SOIL QUALITY AND SUSTAINABILITY INDICATORS OF MAIZE-LIVESTOCK AGROECOSYSTEMS IN WELL-DRAINED SAVANNAS OF VENEZUELA


Introduction
Tropical ecosystems of well drained savannas occupy a large area in South America and Africa. Despite their agricultural constraints they have served as scenarios for agricultural frontier expansion during the last decades, with important ecological, social and economical consequences. Extensive areas of neotropical savannas with natives grasses, Trachypogon, Axonopus, among others, have been substituted by grass species of African origin such as Brachiarias and Andropogon (López-Hernández et al., 2005).

Knowing the low quality of savannah soils, characterized by their acidity and low fertility, any direct and indirect management that induces changes in the soil quality can improve the agro ecosystem sustainability. Proposals of agro ecological management in this type of savannas are: non-tillage, cover crops associated with maize, and phosphorus (P) sources of slow solubility. These agricultural practices offer better forage for livestock in the dry season and more nutrient sources for crop growth (Eusse, 2003). The question remains if those agro ecosystems are sustainable in the savannahs.

In this study two types of indicators were used: (1) indicators of soil quality and (2) indicators of sustainability of agro ecosystem. The objective was to select indicators that allow the monitoring of the sustainability of maize-livestock agro ecosystems in well drained savannas of Venezuela.

Method

Soil:
Typic Plinthustults, located in “La Iguana” Experimental Station, Guarico state, Venezuela (8° 25’ N and 65° 24’ W).

Perennial Cover crops:
Brachiaria dicyconeura (BD).
Centrosema macrocarpum (CM).

Phosphate fertilizer sources:
PRF: Phosphoric rock fertilizer.
DFP: Diammonium phosphate fertilizer.
BF: Native mycorrhizas used as maize’s inoculums.
OF: Mineralization of organic residues of the cover crops.

Seasons:
Before harvesting the cover crops.
At the flowering peak of maize.
After grazing, during six years.

Experimental design:
Completely randomized with a factorial arrangement of 2x4x3 (2 levels per cover crops, 4 levels per fertilization and 3 levels per season). Twelve soil samples were taken in each treatments of cover crop-fertilizer.

Evaluation:
Cover crop biomass production, and physical, chemical and biological soil characteristics were monitored during six years.

Quality indicators were determined and selected using the Principal Component Analysis (PCA) with the program SPSS version 19.

The grade of acceptation of the agro ecosystems by the community was determined through a Rural Participative Survey.

The economic aspects based on the cost/benefit ratio of each agro ecosystem was taken under consideration (accumulated net gain in $/ha), as well as the cover crops, the maize and the meat production, all measured in kg ha⁻¹.

Discussion and conclusions
The evaluated Brachiaria-maize and Centrosema-maize agro ecosystems were discriminated by soil physical, chemical and biological indicators. They were all simple, economic and easy to measure.

The indicators evaluated the integrated information over the ecological functioning of the biogeochemical cycles during the six years.

The agro ecosystem in the association Centrosema-maize resulted in the lowest sustainability compared to the association Brachiaria-maize agro ecosystem. In all the cases the amoeba showed an irregular pattern.

The sustainability of the association leguminous-maize was affected by animals and by the cover crops sub systems. This is reflected in a lower meat production and cover crop biomass.

References