with extra time for social interaction. They also came to be able to have improvements in the quality of their homes.

In table 1, it can still be noted that the producers increased their sense of observation because they began to perceive the importance of their activities for regional sustainability, perceived the need to

offer quality products, thus had greater market opportunity, and realized that they had to produce in the right way, which placed them as an example for regional producers, increasing their self-esteem.

Economic Impacts

Although the environmental and social benefits that ILPF brought to properties and nearby region were important, producers are always entrepreneurs and always seek to maximize profit with the restrictions imposed by and on activity. Table 1 presents some of the economic and financial results reported by Santos (2020).

In Table 1, it is observed that the forest activity of ILPF was considered as a form of capitalization of the producers who adhered to the developed program of use of this system in the properties. After 7 years of planting, the producers achieved an extra income that helped them in investing in improvements in production and housing infrastructure.

In terms of production, one can observe in Table 1 that all farmers reported an increase in the volumes produced, in the best use of pastures, increase in Animal Units per hectare, and increase in the quality of the products offered by the property. With this, they realized that there was greater efficiency in production resulting in the reduction of production costs. Both the increase in productivity per hectare and the reduction of production costs contributed to the increase in the income of the properties in the activities of farming and livestock, meaning more income for the rural producer.

Table 1. Environmental and Social Benefits of Implementing the ILPF System in small properties in the Central Region of Minas Gerais.

Benefits	**Maravilha Region**	**Papagaio Region**	**Sete Lagoas Region - Otter**
Environment	Abandonment of harmful practices to the soil and the environment (e.g. burned). Control of soil erosion (soils covered all year round).	Recovery of areas with eroded soils	Improvement of soil quality.
	Recovery of degraded pasture.	Recovery of degraded pasture	Recovery of degraded pasture.
		Reduction of animal stresses by offering shades.	
	Rotation of crops		Rotation of crops
	Reinsertion of degraded areas	Improvement of the rural landscape.	Improvement of the rural landscape.
Social	Training	Training	Training
	Improving the quality of work.	Improvement of work planning.	Work reduction (improved work planning)
	Interaction with other producers.	Interaction with other producers.	Interaction with other producers.
	Perception of production quality	Perception of production quality	Perception of production quality
	Search for economic and environmental sustainability	Search for Economic and Environmental Sustainability	Search for Economic and Environmental Sustainability
	Improving self-esteem	Improving self-esteem	Improving self-esteem
Economic/ Financial	Eucalyptus = Green savings Income of up to R$ 2,136.40 ha/year from the 7th year.	Eucalyptus = Extra income Income of up to R$ 11,000.00 in 23 ha, in the first cut (R$ 473.00 /ha).	Eucalyptus = Extra income Income of up to R$ 400.40 ha/year in the 1st cut in the 7th year.
	Increased income Cost of corn production plus pasture: R$ 3,132.40/ha/year; Total Milk Revenue plus corn: R$ 5,249.83/ha/year	Increased income	Increased income
	Increased production Milk: went from 150lt/day to 450 liters per day; Corn Yield: 6873 kg/there is in the useful area.	Increased production: Milk: Increased production by 10% / increased quality per animal; Went from 0.5 AU/ha/year to 2.0 AU/ha/year	Increased production Increased the amount of dairy cow head in the same space.
	Cost reduction per unit produced.	Cost reduction per unit produced.	Cost reduction per unit produced.

Source: Santos (2020). Content compiled by the authors.

Noce (2017) is another author who analyzes the implementation of ILPF in the Central Region of Minas Gerais. In his work, he sought “to analyze the process of the transfer of agricultural technologies (TT), usually practiced in Brazil. For the analysis of the process, we opted for a case study related to the program initiated in 2008, at the initiative of the government of the state of Minas Gerais, through the Department of Agriculture, Livestock and Supply (SEAPA-MG). This program aimed to disseminate the Crop-Livestock-Forest (ILPF) integration system among family farmers in the central region of Minas Gerais." To present his analysis of this process, he interviewed 54 producers, as well as extension workers from EMATER-MG and researchers from EPAMIG and Embrapa.

Of the 54 producers surveyed by Noce (2017), 35 became users of the ILPF System, after the implementation of the SEAPA-MG program. Table 2 depicts the items that were important to convince to use ILPF system technologies. It can be seen that at least 71% of the adhering producers had economic reasons to implement ILPF. Although this research was done in 2016 and they still did not have the results of the returns of the forest part of ILPF, they had perception that they were in a better situation than those who did not adopt the system.

To infer about the benefits of the ILPF System, we can turn to Noce´s (2017) research again. In the research he reports that: "As for the levels of satisfaction of producers with the technology implemented, it is observed that only a small minority, less than 6%, declared themselves dissatisfied with the results, while almost 90% say they are satisfied or very satisfied. The interviewed adoptive producers praise the improvement of pasture under eucalyptus, the shading of trees that benefits cattle, the condition of a better and greener pasture in the drought, the preservation of moisture, the production of wood and, in some cases, the production maize in the system”. It can be used as a positive indicator of the environmental and economic benefits of using the ILPF System on properties in the Central region of Minas Gerais.

In the sustainability assessment the benefits are generally comprehensive for the region, not becoming specific to the property, but when it comes to the evaluation of economic returns, the indicators bring results that "site specific", because they represent the values of exclusive analysis of the case (property) and system being evaluated. Thus, in the previous paragraphs we show results that represent an approximation of the analysis of the sustainability of the use of the ILPF System in some properties of the Central Region of Minas Gerais.

Table 2. Reasons pointed out by rural producers as instruments to convince them to use ILPF technology.

Itens	**Levels of importance (%)**
Importance of technology for the environment	5.71
Technology presentation at events	37.15
Donation of inputs and seeds	62.86
It could increase your profits from your production system	71.43
Action by rural extension workers	82.86

Source: Noce (2017). Content compiled by the authors.

CONCLUSIONS

All the analysis of this work was based on the experience of the project of installation of a URT of the ILPF System in the area of Embrapa. In addition, it was thought to present evaluation both to see the sustainable aspects and the economic returns of the use of the ILPF System. In the case of

sustainability analysis, results of two studies were presented that indicate information collected from producers who participated in a technology transfer program that was based on the implementation of URT at Embrapa. The results analyzed showed that the economic, social and environmental impacts of the Systems implemented in the Central Region of Minas Gerais were positive resulting in farmers seeking to increase their areas with the ILPF system and adding new producers, in a spillover effect of the technology.

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