Technological Evolution and Production Arrangements of Crop-Livestock-Forestry Integration Systems in Brazil

Gladys Beatriz Martínez [(1)]; Paulo Roberto Galerani[(2)]; Luiz Adriano Maia Cordeiro[(2)]; Luiz Carlos Balbino [(2)]

[(1)]Embrapa Amazônia Oriental, Belém, Brasil, gladys.martinez@embrapa.br;
[(2)] Embrapa Cerrados, Planaltina, Brasil, paulo.galerani@embrapa.br
luiz.cordeiro@embrapa.br; luizcarlos.balbino@cpac.embrapa.br

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Introduction

With increased demand for food, followed by technological developments in production, farming began to be characterized by simplified and standardized systems of monoculture, agricultural expansion, mechanized soil management, pesticide use, irrigation, in which agricultural activities, livestock and forestry can be, performed in an intensified a manner, independent and decoupled. This model of agricultural production predominates in most rural properties around the world, showing, however, signs of saturation because of their high demand for energy and natural resources. The degraded pasture has become one of the main signs of low sustainability of livestock farming in different regions.

The technological evolution of Integration Crop-Livestock-Forest Systems (ICLF) in Brazil Macedo (2009) states that sustainability can be achieved through technologies like the No Tillage Systems (NT) and agroforestry systems. This scenario led the scientific community to seek sustainable solutions in order to harmonize high productivity with plant and animal preservation of natural resources, where the sustainable production systems gained prominence. In 2001, the "Santa Fe System," is consolidated which is based on grain crops production (especially maize, sorghum, millet and rice), in consortium with tropical forages (mainly Brachiaria sp.) in cropping areas with soil already partially or totally corrected. In Brazil, the integration between crop and livestock has long been used, particularly to open new agricultural frontiers. The "System Barreirão" which is a system composed of a set of technologies and practices for recuperation of degraded areas, is an example. The integration between crop and livestock was incorporated to the technologies applied on the National Recovery Pastures Program ("Propasto") for the recovery of degraded pasture (Dias-Filho and Serrao, 1982). In mid-1995, in Paraná, the terminology Crop-Livestock Integration (ILP) defined in general, the production systems involving agricultural and livestock activities. This concept calls for a minimum of interface between these activities in rotation between crops and pasture (grasses) or legumes (Moraes et al., 1998).

Contribution of ICLF systems to Agricultural Sustainability

ICL allows the soil to be exploited economically throughout the year, favoring an increase in the supply of grain, meat and milk at a lower cost due to synergism between agriculture and pasture. The adoption of ILP helps to enable the NT with the well management of the straw produced by tropical grassland. The forest component functions not only to decrease heat and

intercept solar radiation, but with their debris on the soil it also acts to intercept of soil radiation and hosts of rainfall water (Primavesi et al., 2007).

The technology transfer-TT of ICLF throughout Brazil

From 2007 to 2012, Embrapa Technology Transfer, coordinated an integrated network of 26 Embrapa's research centers in Brazil, National Agricultural Research System organizations, educational institutions and extension agents with technical assistance aimed to organize actions on Technology Transfer project-related on ICLF. This project proposed the transfer of technologies and knowledge for the recovery of pasture degradation and problems with crop productivity and sustainability, mainly through demonstration/observation areas called Units Reference Technology-URTs. It is basically, a physical model of production systems implemented in public or private area, seeking validation, demonstration and transfer of technologies developed, adapted and / or recommended by the National Agricultural Research System (NARS) organizations. Among other goals, the project has generated and provided knowledge on ICLF to farmers through the introduction of technologies and animal husbandry, plant and soil management that minimize environmental impacts from productive activity, contributing not only to the ecosystem but also with rural producers, generating jobs, income and improvement in their quality of life.

The regions of the project were defined according to by homogeneous Eco regions according to similarities and infrastructure. Distribution in macro-regions of the Brazilian states participating in the Project TT-ICLF is: Region 1 (Mato Grosso do Sul, West of Paraná and West of São Paulo); Region 2 (Minas Gerais, Rio de Janeiro, Espirito Santo and the west-central part of Sao Paulo); Region 3 (Maranhão and Piauí); Region 4 (Mato Grosso and Goiás); Regio 5 (Federal District, Western Bahia and Tocantins); Region 6 (Rio Grande do Sul, Santa Catarina and Paraná South-Central); Region 7 (Amazonas, Acre, Pará, Amapá, Rondônia and Roraima); Region 8 (Pernambuco, Paraiba, Ceará, Rio Grande do Norte, Alagoas, Sergipe and Bahia).

