

Integrated crop-livestock-forestry systems: a Brazilian experience for sustainable farming

Davi José Bungenstab¹, Roberto Giolo de Almeida¹ and Horst Jürgen Schwartz^{2*}

¹Embrapa Gado da Corte, Brazil; ²Humboldt-Universität zu Berlin, Albrecht-Thaer-Institute for Agricultural Sciences, Germany

Background

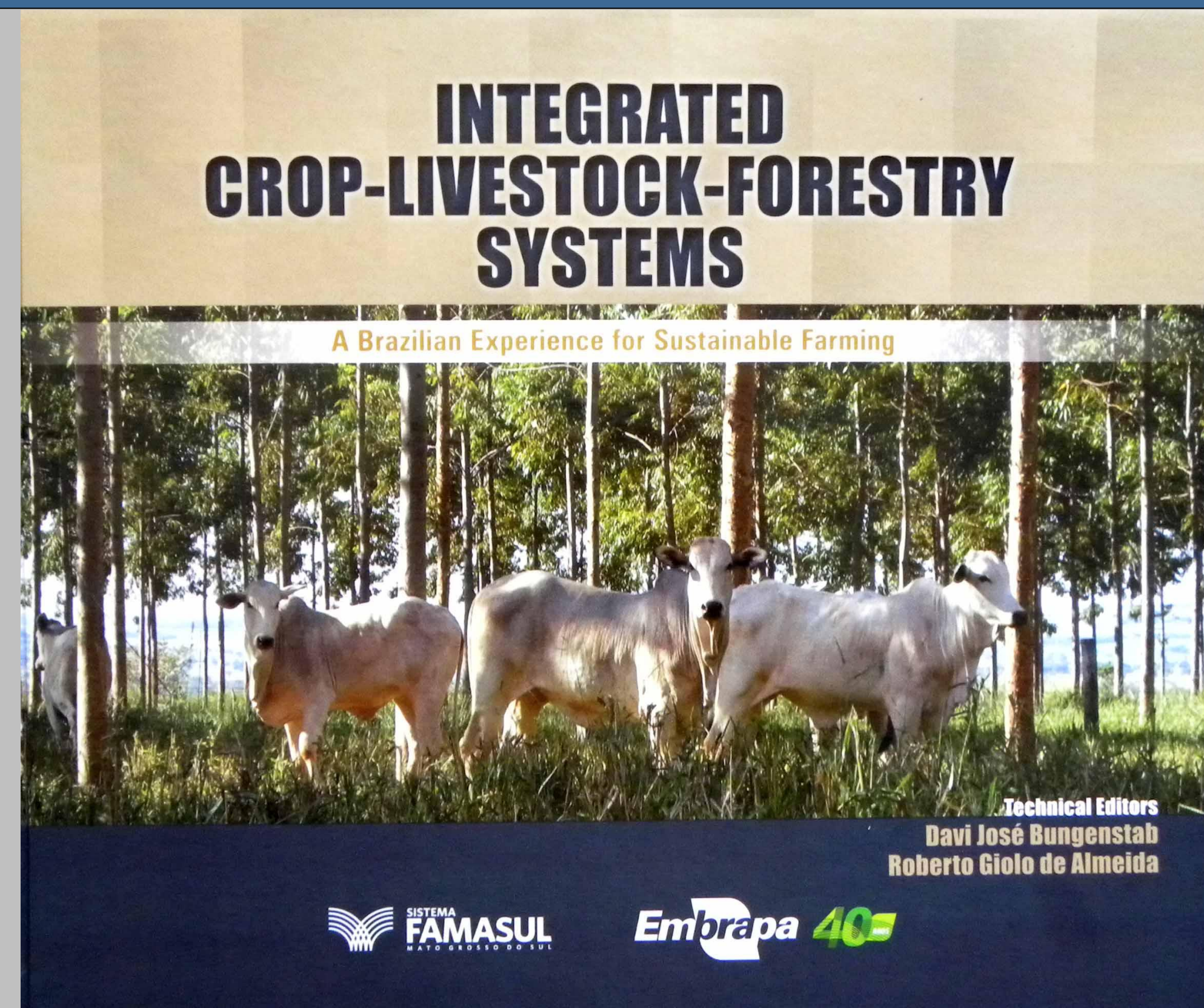
- Agroforestry, silvo-pastoralism, and agro-silvo-pastoralism are means to increase food production while simultaneously providing valuable ecosystem services.
- Such systems halt and revert widespread land degradation, improve and diversify the range of farm products, and safeguard biodiversity.
- Brazil has pioneered some important agricultural technologies in the world, as the no-tillage system, which allows two harvests a year in many parts of the country.

