Research on plant species for animal feeding in two mountainous regions of the Guantanamo province

A. Álvarez[1], Lourdes Savón[1], F. Duran[2], R. González[1], Odilia Gutiérrez[1] and P. O. Mora[1]

[1]*Instituto de Ciencia Animal, Apartado Postal 24, San José de Las Lajas, mayabeque, Cuba*

[2]*Facultad Agroforestal de Montaña, Universidad de Guantánamo, Guantánamo, Cuba*

Email: adanalvarez@ica.co.cu

Techniques of participative diagnosis for the identification and selection of promising species were used to conduct a prospective study of phytogenetic resources with animal feeding potential in two mountainous regions of Guantanamo province. Semi-structured surveys were made to farmers of this region, and a panel was created with the participation of nine experts on animal feeding and nutrition. The statistical analysis of the data was performed through contingency tables and the comparison of chi square proportions (Ψ^2). The species most used in animal feeding were the leaves of *Leucaena leucocephala* (leucaena), *Gliricidia sepium* (gliricidia), *Guazuma ulmifolia* (bastard cedar), and *Brosimum alicastrum* Swarts (breadnut), but also the fruit of *Pithecellobium dulce* (Madras thorn) as another alternative. The principal supply forms in El Salvador municipality were fresh forage (90 %) to housed animals (92 %) and daily grazing (85 %), from eight to ten hours, on species of the Panicum and Paspalum genera in gardens, backyards, or fallow or arable lands, considered as areas of little management. In the Baracoa municipality, the plant most (78%) used in animal feeding is coconut (*Cocos nucifera*). Sheep and goats are the ones consuming plant varieties the most (70 %). It was concluded that El Salvador and Baracoa municipalities, in Guantanamo province, have important species of high forage potential, able of complementing animal feeding in this area. In the Baracoa municipality, compared with El Salvador, there was lower use of the phytogenetic resources, as alternative source of animal feeding.

Key words: *participative diagnosis, forage trees, animal feeding.*

In order to deal with subjects related to the adaptation to the environmental changes and the fulfillment of the human needs for the future (Rossi 2007), it is essential to consider the phytogenetic resources. The development of strategies for the conservation and utilization of these resources is one of the objectives proposed by FAO as part of the Convention on Biological Diversity and the Agenda 21. The wild species considered for the *in situ* conservation are basically trees, forages, and medicinal. Also, those that are family of the cultivated and endangered species are included, as well as those native of certain ecosystem (Frankel *et al*. 1995, cited by Rivas 2001).

Due to their renewable character, forest resources can be non-traditional sources of raw material for animal feeding (Díaz Aguirre *et al*. 2000). In this context, agroforestry is an alternative permitting to make uniform the supply of high-quality forage, diminish production costs and counterbalance the negative environmental effects of the traditional systems. At the same time, it favors the diverse production systems and the applications to manage natural resources (Izquierdo 2006).

In Cuba, several authors (Machado *et al*. 2005, Febles and Ruíz 2009 and Morales *et al*. 2009) have performed important studies on the most promising wild species for animal feeding, as established by the International Treaty on the Phytogenetic Resources for Feeding and Agriculture (Moore and Tymonwski 2005). Out of this analysis, a prospective study was made about the phytogenetic resources with animal feeding potential in two mountainous regions of the Guantanamo province.

Materials and Methods

The study was performed in areas of El Salvador and Baracoa municipalities, of the Guantánamo province. Two fundamental work stages were set, supported on participative techniques (surveys, interviews and workshops) (Ibarra 1994), to identify and select the most promising species for animal feeding, as well as the elements of the flower inventory in each of the regions.

Identification and selection of species. For identifying the most promising species for animal feeding, 30 semi-structured surveys were applied to farmers of the El Salvador and Baracoa municipalities (15 in each). The surveys included questions related to the available animal species and the plants used as feed for each of them. Ten interviews were performed to directors of enterprises, of cooperatives of credits and services (CCS) and of Basic Units of Cooperative Production (UBPC). Besides, specialists of the forest enterprise were included. The object was to know the potential of plant species in this region and their possibilities of application in animal feeding. Researchers and the personnel involved in the participative diagnosis were trained.

The species selection was performed by a panel of nine experts in feeding and nutrition of non-ruminant and ruminant species. The aim was determining among the plants identified by the famers, which were the most used, and those least known, and that

could be of interest for the ecosystems under study, by having greater potentials to be used in animal feeding. The criteria considered for the selection were the following:

A. If the abundance and distribution of the species in the region is representative enough, and if their utilization in animal feeding does not compromise their survival.

