

## Arrangement of Livestock Potential for Climate Change Adjustment in Jimaguayú, Camagüey, Cuba

Zoe G. Acosta Gutiérrez\*, Jorge Pereda Mouso\*\*, Josefa Primelles Fariñas\*, Grisel Reyes Artiles\* and Madelín Cruz Cruz\*\*\*

Center for Environmental Research, Camagüey, Cuba

\*\*Center for Animal Production Studies, Faculty of Agricultural Sciences, Ignacio Agramonte Loynaz University of Camagüey, Cuba

\*\*\* Experimental Station for Pastures and Forages, Camagüey, Cuba

zoe@cimac.cu

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### ABSTRACT

The purpose of this paper was to contribute to environmental arrangement of livestock potential in the municipality of Jimaguayú, Camagüey, Cuba. The indicators, restrictions, categories, and conflicts of livestock potential in the region were identified and placed on a map. Additionally, the policies, guidelines, regulations, and standards for proper environmental management in each livestock raising area were determined. The study concluded that the potential of livestock activity consists in the environmentally recommended use as principal of eight of the seventeen secondary environmental areas that make up the region. One of them was considered for secondary use. In terms of categories, the municipality comprises 126.9 km<sup>2</sup> with no livestock potential. It includes several settlements and water reservoirs; 115.7 km<sup>2</sup> were identified as poor potential; 316.3 km<sup>2</sup> had a mid-potential; and 225.4 km<sup>2</sup> was high. The previous contributed to the environmental arrangement of livestock potential in the municipality of Jimaguayú, Camagüey. Accordingly, restrictions, indicators, categories, and conflicts observed in the sector were determined in order to make recommendations for livestock development in the secondary environmental areas with some potential. It was also useful to set up policies and general and specific guidelines.

Key words: *arrangement, restrictions, livestock, environment*

### I

## INTRODUCTION

The challenge faced by livestock production in Cuba today, with the deterioration of the main natural resources, requires particular considerations of the characteristics and status of the resources in each region. The objective is to select and apply the necessary measures and technologies for sustainable development of production systems, on a case-by-case basis. This issue has been clearly identified and discussed by the Ministry of Science, Technology, and the Environment in recent years (CITMA, 1997, 2006, 2010).

In that sense, within the framework of project Environmental Bases for Local Food Sustainability (BASAL), design and implementation of Environmental Arrangement Models (MOA), were predicted for the regions included in it, depending on their particular development strategies (Cárdenas, *et al.*, 2014).

One of the MOA areas is in the municipality of Jimaguayú; it was chosen for its livestock production potential and contribution to the national food balance (meat and milk).

Accordingly, the goal of this paper was to contribute to the environmental arrangement of livestock raising potential in the municipality of Jimaguayú, based on the results achieved by the Environmental Arrangement Model designed for this particular region.

## MATERIALS AND METHODS

The study was made in the municipality of Jimaguayú, located between 21°, 5', 0" and 21°, 22', 0" north latitude, and between 77°, 36', 0" and 78°, 3', 0" west longitude, in the province of Camagüey, Cuba.

The integrated methodological guide for environmental arrangement models suggested by

Martínez *et al.* (2010) was used for arrangement of the livestock potential in the municipality.

The guide comprised four stages: 1) labor organization, consisting in the creation and instruction of a working team, and the establishment of the working scales. 2) Characterization, which consisted in the design and creation of the Geographic Information System (GIS) for environmental arrangement, and characterization of the areas studied, regarding natural, social-demographic, and economic-productive aspects to define the environmental units.

As a result, four top-priority environmental units, and seventeen intermediate environmental units were determined, according to Primelles *et al.* (2014), used as the groundwork for arrangement of livestock potential in the municipality.

3) Environmental diagnostic, which determined the potentials by sectors, as well as the limitations of use. Then the potential use was determined according to the type of environmental unit. Finally, the potential use was determined according to the environmental unit.

4) Purpose-built, which was useful to establish the policy to follow in every environmental unit, the recommended environmental use, and the guidelines and regulations for each environmental unit.

Software Mapinfo 12 with the Encom Discover 12 module, and ArcGIS 10, were used for analyses and maps.

## RESULTS AND DISCUSSION

As a result of previous analysis to design the municipal MOA, nine restrictions that hindered improvements in the livestock raising sector were identified. Excluding slopes greater than 20°, the region does not have natural limitations for sector expansion; the most frequently observed were associated to natural risks, like floods or severe droughts.

Regarding the latter, Cutié *et al.* (2013) considered droughts as one of the most important limitations that strike agriculture today. Besides, Planos, Vega and Guevara (2013), included them within the most significant vulnerabilities in Cuban agricultural systems. They also pointed out the need to set up strategies to reduce them, depending on the current conditions and further changes in the global climate.

Other restrictions observed during the diagnosis were, brush fires and livestock-related epizootics, as a consequence of the above-mentioned phenomenon. Secondly, legal limitations were identified too, particularly given by the existence of forests and hydro-regulation stripes, a protected area, and some areas with different land uses.