Objective

- Intending to contribute information regarding such integrated systems, a publication was produced by the Brazilian Agricultural Research Corporation – Embrapa.
- Titled “Integrated Crop-Livestock-Forestry Systems” it is a richly illustrated, 282 page book, with 20 chapters involving many scientists from different institutions, approaching the major themes related to the subject, addressing technologies available and their potential for further improvement and expansion.

Overview

- Concepts and initiatives for sustainable agriculture
- Integrated Systems: Advantages and limitations
- Crop-livestock-forestry integration and progress in Brazilian agriculture
- ICLF systems and innovation in Brazilian agriculture
- Entrepreneurship for sustainability with ICLF
- Integrated crop-livestock systems to recover degraded pastures
- Fundamentals of ICLF systems with Eucalyptus trees
- Planning tools for crop-livestock-forestry integration
- Forage grasses in integrated cattle production systems
- Tree species in integrated production systems



- Tree management and wood properties in ICLF systems with Eucalyptus
- Benefits of tree shade for beef cattle in ICLF
- Supplementary feeding for beef cattle in ICLF
- Parasite control for beef cattle in ICLF
- Sheep farming for mutton production in integrated systems
- Geospatial monitoring of ICLF systems in Brazil
- Cost-effectiveness of integrated production systems
- Economic sustainability of silvo-pastoral systems using Eucalyptus for timber
- The strategic position of integrated farming systems in the context of agriculture and environment
- Potential for integrated production systems in semi-arid and arid zones of Africa

Content Samples

Economic advantages of ICLF

- Increase in total yield per unit area
- More efficient use of labour
- Reducing per unit costs of outputs
- Increased profits as result of higher yields and lower profits
- Better distribution and diversification of revenue throughout the year, generating a more balanced cash flow
- Risk mitigation in production and prices due to diversification



