Journal of Animal Production, 29 *(*1), pages 16-20, 2017

Bioeconomic Indicators of *Ateleia cubensis* (DC) Dietr for Production with Ruminants in Camaguey, Cuba

Delmy Triana González, Lino Curbelo Rodríguez, Oscar Loyola Hernández

Department of Agronomy, Faculty of Agricultural Sciences, Ignacio Agramonte Loynaz University of Camaguey, Cuba

delmy.triana@reduc.edu.cu

ABSTRACT

Assessment of bioeconomic indicators of Ateleia cubensis (DC) Dietr. for production with ruminants was made, on ferromagnesium brown-red fersialitic soils of ultramafic savannahs in Camaguey, Cuba. The bioeconomic effect was simulated with a dual-purpose production system oriented to milk sales as the main product, on land covering 35 ha. The creation of a protein bank is recommended in the area, using *A. cubensis* (DC) Dietr, on 15% of the total farm area. To simulate milk production response, feed balances were performed, all based on likely grass consumption and feeds used, according to their nutritional quality. The budget was portioned for analysis to determine plant suitability for protein banks. Feasibility of the plant as a local source of protein for cattle was demonstrated through a bioeconomic perspective.

Key words: *protein bank, bioeconomic effect, cattle, milk production, legume, simulation*

INTRODUCTION

A management alternative that can be assessed through simulation is a protein bank with a unique plant species rich in protein. It could be used in controlled grazing, or may be harvested by cutting, allowing a possible productive response (Triana *et al*, 2012).

The use of local nutritional resources for a more sustainable animal production is essential. Many of those resources are sometimes called non-conventional, and need assessment for more efficient use in the animal diet (Pedraza *et al*., 2011).

One strategy to recover and improve livestock systems, and deal with climatic change, is the establishment of forest-grazing systems (FGS), some sort of agroforestry, in which trees and/or shrubs interact with forage herbaceous plants and animals (Karki and Goodman, 2010). In that case, there is not enough information of bioeconomic indicators about effective use of *Ateleia cubensis* (DC) Dietr. for dairy production in the region. It is an interesting fact, considering that the species is an important native resource to set up forest-grazing systems, and that it can be used as a nutritional supplement for bovines, ovines and caprine that graze in the area.

The aim of this research was to assess the bioeconomic indicators of *Ateleia cubensis* (DC) Dietr. for ruminant, on ferromagnesium brown-red fersialitic soils of ultramafic savannahs in Camaguey, Cuba.

MATERIALS AND METHODS

The study was developed at the UBPC Finca Habana, from the Livestock Company in Minas, Camaguey, Cuba, located between 21º28’50” and 21º29’15” north latitude, and 77º39’50” and 77º40’20” west longitude, 80 m above sea level.

The experimental work was done on red-brown ferromagnesial fersialitic soil, according to trial pits 759 and 760, located in San Serapio Charts, 4 680 IIa, scale 1:25 000 (Hernández *et al*., 1999). The soils are characterized by a fairly acidic pH and low fertility.

The climate is humid tropical, from inland plains, with seasonal humidity and high evaporation (Rivero, 2010).

Fabaceae cubensis (DC) Dietr. (endemic to Cuba) was used in the study. It grows in ultramafic systems in Camaguey, and has been well accepted by ruminants (30 - 48%) (Loyola, 2011).

The bioeconomic effects produced by the new protein banks (PB) was simulated with *A. cubensis* in dual-purpose cattle systems, in Camagueyan ultramafic savannahs. The scenario used was a farm with dual-purpose animals for dairy production.

It comprises 35 ha of native grass, on ultramafic savanna soils, with predominance of graminaceae (*Sporobolus pyramidatus* (lam.), *Dichanthium caricosum* (L.), *Dichanthium annulatum* (Forsk.), and others). Also included were crawling legumes, undesirable plants, and 12% infestation with *Dichrostachys cinerea* (L.) Wight et Arm. The farm was enclosed with a perimetric fence, and included two grazing fields and stocking rate of 0.87 LU/ha, as well as a stable source of water for the herds and farm work.