B. The degree of conservation and threat of this species in the region and the interference of both in the proposed use.

C. If their application in animal feeding opposes the most common uses of this species.

D. The interaction of the species with the variables temperature, relative humidity, rainfall, height and type of soil.

E. The mode of reproduction of the species and how much it could affect their exploitation.

F. The compatibility between the technologies of exploitation and production of the animal feed and the silvopastoral system.

The statistical analysis of the data was performed by the method of contingency tables and the comparison of chi square proportions (Ψ^2) to prove the interaction between the effects criteria and species, as well as the independent effects. The statistical software InfoStat (Balzarini *et al*. 2001) and COMPARPRO (Font 2007) were used.

Flower inventory. The flower inventory was made with the results obtained in the stage of identification. Thus, the methodologies of Claro (2002) and Sánchez *et al*. (2007) were adapted. Two geo-ecological profiles (A and B) were outlined and localities of reference in each of them (figure 1) were defined, with the object of making the flower inventories through temporary plots of 0.1 ha (an and bn), with five subplots of 20 x 20 m. Twenty-five inventories were made as total.

Results and Discussion

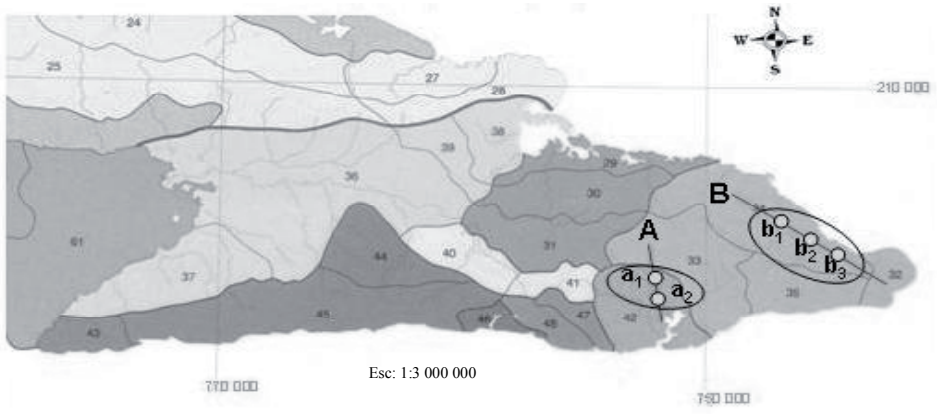
Out of the number of animals reported, it was proved that in El Salvador municipality, the most used animal species are poultry and swine, followed by horses and cattle and, up to a smaller extent, sheep and goats (figure 2). This result responds to the socioeconomic and productive structure of the municipality, which conditions the use of the phytogenetic resources of the territory.

The main forms of feed supply in all the animal species were the fresh forage (90 %) for the housed animals (92 %) and the daily grazing, from eight to ten hours (85 %), with pasture species of the genera Panicum and Paspalum in areas with little management, such as gardens, backyards or fallow or arable lands.

In El Salvador municipality, among the plants identified as the most used in animal feeding, leucaena (75 %) and breadnut (60 %) were outstanding, being consumed by almost all the animal species. Leucaena is used as fresh forage (82%) and, in some instances, where there are conditions for being grounded, it is used in form of meal (18 %), mixed with other products. This plant has great capacity of adaptation to the different types of soil in the region, criterion that agreed with the considerations of Pérez *et al*. (2008). The fruit of the Madras thorn, species having wide distribution in the area, is used in sheep. Rain tree (53 %) is considered as useful feed for the herd, with good acceptance by the cattle. As leucaena, breadnut is used widely in the feeding of horses and cattle, as well as in sheep and goats. Guinea grass (91%) and oro azul (78 %) are spread in the lowlands of the municipality, together with natural pastures that are intercropped with sugarcane plantations. These latter serve as important sources of feed (79 %) for swine.

When analyzing the surveys and the interviews, it was proved that the results related to the animal species that

Physico - geographical regionalization of the eastern part of Cuba
(Mateo and Acevedo, 1989)



Profile A: El Salvador municipality (Region Plateau of Guaso - Los Montes)
Profile B: Baracoa municipality (Mountain Region of Moa - Toa - Baracoa)

Figure 1. Geo-ecological profiles in the areas of El Salvador and Baracoa

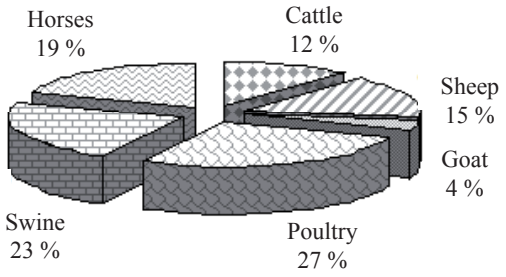


Figure 2. Distribution of animal species in El Salvador municipality

are most exploited were similar in both municipalities (figure 3).