Establishment of an ICLF system



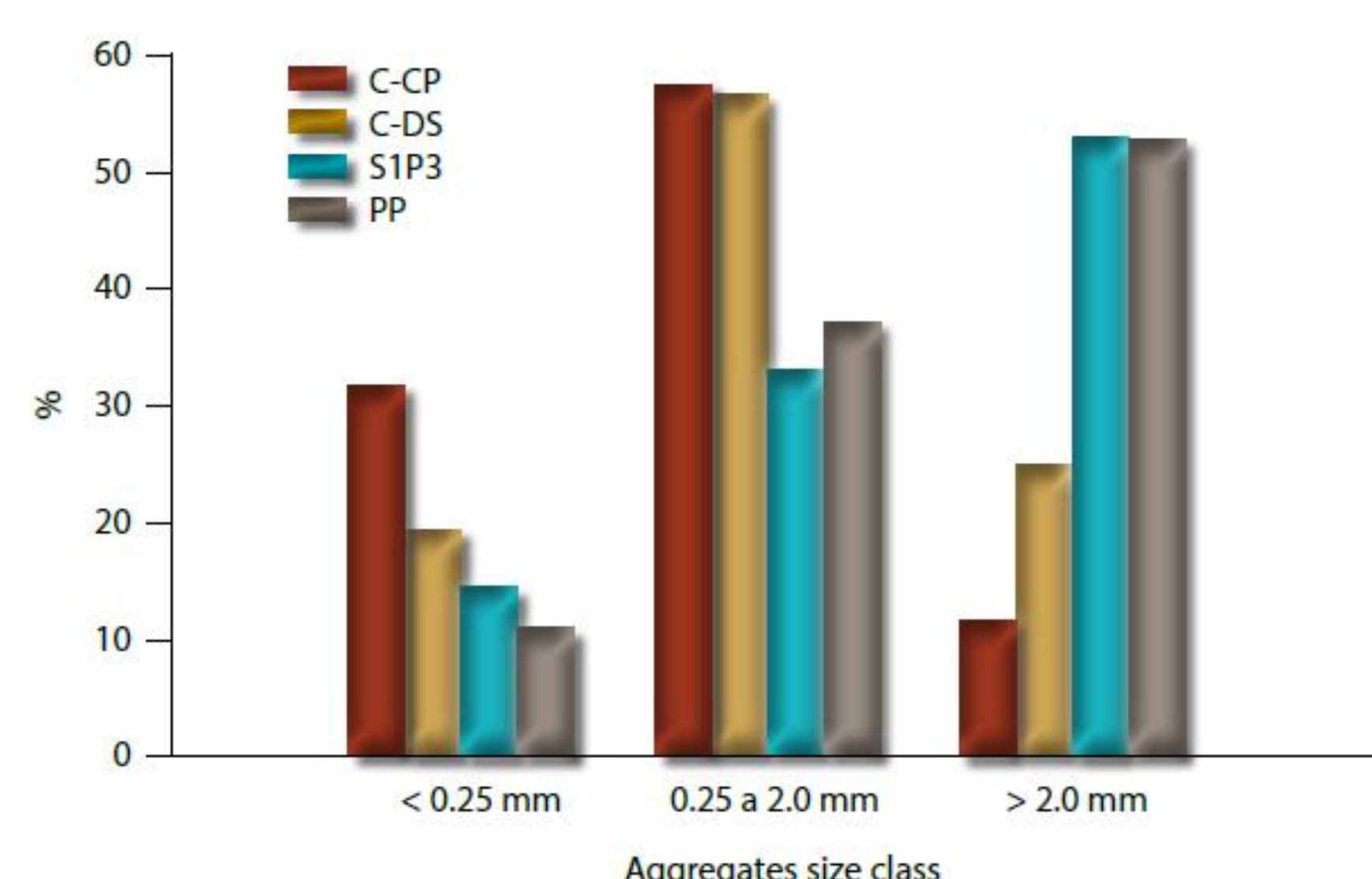
Soybeans crop in an ICLF system under implementation, with newly planted eucalyptus in single rows.

Cultivation scheme of an ICLF System

Year / Mon.	Jan	Fev	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008					1	1	1	1	1	1	2	2
2009	3	3	3	4	4	4	4	5	5	5	6	6
2010	6	6	6	4	4	4	4	7	7	7	7	7
2011-2013	7	7	7	7	7	7	7	7	7	7	7	7
2014	7	7	7	7	7	7	8	7	7	7	6	6
2015	6	6	6	4	4	4	4	7	7	7	7	7
2016-2019	7	7	7	7	7	7	7	7	7	7	7	7
2020	7	7	7	7	7	7	9					

1. Soil preparation (Tillage, Lime, Fertilization)
2. Soy beans cultivation
3. Planting Eucalyptus while soy beans grow (22 m distance between rows and 1,5 m between trees)
4. After soy beans harvest, sorghum or maize is seeded under no-till system in combination with Brachiaria grass
5. Maize/Sorghum harvest / Brachiaria is kept as surface residue for next soy beans no-till seeding
6. Soy beans cultivation over Brachiaria using no-till system
7. Brachiaria grass is kept for several years as pasture among the trees (Stocking rates are adjusted according to biomass production)
8. The half of the Eucalyptus trees (every second row) is harvested and sold as fuel wood (providing more light for the next cash crop as integrated cultivation)
9. The rest of the trees are harvested. A new cycle begins.

