Journal of Animal Production 29 (3), 6-11, 2017

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

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ABSTRACT

The purpose of this paper was to make a contribution to the environmental arrangement of the livestock potential in the municipality of Jimaguayú, Camagüey, Cuba. The indicators restrictions, categories, and conflicts of the livestock potential in the region were identified and located on a map. Additionally, the policies, guidelines, regulations and standards for proper environmental management in each livestock area were determined. The study concluded that the potential of livestock activity consists in environmentally recommended use in the main 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^2without livestock potential, including several settlements and water reservoirs; 115.7 km^2 were identified as having a poor potential; 316.3 km^2 had a mid-potential; and 225.4 km^2 was high. The previous contributed to the environmental arrangement of the livestock potential in the municipality of Jimaguayú, Camagüey. Accordingly, the restrictions, indicators, categories, and conflicts observed in the sector were determined, and their use was recommended for development in the secondary environmental areas with some potential, as well as to set up policies and general and specific guidelines.

Keywords:*arrangement, restrictions, livestock, environment*

INTRODUCTION

The challenge faced by livestock production in Cuba today with the deterioration of the main natural resources, requires special considerations of the characteristics and status of the resources in each region. The goal 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 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 the 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 located in the municipality of Jimaguayú; it was chosen for its livestock production potential and its 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°, 05', 00" and 21°, 22', 00" north latitude, and between 77°, 36', 00" and 78°, 03', 00" west longitude, in the province of Camaguey, Cuba.

The integrated methodological guide for environmental arrangement models suggested by Martínez *et al*. (2010) was used for livestock potential arrangement in the municipality.

The guide comprised four stages:

1) Labor organization, with the creation and instruction of a working team, and establishment of the working scales.

2) Characterization, with the design and creation of the Geographic Information System (GIS) for environmental arrangement, and characterization of the areas studied, in terms of

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 sector, as well as the limitations for use. Then the potential use was determined according to the type of environmental unit.

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

MapInfo 12 with Encom Discover 12, and ArcGIS 10, for Windows, were used for analyses and maps.

RESULTS AND DISCUSSION

As a result of the diagnostic made to design the municipal MOA, nine limitations that endangered the livestock raising sector were identified. Excluding slopes greater than 20º, the region does not have natural limitations for expansion in the sector; 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. Also Planos, Vega and Guevara (2013) included them within the most significant vulnerabilities in Cuban agricultural systems. Besides, they pointed the need to set up strategies to reduce such risks, depending on the current conditions and new changes in global climate.

Other restrictions determined during the diagnostics were, brush fires and livestock-related epizootics, as a consequence of the above-mentioned phenomena. Secondly, legal limitations were identified, 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:

Agroproductivity for grasslands: The municipality has a high edaphologic potential for pastures (approx. 580 km^2), within categories I and II, accounting for 74% of the region.

Main food source: Approximately 360 km^2, mostly low-quality native grass, representing 39% of the region, that supports the current dairy production of the municipality.

Soil agroproductivity for fruit and various crops: Approximately 52% of the soils (405 km^2) are within I-II productivity, and a potential for improvements.

Distance from rivers: Between 89 and 55 km^2 (11 and 5% of the municipality, respectively) 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 83 km^2 are located between 500 and 1 000 meters from the water supplies. These areas have a more complex potential use.

Distance from water reservoirs: Between 102 and 64 km^2 (13 and 18% of the municipal territory, respectively), are located less than 500 and 300 meters from dams, based on the most convenient alternative established for livestock, and the various crop and fruit sectors, taking into account the distance animals should move, or the construction of irrigation infrastructure. Another 118 km^2 of the region are located between 500 and 1 000 meters from the water supplies. These areas have a more complex potential use.

Distance from wells: 76 km^2 (10 % of the municipal territory) are located less than 300 meters from wells, based on the most convenient alternative established for livestock, and various crop and fruit sectors, according to the distances animals should move, or for the construction of irrigation system infrastructures. Another, 105 km^2 of the region are located between 300 and 500 meters from the water supply. These areas have a more complex potential use.

Quality of the water dammed for humans, animals and irrigation: The quality of water sources is within the standards for surface water supply, including the standards for irrigation crops.The quality and availability of water in the region are fundamental for the production potential, though

poorly used for livestock management, various crops,fruit, and water management.

Quality of ground water for human and animal supplies and for 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 well water levels: The specific water level varies in most wells (0.5 and 4 l/s), which hinders the ground water potential in the municipality. However, this type of source supports local agricultural activities, so it has a natural potential of interest for the sector, as well as for various crops and fruits.

The above determined the recommendation of six indicators related to the existing natural resources in Jimaguayú, to encourage livestock development in the region. These indicators derived into four suggested categories that identify the state of agricultural potential in the municipality: high, medium, low, and without potential, described below (Table 1).

In terms of categories, the municipality comprises 126.9 km^2without livestock potential, including several settlements and water reservoirs; 115.7 km^2 were identified as poor potential for economic activities; 316.3 km^2 had a mid-potential; and 225.4 km^2 was high (Fig 1.)

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

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

Livestock raising 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 infliltration of waters contaminated with animal feces.

Livestock raising vs. renewable energy sector: poor use of manure produced in dairy farms, which must be returned to the fields to enhance soil fertility, wormcast production, etc.

Livestock vs. various 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 current use and recommended map use with spatial analysis tools made possible the identification of the main conflict: the existence of 326 km^2 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 coincide with Muñoz *et al.* (2013) for the area studied. It is one of the factors largely affecting livestock raising, along with increased animal stocking rate, considered by Valdés *et al.* (2013) as critical for production and sustainability of animal areas.