The distribution of the population in a disperse form in the forest area, as well as the aims of cattle development, permit that the rearing be extensive, with free grazing in 60 % of the instances, mainly in poultry, swine, and sheep-goats that use species of plants from the undergrowth. Housing (85 %) is established as control and security measure for cattle, sheep and swine, at night hours, mainly. The fresh forage (95 %) cut at daytime is used.

In El Salvador municipality, there was little use

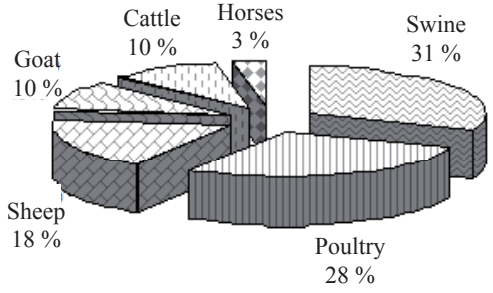


Figure 3. Distribution of animal species in Baracoa municipality

of the trees and the shrubs in animal feeding. The most (78 %) used was coconut (*Cocos nucifera*). It was concluded that due to the management characteristics, sheep and goats are the ones consuming more varieties (70 %). The breadfruit tree (48 %), in its two varieties, has a wide distribution, which agreed with Leyva *et al*. (2007), although it is not used in the same form in all the places. Leucaena (13%), although not distributed abundantly in this territory, is used by farmers as excellent protein source in the animal diet. The fruits of the palma real (*Roystonea regia*) have great acceptance (43 %) in swine feeding. Its utilization is possible because palma real is abundant in this territory. Banana (52 %) is a common species in backyards and areas adjacent to the houses for being an important feed in the human diet. All the parts of this plant are used for animal feeding.

By having the information supplied by farmers and by including the species of interest for the ecosystems under study, nine species were obtained with potentials for animal feeding in El Salvador, and ten in Baracoa. Out of them, six are in both (tabla 1).

These species were subject to the criteria of the panel of experts (table 2). Between 61 and 89 % of them agreed about the fact of studying them for animal feeding in this area. There were between 72 and 82 % of coincidence in the criteria.

By making the contingency analysis to prove the interaction between the effects criteria and species, it was evidenced that it was not significant, thus, the analysis of the independent factors was conducted. This result is shown in table 3.

The species factor kept a similar performance, which suggests that any of the plants analyzed can be used for animal feeding, according to the characteristics and intake habits of each species, although leucaena and bastard cedar are presented

Table 1. Species most used in animal feeding in El Salvador and Baracoa municipalities

No.	Common name	Scientific name	Municipality	
				Baracoa
1	Leucaena	*Leucaena leucocephala*	X	X
2	Bastard cedar	*Guazuma ulmifolia Lam*	X	X
3	Rain tree	*Samanean saman*	X	X
4	Gliricidia	*Gliricidia sepium*	X	X
5	Oro azul	*Phylla strigillosa*		X
6	King grass	*Pennisetum purpureum vc.* king grass	X	X
7	Umbrella palm	*Cyperus alternifolius*		X
8	Madras thorn	*Pithecelobium dulce*	X	
9	Pumpwood	*Cecropia peltata*		X
10	Mango	*Mangifera indica L.*	X	X
11	Guinea grass	*Panicum maximun*	X	
12	Breadfruit tree	*Artocarpus comunis*		X
13	Breadnut	*Brosimum alicastrum* Swarts	X	

as the most promising due to their physic-chemical properties (Savón *et al* 2011). It is known that bastard cedar has greater presence in this area, by being one of the typical species of the perennial forests in this territory.

As to the criteria, it is evident that all have a similar performance. The third criterion is outstanding, corresponding to the most common uses.

In El Salvador and Baracoa municipalities, the flower inventory of all the plants noteworthy for their abundance and distribution in the area was of popular knowledge due to their properties and contributions to animal nutrition (table 1). As total, 25 flower inventories were made, recording 13 genera (9 trees and 4 grasses) and 8 families. The Moraceae family was oustanding, with three species. Mimosaceae, Sterculiaceae and Anacardiaceae were present in both areas under study, whereas Cyperaceae and Verbenaceae were only in the plots of the Baracoa municipality profile (table 4).