Another important aspect considered was the determination of key indicators, as basic elements to consider for livestock development.

*Soil agroproductivity for pastures.* The municipality has a high edaphic potential for pastures (approx. 580 km<sup>2</sup>), within agroproductivity categories types I and II (74% of the region).

*Food base for livestock.* Approximately 306 km<sup>2</sup>, mostly low-quality native grass, representing 39% of the region, sustain the current dairy production of the municipality.

*Soil agroproductivity for pastures, varied crops, and fruits.* Approximately 52% of the soils in the municipality (406 km<sup>2</sup>) classify as agroproductive types I and II, with a potential for further development of the sector.

*Distance from rivers.* Between 55 and 89 km<sup>2</sup> (7 and 11% of the municipality) are located less than 300 and 500 m from rivers (intermittent streams were not considered), based on the most convenient alternatives established for livestock, and the various crop and fruit sectors, taking into account the distances animals should move, or the construction of irrigation infrastructure. Other, 83 km<sup>2</sup> of the region are located between 500 and 1 000 meters from the water supply. These areas have a more complex potential use.

*Distance from rivers.* Between 64 and 102 km<sup>2</sup> (8 and 13% of the municipality) are located less than 500 and 300 m from rivers (intermittent streams were not considered), based on the most convenient alternatives established for livestock, and the various crop and fruit sectors, taking into account the distances animals should move, or the construction of irrigation infrastructure. Other, 118 km<sup>2</sup> of the region are located between 500 and 1 000 meters from the water supply. These areas have a more complex potential use.

*Distance from wells.* Around 76 km<sup>2</sup> (10% of the municipality) are located less than 300 m from wells, according to the most convenient alternatives established for the livestock, and the various crop and fruit sectors, considering the distances animals should move, and for the construction of

irrigation infrastructure. Other 105 km<sup>2</sup> of the region are located between 300 and 500 meters from this water supply. These areas have a more complex potential use.

*Quality of dammed water for human and animal consumption, and irrigation.* The quality of water sources is within the standards for surface water supply, including standards for crop irrigation. Quality and availability of water in the region are important but poorly used resources by the municipality today, for for livestock, various crops and fruits, and water management.

*Quality of ground water for human and animal consumption, and irrigation.* Although this does not represent a high potential due to physical, chemical or bacteriological limitations that exclude it from the Provincial Soil Laboratory Standards (LPS, 2015), it supports the social and economic activities of the municipality.

*Specific capacity of wells.* The specific capacity varies in most wells (0.5-4 L/s), which limits the ground water potential in the territory. However, this type of source supports local agricultural activities (still insufficient), so it has a natural potential of interest for the sector, as well as for various crops and fruits.

As a result, six indicators related to the existing natural resources in Jimaguayú that stimulate livestock development in the region were suggested. They derived into four categories that identify the state of agricultural potential in the municipality: high, medium, low, and without potential, described below (see the Table).

In terms of categories, the municipality comprises 126.9 km<sup>2</sup> with no livestock potential, including several settlements and water reservoirs; 115.7 km<sup>2</sup> were identified as poor potential for economic activities; 316.3 km<sup>2</sup> had a mid-potential; and 225.4 km<sup>2</sup> was high (Fig. 1).

Five types of conflicts between livestock activities and other sectors were identified:

*Livestock sector vs. forestry sector.* The presence of animals less than three km from the boundaries of protected areas.

*Livestock sector vs. forestry sector.* The presence of animals in hydro-regulated areas.

*Livestock sector vs. water management.* Pollution of ground and surface waters, caused by draining and infiltration of waters contaminated with animal feces.

*Livestock sector vs. renewable energy sector.* Poor use of manure produced in dairy farms, which must be returned to the fields to enhance soil fertility, worm casting, etc.

*Soil agropeductivity for pastures, varied crops, and fruits.* Competition over water use which aggravates overall availability and affects ground water quality caused by geologic salinization from rocks where rational use has been overridden (large number of wells dug).

Moreover, overlapping of maps of current and recommended uses with spatial analysis tools made possible the identification of the main conflict; the existence of 326 km<sup>2</sup> of idle lands especially infested with sickle bush (42% of municipal areas), thus reducing land surface for development of the livestock and various crops sectors. It creates a negative impact on the local and provincial economies.

These results coincided with Muñoz *et al.* (2013) for the area studied. It is one of the factors widely affecting livestock development, along with increased animal stocking rate, considered by Valdés *et al.* (2013) as critical for maintaining production and sustainability of animal areas.

The propositional stage of MOA concluded that the potential of livestock activity consists in the environmentally recommended use as principal of eight of the seventeen secondary environmental areas that make up the region. One of them was considered as secondary.

The study called for two main critical policies to implement: Restoration and optimal use, as the main environmental policy; and protection and preservation, as the secondary environmental policy.

Finally, the general and specific guidelines fitting the particular characteristics of every secondary environmental unit, leading to sector development and adaptation to climatic change, were specified.