The herd was made of 30 heads of Cuban Siboney crossbreds (24.0 LU) (5/8 Holstein x 3/8 Zebu), weighing 380 kg of LW (18 cows, 6 heifers, 3, young cows, and 3 calves). The milking cows accounted for 48%. Milk production was 2.7 and 2.3 kg/cow/day for the rainy and dry seasons (RS and DS), respectively, according to data provided by the livestock company of Minas. The animals had 4.0 % of fat, from non-supplemented native grass. Milking was manual, and a system for restricted herd milking was used. Animal management requirements were taken from farm averages.

The creation of a protein bank was recommended, using controlled grazing of *A. cubensis* in 15% of the farm area (5.25 ha), considering a first stage exclusively for milking cows. Gamic or botanical seeds were used for the legume plants, in furrows, at a distance of 2.0 x 0.50 m. The area comprising the protein bank was enclosed with a fence covering the perimeter, and splitting the field in two similar subareas. After plant growth (7-8 months), the animals were introduced in the area, ensuring 45 resting days in each sub area, during the rainy season, and 60 days in the dry season, thus guaranteeing seven occupations in the year. The animals were taken to the protein bank (PB) at the end of the morning milking, and stayed there for 2h. Then they were taken back to the grazing fields along with the herd.

Individual forage consumption needs were estimated at a ratio of 11.4 kg/DM/LU/day (3% LW), considering LU as having 380 kg of LW, and RS/DS duration of 155/210 days, respectively. The PB could provide up to 3.0 kg of DM of Ateleia/day, according to previous research using PB of tree-like legumes (Pérez Infante, 2010).

Annual yields of Ateleia were based on experimental results from Loyola (2011), on the species yield for these kinds of ecosystems, determined in a three-year study. The bromatological composition of grasslands is shown in Table 1. To simulate milk production response, feed balances were performed (CALRAC, version 1.0, 1996), all based on likely grass consumption, and the kinds of feeds used, according to their nutritional quality. The consumption values were assigned according to recommendations of Pérez Infante (1983) on available grass consumption in the grazing fields.

Economic analysis of the proposal for nutritional improvement

To estimate economic feasibility of the assessed proposal application, Initial Budget Analysis (IBA) was used to determine the Net Profit Change (NPC) (Luening, 1996).

NPC= (TIT + PCT) - (LIT + PTC)

Where,

TIT: Total income /Technology

PCT: Prevented costs /Technology

LI: Lost income /Technology

PTC: Proposed technology costs

RESULTS AND DISCUSSION

Bioeconomic response of A. cubensis in the protein bank for dual cattle systems in the region

According to nutrient contribution and perspective animal requirements, Table 2, a protein bank of *Ateleia* on 15% of the farm area, would lead to milk production of 4.5 and 3 kg/cow/day. These production levels are given, mainly, by the nutrient contribution of the legume, and are limited by the low availability and quality of native grass in the area, which hinder voluntary consumption by cattle (Acosta, 2003).

The production levels at the protein bank proposal reached 1.8 and 0.7 kg of milk/cow/day during these periods, above the total real production in the area studied. It suggests possible production improvements of cattle systems by using Ateleia. It is a locally available resource, which is not properly exploited today. These results are even more significant, considering the introduction of other legumes or improved graminaceae in the region, which is extremely difficult and costly, due to the edaphic limitations of the area.

Other additional benefits of legumes use are wood production for cooking, atmospheric carbon retention services, soil fertility improvements from dry leaves (Loyola, 2011). Though in Cuba these services do not have acceptable economic recognition (Zequeira *et al*., 2010), they are an important contribution to sustainability of the productive systems studied.

However, that response was not achieved until the bank was used, 9-10 months after establishing. During that stage, it was possible to make bean productions in fields shared with other crops, like *Sesamum indicum* (sesame), Vignas, and others.

They could cushion the expenses made during the creation of the protein bank. This possibility has been demonstrated in studies by Díaz and Padilla (2003), and it is a very convenient practice, because, aside from contributing to farm income increase, it can also guarantee agricultural labor to legumes for the first 120 days of plantation (Febles *et al*., 2003).

The importance of *Ateleia cubensis* for these agroecosystems is obvious. It is remarkable in terms of production, with an outstanding effect on natural fertility recovery and soil protection, as well as improvements in associated grass availability and nutritional quality. These aspects will have a positive impact on livestock production, by making efficient use of natural potentials, including ensuing economic advantages and possible improvements in milk and meat productions.