The results of the field work agreed with the reports of Olivera *et al*. (2008), who noted that the species under study, up to a greater extent or not, belong to the natural plants of this area. Besides, they constitute an alternative feed source to different animal species. According to Renda *et al*. (1997), they perform ecological functions by protecting the soil from erosion, preserving its humidity and diminishing the evapotranspiration of the plants.

All the tree species accept a wide range of rainfall (from 600-800 mm up to 1000-1500mm) and adapt to soils of this region without great demands, which makes them develop the mountain foot up to heights from 600 to 700 m. Pumpwood grows mainly in the slopes of the calcareous hills and in lowlands. This aspect was agreement with Roig (1974). The plant coverage species (king grass, Guinea grass and oro azul), due to their characteristics, grow widely in inter-mountain valleys of little lope and in the undergrowth. Umbrella palm is abundant in humid areas of ponds and water accumulation; thus, it is an alternative feed for animals on free-range grazing.

Ten species out of the thirteen under study were reported in Baracoa municipality, and nine in El Salvador. This proves the biodiversity of the regions under study and the knowledge of the farmers about medullar subjects such as the management and the use of natural resources in the agroecosystems. Nevertheless, special attention should be paid the management and preservation of these species in the mountainous areas.

El Salvador and Baracoa municipalities, in Guantanamo province, have important species with high forage potential, able of complementing the animal feeding in the area. They are part of the stock of phytogenetic resources of the eastern mountain region. In the Baracoa municipality, there was lower use of the phytogenetic resources as alternative feed source for the animals.

Table 2. Percentage of coincidence according to the result of the panel of experts

No.	Species	Selection criteria						Total
		A	B	C	D	E	F	
1	Bastard cedar	100.0	77.8	88.9	88.9	88.9	66.7	85.2
2	Gliricidia	88.9	88.9	100.0	55.6	66.7	77.8	79.6
3	Rain tree	100.0	66.7	66.7	88.8	77.8	66.7	77.8
4	Leucaena	77.8	88.9	77.8	100.0	88.9	100.0	88.9
5	Oro Azul	88.9	66.7	88.9	66.7	77.8	55.6	72.2
6	King grass	44.5	88.9	100.0	77.8	77.8	100.0	81.5
7	Umbrella palm	100.0	88.9	55.6	55.6	66.7	33.3	62.9
8	Madras thorn	100.0	100.0	55.6	77.8	77.8	66.7	79.6
9	Pumpwood	55.6	55.6	77.8	44.4	55.6	77.8	61.1
10	Mango	88.9	66.7	66.7	55.6	66.7	66.7	66.7
11	Guineagrass	44.4	100.0	100.0	100.0	77.8	100.0	87.0
12	Breadfruit tree	44.4	66.7	100.0	77.8	44.4	100.0	72.2
13	Breadnut	100.0	100.0	55.6	77.8	77.8	66.7	79.6
	Total	77.8	75.9	81.5	74.1	72.0	75.9	

Table 3. Analysis of the principal effects

No.Factor	1	2	3	4	5	6	7	8	9	10	11	12	13	± EE	Sign.
Species	9.3	8.7	8.5	9.7	7.9	8.9	6.9	8.7	6.7	7.3	9.5	7.9	8.7	1.24	NS
Criteria	17.0	16.6	17.8	16.2	15.8	16.6	-	-	-	-	-	-	-	1.68	NS

Table 4. Distribution of the botanical families per municipality

Family	Amount of species		
	Total	El Salvador	Baracoa
Moraceae	3	1	2
Fabaceae	2	2	1
Mimosaceae	2	2	2
Graminaceae	2	2	1
Sterculiaceae	1	1	1
Anacardiaceae	1	1	1
Cyperaceae	1	-	1
Verbenaceae	1	-	1

References

Balzarinim, M.G., Casanoaves, F., Di Rienzo, J.A., González, L. & Robledo, C.W. 2001. InfoStat. Versión 1. Córdova

Claro, A. 2002. La distribución de especies forestales en las montañas de cuba y su relación con las condiciones geoecológicas. PhD Thesis. Facultad de Geografía, Universidad de La Habana. p. 105