Effects on soils



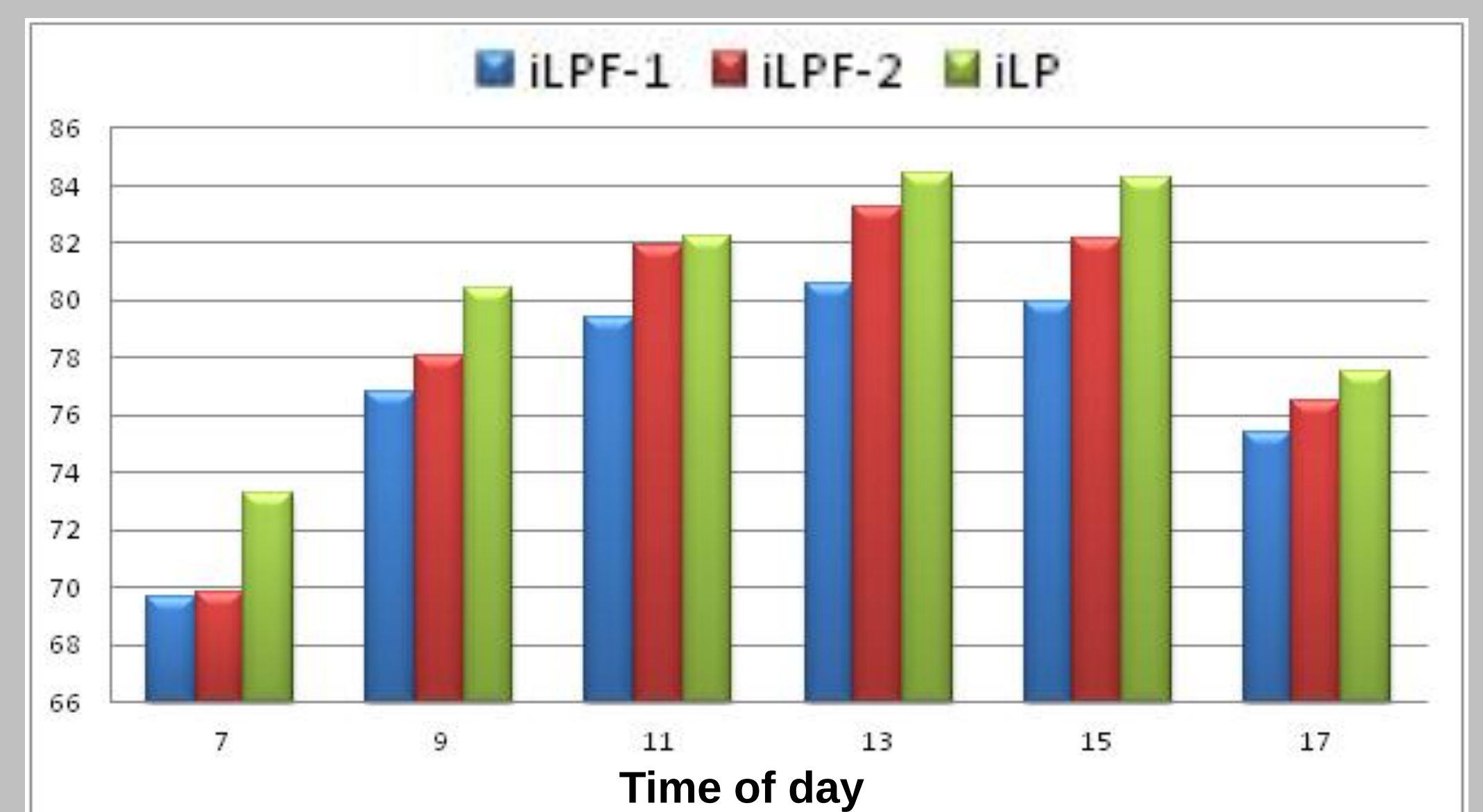
Distribution of aggregates in the 0-5 cm deep layer, grouped into three size classes for crop systems under conventional preparation (C-CP); crop under no-till system (C-DS); soybean rotation for 1 year - pasture (*B. brizantha*) for 3 years (S1P3); permanent pasture (*B. decumbens*) (PP). Source: Salton, 2005.

A fully functional system



Nellore cattle grazing in a shaded area in an integrated Crop-Livestock-Forestry system. Photo: D. J. Bungenstab.

Effect on microclimate



Effect of tree density on micro-climate (Globe Temperature and Humidity Index) in different ICLF systems: ILPF-1, with 357 eucalyptus trees/ha; ILPF-2, with 227 eucalyptus trees/ha; (ILP, with five remaining native trees/ha) from 7:00 a.m. to 5:00 p.m. in Campo Grande. Source: Adapted from Oliveira et al. (2012c).