Moreover, the initial economic impact of any investment after year 0 (the period when the investment is implemented), is often crucial to farmer acceptance of technology and other related factors involved in production (Soto, 2010). Hence, a positive effect on the results will represent and edge when deciding on technology investment. In this particular case, the introduction of *Ateleia* led to a positive change in profits, according to the partial budget analysis in Table 3, which suggests economic convenience of implementation.

Legumes have demonstrated the possibility to reach high milk productions and increased live weight gains, by becoming a part of livestock systems. Besides, it is an effective way to achieve significant increases of herd production and reproduction (Díaz *et al*., 2012).

However, the success brought by introducing foreign germplasm on ultramafic soil ecosystems, has been limited by adaptation difficulties of species to edaphic conditions (Acosta, 2003 and Curbelo, 2004). Using endemic or natured vegetation would be very convenient in these ecosystems, particularly legumes. They can be used for animal nutrition, and can provide several environmental services (Loyola, 2011). In that sense, flower prospection in the region has indicated the presence of several legume species with forage potential, including Ateleia.

Paciullo *et al.* (2014) demonstrated that fostering forage legumes that proliferate spontaneously in livestock areas might help recover natural flower features, particularly if the species have a convenient productive potential, depending on adaptation and association capacities, according to the production system used. It would provide more balanced grass-based nutrition, regardless of animal management and low inputs in the grazing fields.

Apart from direct economic benefits, one important effect of these associations would be an increase in production of agroecosystems which could contribute to stabilization of local inhabitants and the return of previous farmers who had migrated to urban areas. It could help solve countryside migration problems and the absence of farmers (Guevara *et al*., 2002).

CONCLUSIONS

Milk production was increased by using *Ateleia cubensis* (DC) Dietr. in the two seasons; NPC was also positive. *Ateleia cubensis* proved its effectiveness in protein banks created in ultramafic savannahs of Camaguey.

REFERENCES

ACOSTA, Z. (2003, junio). *Cambio en la composición florística de una sabana ultramáfica con suelos mejorados*. Fourt Internacional Conference on Serpentine Ecology, 15-20, La Habana, Cuba.

CALRAC. (1996). Software para la alimentación de rumiantes (versión 1.0). La Habana, Cuba: Instituto de Ciencia Animal.

CURBELO, L. M. (2004). *Alternativas forraje ganadería para las sabanas infértiles del norte de Camagüey*. Tesis de doctorado en Ciencias Veterinarias, Universidad de Camagüey, Cuba.

DÍAZ, A.; MARTÍN, P.; CASTILLO, E. y HERNÁNDEZ, J. (2012). Suplementación de añojos Charolais de Cuba en pastoreo de asociación múltiple de leguminosas herbáceas y gramíneas tropicales. *Revista Cubana de Ciencia Agrícola*, *46* (3), 249.

DÍAZ, M. F. y PADILLA, C. (2003, noviembre). *Alternativas de utilización de leguminosas temporales en el trópico*. II Foro Latinoamericano de Pastos y Forrajes, 15-20, Instituto de Ciencia Animal, La Habana, Cuba.

FEBLES, G.; RUÍZ, T. y CRESPO, G. (2003). Aspectos prácticos para establecer leguminosas en pastizales. En *Manual de tecnologías* (2da Ed., pp. 25-30). La Habana. Cuba: ICA.

GUEVARA, R.; GUEVARA, G.; CURBELO, L. y PEDRAZA, R. (2002). Eficiencia de los sistemas de producción de leche a pastoreo. *Hidra. Boletín informativo para ganaderos*, (2), 13-14.

HERNÁNDEZ, A.; PÉREZ, J. M.; BOSCH, D.; RIVERO, L.; CAMACHO, E.; RUIZ, J. *et al.* (1999). *Clasificación genética de los suelos de Cuba*. Ciudad de La Habana, Cuba: Instituto de Suelos, Ministerio de Agricultura, AGRINFOR.

KARKI, U. y GOODMAN, M. S. (2010). Cattle Distribution and Behavior in Southern-Pine Silvopasture Versus Open-Pasture. *Agroforestry systems*, *78* (2), 159-168.

LOYOLA, O. (2011). *Integración de leguminosas nativas, árboles frutales y multipropósitos a sistemas de producción vacuna en sabanas ultramáficas del centro norte de Camagüey*. Tesis de doctorado en Ciencias Veterinarias, Universidad de Camagüey, Cuba.