The MOAstudyconcluded that the potential of livestock activity is the environmentally recommended use as main areas in eight of the seventeen secondary environmental sites that make up the region. One of them was considered for secondary use.

The study called for critical policies, like restoration and optimal use, as the principal environmental policy; and protection and preservation, as the secondary environmental policy.

Finally, the general and specific guidelines fitting the particular feature of every secondary environmental unit, to foster the 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, Camaguey. Accordingly, the restrictions, indicators, categories, and conflicts observed in the sector were determined, 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

The implementation of MOA as the arranging platform will be critical for Jimaguayú, along with correction of deficiencies that hinder livestock development, with the intention of better natural resourceuse.

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Received: 7-12-2017
Accepted: 7-20-2017

Table1. Description of categories that identify the state of livestock potential in Jimaguayú

Lvestock raising potential	Categories
High	Availability of quality water between 0-500 m (surface sources), and/ 0-300 m (ground water) Soils with agroproductivity potential (I and II) for establishing and developing pastures and forages. Native and/or established pasture and forage ecosystems
Medium	Availability of quality water between 500-1 000 m (surface sources), and/ 300-500 m (ground water) Soils with agroproductivity potential (III) 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 over1 000 m (surface sources), and/ 500 m (ground water) Soils with agroproductivity potential (IV) for establishing and developing pastures and forages Prevalence of areas for other uses, like settlements and dams in which pastures and forages cannot be developed
Very low	Without potential

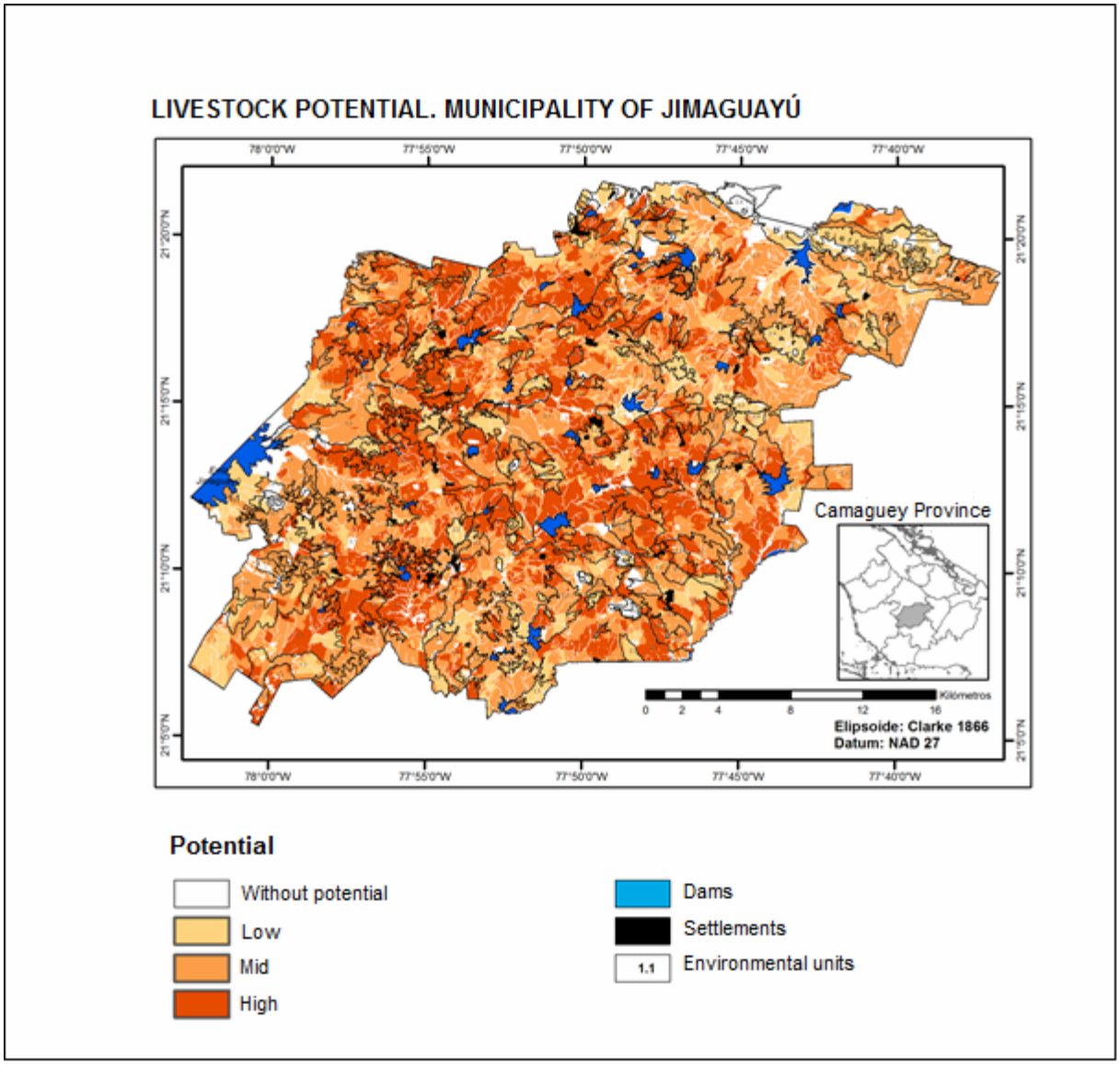

Fig. 1. Livestock raising potential in the municipality of Jimaguayú