## CONCLUSIONS

This study contributed to the environmental arrangement of livestock potential in the municipality of Jimaguayú, Camagüey. Accordingly, restrictions, indicators, categories, and conflicts observed in the sector were specified in order to make recommendations for development in the secondary environmental areas with some potential, as well as to set up policies, and general and specific guidelines.

## RECOMMENDATIONS

It is important to implement MOA as an arranging platform in Jimaguayú. The deficiencies that hinder livestock development should be corrected to make a better use of natural resources.

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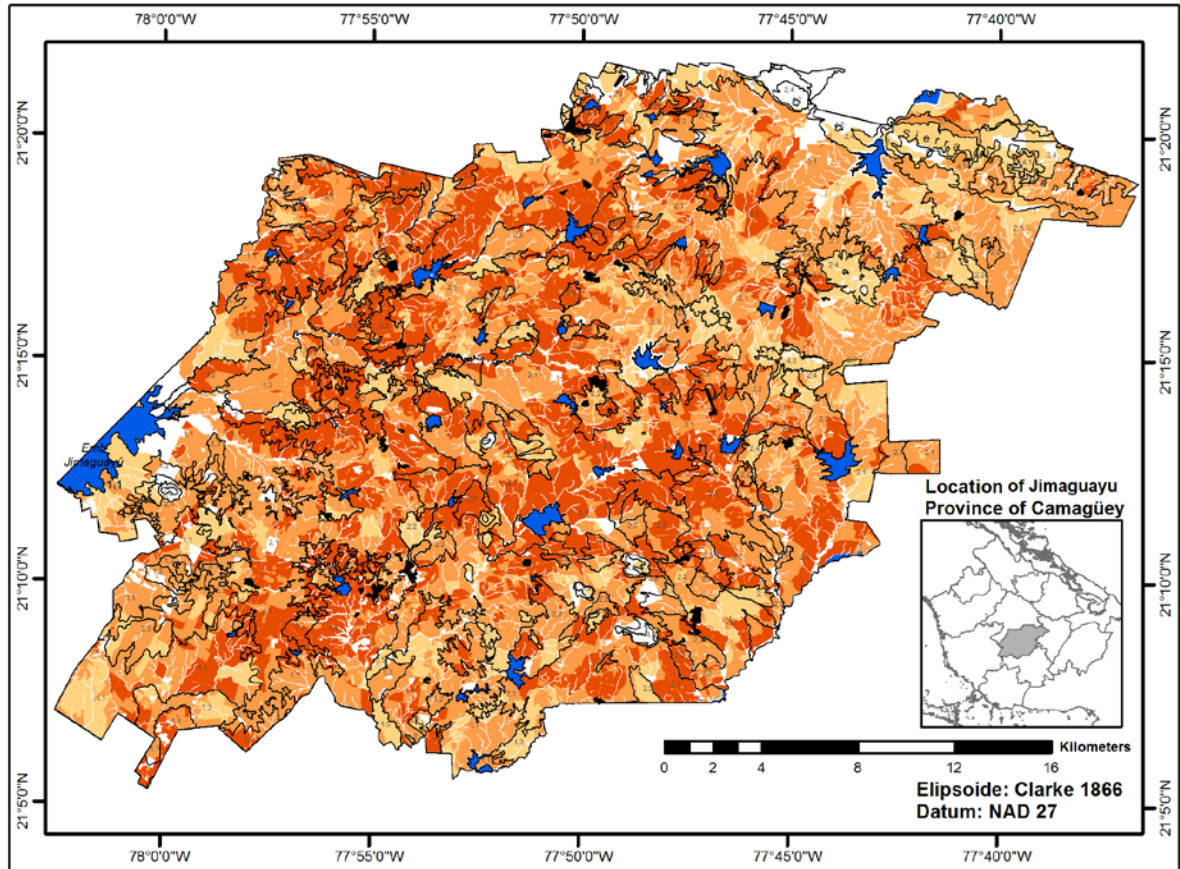
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**Table. Description of categories that identify the state of livestock potential in Jimaguayú**

Livestock raising potential		Categories
High		Availability of quality water between 0-500 m (surface sources), and/or 0-300 m (ground water). Soils with agroproductivity potential types I and II, to establish and develop pastures and forages. Native and/or established pasture and forage ecosystems
Medium		Availability of quality water between 500-1 000 m (surface sources), and/or 300-500 m (ground water). Soils with agroproductivity potential type II for establishing and developing pastures and forages. Prevalence of idle areas due to invading and undesirable plants that can be removed, to establish livestock feeding areas.
Low		Availability of quality water over 1 000 m (surface sources), and/or 500 m (ground water). Soils with agroproductivity potential type IV for establishing and developing pastures and forages. Prevalence of areas for other uses, like settlements and dams in which pastures and forages that cannot be developed.
Very low		Without potential

# LIVESTOCK POTENTIAL IN JIMAGUAYU



## Potential



**Fig. 1. Livestock raising potential in the municipality of Jimaguayú**