LUENING, R. (1996). *Manual de administración de empresas lecheras*. Wisconsin, USA: Univ. Wisconsin.

TRIANA, D.; LOYOLA, O.; CURBELO, L. y GUEVARA, R. (2012). Evaluación de la carga de semillas y la nodulación como factores que inciden en la persistencia de *Clitoria falcata* Lam y *Alysicarpus vaginalis* (L) DC en pastoreo. Rev. *prod. anim.*, *24* (2), 13-16.

MUÑOZ, D.; PEREDA, J.; LABAÑINO, L. y AGUILERA, L. (2005, marzo). Control ecológico y producción de leche en la leñosa marabú (*Dichrostachys cinerea*). I Congreso Internacional de Producción Animal, 7-14, La Habana, Cuba.

PACIULLO, D. S. C.; PIRES, M. F. A.; AROEIRA, L. J. M.; MORENZ, M. J. F.; MAURÍCIO, R. M.; GOMIDE, C. A. M. *et al.* (2014). Sward Characteristics and Performance of Dairy Cows in Organic Grass–Legume Pastures Shaded by Tropical Trees. *Animal*, *8* (08), 1264-1271.

PEDRAZA, R. M.; RUÍZ, R.; RIVERO, M.; MARTÍNEZ, S. J. y GONZÁLEZ, C. (2011). Sugerencias para implementar en una granja porcina la técnica de bolsa móvil para medir digestibilidad. *Prod. Anim.*, *21* (1), 81-183.

PÉREZ INFANTE, F. (1983). Consideraciones sobre el balance alimentario. En *Los pastos en Cuba* (Vol. 2, 246-253). La Habana, Cuba.

PÉREZ INFANTE, F. (2010). *Ganadería eficiente*. La Habana, Cuba: Asociación Cubana de Producción Animal.

RIVERO, R. (2010). *Consideraciones sobre los cambios climáticos en Camagüey y su efecto en la ganadería*. Camagüey, Cuba: Centro Meteorológico de Camagüey.

ZEQUEIRA, MARÍA E.; GONZÁLEZ, Iris M. y PELEGRÍN A. (2010). Valoración económica de bienes y servicios ambientales forestales en un refugio de fauna. *Retos de la dirección*., *4* (2), 13-19.

.

Received: 5-15-2016
Accepted: 5-20-2016

Table 1 Bromatological composition of feeds used for simulation (SB)

Feed	DM	ME (Mcal/kg DM)	BP (g/kg DM)	IC
Native grass RS	28.6	2.04	61.3	0.96
Native grass DS	32.1	1.8	53.1	0.84
A. cubensis (RS)	30.0	2.2	205.0	0.92
A. cubensis (DS)	31.5	2.0	199.0	0.93

Source: Loyola (2011).

Table 2. Nutritional balance estimated for 380 kg LU, in production conditions, using an *A. cubensis* protein bank on 15 % of farm area

Period		Consumption (kg DM)	EM (Mcal)	BP (g/kg DM)
RS[a]	Grass	5.72	10.90	351.00
	Ateleia	2.40	5.30	492.00
	Supplementation	0.05	0.10	12.00
	Total	8.17	16.20	855.00
	Demands		19.60	691.00
	Difference		-3.40	164.00
DS[b]	Grass	4.81	8.70	256.00
	Ateleia	1.89	3.80	376.00
	Supplementation	0.05	0.10	12.00
	Total	6.75	12.50	644.00
	Demands		18.00	572.00
	Difference		-5.40	73.00

[a] estimated milk production: 4.5 kg/cow/day, 4% fat.
[b] Estimated milk production: 3.0kg/cow/day, 4% fat
Dry matter values of *A. cubensis* and native grass were estimated, based on Loyola (2011), in the same ecosystem.

Table 3. Partial budget analysis (PBA) for *A. cubensis* protein bank in dual-purpose animals on ultramafic soils covering 15% of the farm area

Elements	Technology costs (CUP)	Technology income (CUP)
Fences (salary, wire, nails, stakes)	14 250.00	
Sowing (soil prepraration and salary) per ha	294.00	-
Establishment (grass cutting)	180.00	
Milk sales	-	15 336.00
Total	14 724.00	15 336.00
CNU	612.00	