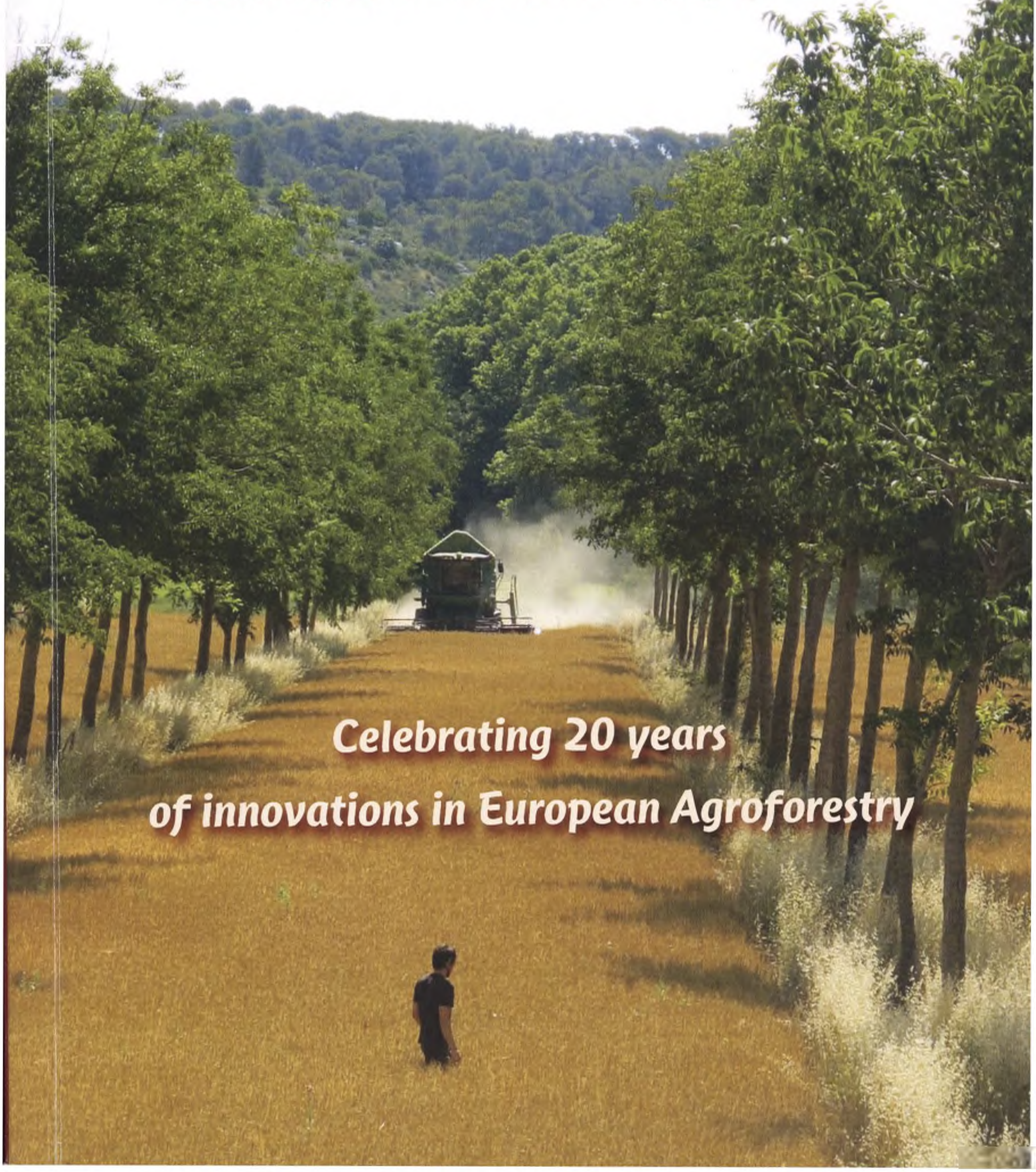
Book of Abstracts

3rd European AGROFORESTRY Conference 2016

23-25 May 2016 – Montpellier SupAgro, France



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EUROPEAN AGROFORESTRY FEDERATION