Díaz Aguirre, S., Díaz, M. A., Alvárez Godoy, E. & Herrera, A. 2000. El aprovechamiento del follaje de las coníferas. Una alternativa en la alimentación animal. Available: <http://www.ciget.pinar.cu/No.%202000-4/comunicaciones.htm>

Febles, G. & Ruíz, T. 2009. La diversidad biológica en Cuba. Características, causas de deterioro, estrategia nacional y plan de acción. VIII Taller Internacional Silvopastoril. Estación Experimental "Indio Hatuey". Universidad de Matanzas. Matanzas, Cuba

Font, H., Noda, A., Torres, V., Herrera, M., Lizazo, D., Sarduy, L. & Rodríguez, L. 2007. COMPARPRO. Versión 1. Instituto de Ciencia Animal

Ibarra, F. 1994. Metodología de la investigación social. Ed. UNION. Ciudad de La Habana, Cuba. Primera edición. p. 212

Izquierdo Vallina, J. 2006. Los recursos fitogenéticos de interés agrolimentario. Entre la biodiversidad, el desarrollo rural y la conservación del paisaje. Tecnología Agroalimentaria. 2006: 42

Leyva, S., Ortiz, A. & Valdivie, M. 2007. Producción sostenible de carne de ovinos a partir de la harina del fruto y la hoja del árbol del pan (*Artocarpus altilis*). Pastos y Forrajes 30:1

Machado, R., Navarro, M., Fung, C. & Reino, J. 2005. Prospección y colecta de legunimosas multiproposito en áreas marginales al centro y sur de tres provincias cubanas. Pastos y Forrajes 28: 187

Mateo, J. & Acevedo, M. 1989. Regionalización físico-geográfica de Cuba. In: Nuevo Atlas Nacional de Cuba. Eds. G. Oliva, E. Lluís, E.A. Sánchez. Instituto de Geografía. Academia de Ciencias de Cuba. La Habana, Cuba. p.180

Moore, G. & Tymowski, W. 2005. Explanatory Guide to the International Treaty on Plant Genetic Resources for Food and Agriculture; IUCN, Gland, Switzerland and Cambridge, UK. 212 pp.

Morales, M.E., Ferrera, J., Cárdenas, J.L. & Sánchez, S. 2009. Inventario de la diversidad arbórea en la finca Santo Domingo, municipio Colón: un estudio de caso. VIII Taller Internacional Silvopastoril. Matanzas, Cuba

Oliveira, Y., Machado, R. & Fung, C. 2008. Colecta de leguminosas forrajeras en tres provincias orientales de Cuba. Pastos y Forrajes 31:1

Pérez, A., Wencomo, H., Navarro, M., Iglesias, J.M., Soca, M., Cepero, L. & Canchila, E.R. 2008. Consideraciones acerca de la *Leucaena leucocephala* cv. X: una nueva opción forrajera para un ecosistema ganadero con suelos ácidos e infértiles. Pastos y Forrajes 31:1

Renda, A., Calzadilla, E., Jiménez, M. & Sánchez, J. 1997. El silvopastoreo en Cuba. In: La Agroforestería en Cuba. Ed. Red Latinoamericana de Cooperación Técnica en Sistemas Agroforestales. Santiago de Chile, Chile. p. 150

Rivas, M. 2001. Conservación *in situ* de los recursos fitogenéticos. En: Estrategia en recursos fitogenéticos para los países del Cono Sur. PROCISUR. p. 7

Roig Mesa, J.T. 1974. Plantas medicinales, aromáticas y venenosas de Cuba. Ed. Ciencia y Técnica. La Habana. 952 pp.

Rossi, D. 2007. Los recursos fitogenéticos y su marco regulatorio internacional. Available: <http://rephip.unr.edu.ar/bitstream/handle/2133/885/Los%20recursos%20fitogeneticos%20y%20su%20marco%20regulatorio%20internacional.pdf?sequence=1> [Consulted: 25/04/2007]

Sánchez, L.R., Gelvis, G.S.M. & Solano, F. 2007. Plantas con flores de la reserva El Volcán, Veredad Alto Grande Pamplona, Norte de Santander. p. 10

Savón, L., Álvarez, A., Duran, F., Scull, I., González, R., Torres, V., Gutiérrez, O., Orta, I., Hernández, Y. & Noda, A. 2011. Evaluación y utilización de recursos fitogenéticos naturales para contribuir a la seguridad alimentaria en las regiones montañosas del oriente cubano. Thecnical report. Ed. Ministerio de la Agricultura. Programa de Desarrollo Integral de la Montaña. p. 30

Received: April 3, 2011