EFFECTS OF SILVOPASTORAL SYSTEMS ON THE PRODUCTION OF BUFFALOES ON EASTERN AMAZON, BRAZIL

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Introduction: The silvopastoral systems (SPS) are characterized by the deliberate combination of trees, pasture and animals in the same area and at the same time. In these systems, the components present integrated management, with the aim of increasing productivity per area unit, with interaction in all directions and at different magnitudes. These production systems aim at the utilization of areas altered by inappropriate use, adding value to land, via a tree component, allowing better nutrient cycling and animal comfort. This is an alternative to maximize land use and to enhance sustainability.The processes of occupation of rural areas and integration of the Amazon began in 1960, based on a government policy decision, which gave priority to agricultural activity, mainly by the ability to occupy large areas in short time, with provision credits, technical assistance and infrastructure. For pastures, logging and agriculture, large areas of forests were cleared. Recent studies show that in the Brazilian Amazon, around 58 million hectares of forests were cleared, with only 29 million hectares in Para State, of which 15 million hectares were allocated for the establishment of pastures. Reports of detection of deforestation in real time mention that Amazon lost 2,995.5 km2 of native forest between May 2009 and April 2010 (INPE 2010).The environmental and socioeconomic impacts caused by the replacement of large areas of forests by pastures have been a constant concern for the Brazilian and international communities. Thus, it´s of fundamental importance to fostering sustainable economic activities and generating technological solutions that allow the livestock production in altered areas of Amazon, giving priority to systems that are environmentally recommended, socially equitable and economically profitable.The research about silvopastoral systems were initiated at Embrapa Eastern Amazon, in the 70s, but they initially did not attracted much interest among producers, mainly because they have been chosen tree species of a low commercial value. Today, with the increase in the cost of land, valuation of environmental aspects, reduction of stocks of natural wood, greater demand for employment and social need for increased income, and competitiveness in livestock production, there is a tendency to work with higher market value and rapid growth species. Among these species, stand out from the Brazilian mahogany (Swietenia macrophylla King), African mahogany (Khaya ivorensis), Indian neem (Azadirachta indica), teak (Tectona grandis) and ipe (Tabebuia rosea). There can also be used tree species and palms in order to produce fruit and oil for the food industry, cosmetic and biofuel production.Different arrangements of silvopastoral systems have been tested and validated in experimental fields, with outstanding results in the forest and forage production on animal performance and thermal comfort as well as breeding, nutrition and health. Because of their success, these models were transferred and adopted by private property, in the buffalo and cattle livestock. Some characteristics of systems deployed in Para State, Brazil, are shown in table 1.Table 1. Characteristics of several silvopastoral systems deployed in Para State, Brazil.

Animal	Forest Essences	Grass	Property	Implantation
Cattle and buffalo	*Hevea brasiliensis*	*Brachiaria humidicola*	Embrapa*	1978
Buffalo	*Elaeais guineensis e Hevea brasiliensis*	*Panicum maximum e Brachiaria humidicola*	Embrapa*	1995
Cattle	*Elaeais guineensis*	*Brachiaria brizantha*	Embrapa*	1995
Buffalo	*Khaya ivorensis e Azadirachta indica*	*Cynodon nlemfuensis*	Embrapa*	2002
Buffalo	*Racosperma mangium*	*Brachiaria humidicola*	Embrapa*	2006
Buffalo	*Oenocarpus bacaba e Elaeais guineensis*	*Panicum maximum*	Embrapa*	2008
Buffalo	*Khaya ivorensis e Azadirachta indica*	*Panicum maximum*	Embrapa*	2008
Buffalo	*Khaya ivorensis*	*Brachiaria humidicola*	Private	2003
Buffalo	*Khaya ivorensis*	*Brachiaria brizantha*	Private	2005
Buffalo	*Tabebuia rósea*	*Brachiaria brizantha e Brachiaria humidicola*	Private	2005
Cattle	*Khaya ivorensis*	*Brachiaria humidicola e Brachiaria dictyoneura*	Private	2005

*Embrapa: Brazilian Agricultural Research Corporation.

[table1]

When buffaloes are raised on systems without access to shade or water for bathing, their thermoregulatory system is immediately activated in order to maintain the heat balance, spending energy that could be used for producing meat and milk (figure 1).

Therefore, systems that allow access to shade, like silvopastoral systems, improve tolerance of buffaloes to tropical climate and increase productivity (Silva *et al* 2010).

In research on buffalo raised in SPS and intensive rotational grazing, in Belem, Para State, Brazil, there was herbage mass of 3,318.9 kg DM.ha-1, a grazing Cynodon nlemfuensis, with the average weight gain of 0.911 kg.day-1 (Castro *et al* 2008). In SPS Panicum maximum, with the shadow between 20% and 25%, and animal supplementation with byproducts of agro-industry, the average weight gain of buffaloes was 1.007 kg.day-1. It is noteworthy that, after slaughter, carcass yield was 58%, which is exceptional, and highlights the potential of these animals for meat production (Oliveira *et al* 2010).The SPS are important for the animal environment as they reduce solar radiation and temperature, promoting better performance, due to ideal conditions of acclimation. These systems, with African mahogany and Indian neem, provide enough shade to promote greater ambiance and increase the productive performance of dairy buffaloes, with ideal comfort index near 2.0, in 70% of observations. This proves the importance of shadow in the animal environment, in tropical climates, such as the Brazilian Amazon (Lourenço Jr *et al* 2006).The provision of shade by the SPS is as efficient as access to water for bathing, in the maintenance of homeothermy of buffaloes, or young adults, maintaining body temperature within normal values, and being able to reduce skin temperature, depending on lower incident solar radiation on animals (Morales Jr *et al* 2010).Higher rates of conception occur when the animals presented thermal comfort index between 1.9 and 2.1 (Matos *et al* 2007). Buffaloes raised in SPS and inseminated at fixed time showed conception rate of 53.84% against 43.33% without shading. The animal comfort during synchronization of estrus process appears to be more important in increasing the fertility than during insemination (Garcia *et al* 2007). For this reason, the conception rate of buffaloes in conditions of hot and humid climate is associated with climatic variables, which are liable for the physiological variation of animals and whose impacts are minimized by use of SPS (Dantas *et al* 2008).Likewise, there are beneficial effects of SPS on male performance. Thus, buffalo bulls with 5.3 ± 1.8 years and 709.5 ± 35.5 kg, reared in shaded pastures, suffer less the harsh tropical climate and produce high quality ejaculates characterized by milky aspect, volume 4.5 ± 1.4 mL, pH 6.0 ± 0.72, sperm concentration of 1.390 million cells.mL-1, progressive motility of 77.7 ± 6.1%, percentage of sperm with intact plasma membrane of 85.4 ± 8.3%, and total defects of 25.1 ± 7.5% (Castro 2010).**In conclusion**, technologies provided by Amazonian research and teaching institutions about integration animal-pasture-forestry can make it a bioeconomy viable activity, globally competitive, environmentally and socially correct. Livestock production expansion will occur via increasing the carrying capacity of the pasture and the recovery of degraded areas, without the need to overthrow the forest. Thus, there is a need for constant improvement of silvopastoral systems, with more suited arrangements to tropical conditions, seeking better land use.

[figure 1 & 2]

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