3rd European Agroforestry Conference

Celebrating 20 years of Agroforestry research in Europe

Montpellier, France, 23-25 May 2016

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CROP-CATTLE-TREE INTEGRATION IN RORAIMA STATE, BRAZILIAN AMAZON

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Introduction

The increasing population in the Brazilian Amazonia, especially in urban areas, has led to an increasing local demand for food, including meat (Tourrand et al. 2006; Bendahan et al. 2013). High rates of forage production, due to good weather conditions in terms of rainfall and temperature, added to the security and flexibility of cattle ranching are contributing to the rapid expansion of livestock farming in the Amazonia (Veiga et al. 2004). Hence, cattle breeding is considered as one of the main drivers of Amazonian deforestation (Tourrand et al. 2006). More recently, the environmental impact of the associated greenhouse gas emissions have also been highlighted (MAPA and MDA 2011).

In the early twenty first century, restrictive and repressive measures have been enacted in Brazilian Amazonia to reduce deforestation (MMA 2013) and consequently the expansion of livestock farming. An alternative approach supported by EMBRAPA has been focused on sustainable farming systems such as "crop-cattle-tree integration systems", locally called "Sistema Integrado Lavoura – Pecuária – Floresta" (or SILPF). However, the expansion of SILPF at a large scale is difficult, and the integration is often more an association rather than real integration, at least regarding the tree component (Bendahan 2015).

The Roraima is a Brazilian State in the Northern Amazonia, at the border of Venezuela and Guyana. Roraima State has also invested in SILPF research as an alternative to pure cattle ranching in forest and savanna biomes. In 2008, the first SILPF were tested at the Experimental Research Station of Embrapa Roraima, before further extension. Our two research hypotheses are: i) SILPF offers better economic and financial results than cattle ranching due to the efficient use of resources, and ii) the capacity to manage multi-component and multi-product systems such as SILPF is a constraint to its implementation.

Methodology

The factors determining the success of SILPF were considered in three areas: i) environmental factors; ii) external factors to the farm; and iii) internal factors (Bendahan 2015; Wood 2015). The analyzed environment factors were soil and climate. External factors were: i) availability and access to credit; ii) conditions of education and transport; iii) availability and quality of the technical assistance; iv) meat, grain and wood markets; v) human capital in the state; and vi) livestock characteristics. Our methodology relied on the analysis of public databases, interviews with key-informants in the appropriate sectors and through participant workshops, and interviews on farms that have adopted SILPF. The internal factors were: i) labour, ii) infrastructure, iii) economic analysis of three models of SILPFs, iv) practices and activities inherent in these systems, v) cash flow, vi) dynamics of soil fertility under different SILPFs, vii) productivity and interactions between components of SILPF, and viii) management of internal and external factors to the farm.

We used interviews and workshops with producers and technicians together especially monthly or bi-monthly interviews on four private farms, over four years, between 2008 and 2011 to analyze factors such as labour, infrastructure, cash flow, and practices and activities of SILPFs. For the economic analysis, we used the results obtained in the characterization of livestock activity and the results obtained in the monitoring of private farms. We used experimental data from the Embrapa Research Station to determine the soil fertility and the productivity of the components and their interactions.

Results

Physical environmental factors did not constitute significant barriers to the expansion of SILPFs in the State of Roraima, but the specific environmental conditions should be considered, in system design. The zoning exercise highlighted the climate risks faced by each farmer in implementing SILPFs. Each region and each municipality has specific characteristics in this regard. Improved soil management was often a driver for the implementation of SILPFs.

External factors to the farms were important. We determined that the barriers to the expansion of SILPFs in Roraima included low school enrollment and poor quality of education in rural areas The road network was also poor with 85% of roads being unpaved. The levels of available technical assistance were also poor, and financial institutions provided little funding to increase production. Livestock production often receives a low priority and cattlemen do not use formal management tools. Trees are generally not considered as a production system and the wood market is still very informal. The market for crops such as cowpeas is also small in Roraima. One of the internal factors in relation to the farm, as demonstrated by experiments by Embrapa, is that chemically impoverished soils can respond quickly to fertilization.

The development of eucalyptus trees with crops in the savanna region led to declines in crop yields near the trees. Teak trees were observed to benefit from the planting of beans in the transition forest region.