Figure 1 represents the quantitative performance of the TT project in ICLF in eight regions. The activities were grouped into: Field Days, courses / short courses, seminars, technical meetings, technical visits and publications related to the theme. Typically, field days and some other actions were performed in Reference Units Technological-URTs in different numbers for each region according to the needs and management capacity of these areas. According to Table 1, the participating public of different activities throughout the period was 87,105 professionals including: producers, technicians and students in courses related to the agricultural sector and forestry. It can be observed that the increased participation in numbers focused first, on the actions of Field Days, and second, lectures. These data suggest that the Field Days are very attractive because they allow stakeholders to interact with the proposed systems and more easily view / internalize the information passed on by researchers. The lectures, however, are easily organized and are usually filled with information and illustrations (photos) of the systems. The same occurred with the courses / short courses, which are the third most active activity in the project in terms of participation. The media insertions are the form of rapid dissemination, which aim to aware / update the general public on new technologies and processes. And finally, both scientific publications and booklets are the means to fix the information.

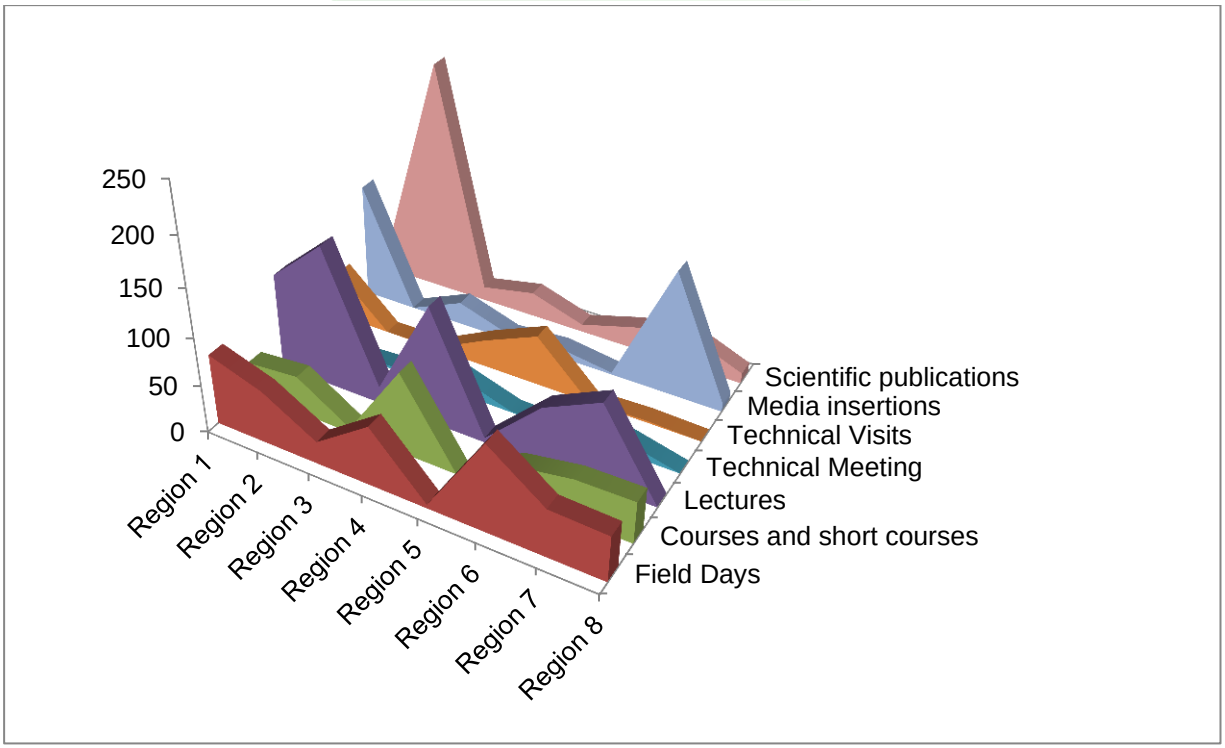

Figure 1- Events of the TT project in ICLF in eight regions of Brazil, in the period 2007-2012.

Table 1 - Performance Quantitative Project TT shares ICLF in eight regions of Brazil, in the period 2007-2012.

Events of TT 2007-2012	Region 1	Region 2	Região 3	Region 4	Region 5	Region 6	Region 7	Region 8	Public
URTs	18	20	19	18	4		19	43	
Field Days	74	56	24	63	4	92	50	48	37.671
Courses/short courses	35	40	5	86		33	43	44	9.608
Lectures	101	148	18	123	5	60	87		35.336
Technical Meeting		1	4	19	1		14		2.930
Technical Visits	50		1	29	53		2		1.560
Media insertions	120		24	6	10	2	131	9	
Scientific publications	46	240	15	26	8	24	34	11	
Total									87.105

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