The experimental results showed that in the third year, the cultivation of teak trees did not affect the yield per hectare of soybeans and corn. By contrast, eucalyptus trees of a similar age reduced the yields of corn until a distance of 4.2 m (Figure 1) and soybean until a distance of 4.5 m. This occurred in systems where the distance between the tree rows was 18 m (called E3_20) and 54 m (treatment name: E3_50). Within these areas (4.2 m for corn and 4.5 m for soybean, the crop yields were reduced by 41-44% compared to the yields observed out of this areas (Table 1).

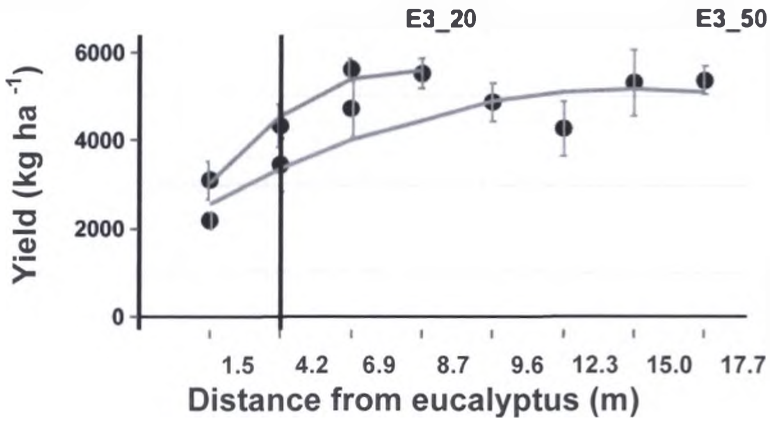

Figure 1: The effect of distance from Eucalyptus trees on the yield of corn in two agroforestry systems (E3_20 and E3_50) at the Aqua Boa experimental station in 2010.

Table 1: Yield of soybean and corn according to the distance from eucalyptus trees in the third year of cultivation in savannah region of Roraima.

Zone	Soybean	Corn
Yield away from trees (kg ha^{-1})	3598	4799
Yield near to trees (kg ha^{-1})	1997	2816
Reduction %	44%	41%

During the 120 days of intercrop period, in the transition forest region, we observed that, the daily liveweight gains per animal and per hectare were 45% and 166% higher respectively in the integrated crop-livestock system (ICL) when compared to a rotational grazing system (RG), without fertilization (Table 2).

The successful adoption of agroforestry systems requires the careful scheduling of operations. SILPF systems require additional labour. We estimate an increase of 80% more labour in milk subsistence systems and 30% in the fatting cattle systems (the two systems located in transition forest region), and 166% more labour in the system creates in savanna of

Roraima, when compared with similar farms but without SILPFs. Beside the need for more labor, the labour needs to be more skilled.

Table 2: Animal performance in the intercrop period in ICL systems, in transition forest region, was superior to that achieved in rotational system without fertilizing pastures.

System	Rotational grazing system (RG)	Integrated crop-livestock system (ICL)	
Daily animal gain (kg)	0,475	0,692	+45%
Gain per hectare (kg ha^{-1})	153	408	+166%

Farms with SILPFs were more profitable in terms of Net Present Value (NPV) and Internal Rate of Return (IRR) when compared with farms only with cattle (Table 3). These results were due the SILPFs were more efficient in the use of resources. The animal component is the largest source of cash flow in the SILPFs.

Table 3: Economic analysis of three livestock production models in the state of Roraima.

		Subsistence milk production	Fattening cattle	Livestock breeding
Without SILPF	Net present value (R$)	28,000	334,000	- 677,000
	Internal rate of return (%)	2	10	-
With SILPF	Net present value (R$)	30,000	554,000	280,000
	Internal rate of return (%)	11	9	6

Conclusions

Integrating trees, crops and livestock appears to be more profitable than livestock farming alone in the savanna and transition forest regions in Roraima. However the absence of effective management tools still creates a barrier to the adoption of SILPF by farmers in the state of Roraima in Brazil. The increased number of components, activities and practices complicate farm management (Durand 1990; Minati 2001; Morin 2005). The complexity also means that farmers must understand more legislation, a greater range of markets and inputs, and an understanding of the interactions between components (Minati 2001; Morin 2009; Teixeira et al. 2010).

There appear to be substantial external constraints, such as the lack of roads, education, communication, legal uncertainty and technical assistance, in Roraima and this is likely to constrain the immediate expansion of SILPFs, despite the economic, environmental and social benefits of such systems.

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