Replacement Charolais cows grazing a *Leucaena leucocephala-Cynodon nlemfuensis* association: economic and financial indicators

Delia M. Cino[1], A. Díaz[1] and Ana M. Vega[2]
[1]*Instituto de Ciencia Animal, Apartado Postal 24, San José de las Lajas, Mayabeque, Cuba*
[2] *Empresa de Genética y de Cría "Manuel Fajardo", Granma, Cuba*
Email: dcino@ica.co.cu

An economic and financial assessment was carried out of the rearing of replacement Charolais cows grazing star grass and Leucaena in association and without association. The study was developed in the Cattle Breeding and Rearing Enterprise "Manuel Fajardo", Granma province. One hundred twenty animals were used distributed in two treatments: a) association and b) star grass monoculture in two successive cycles with a stocking rate of 1 animal.ha^{-1} and 50 g of minerals.animal^{-1}.d^{-1}. Records of the costs.treatment^{-1} were completed with fixed, variable, indirect and investment costs. The following indicators were estimated: total cost, production value, profit or economic loss, cost. animal^{-1}, cost. kg^{-1} of live weight, cost.peso produced ($^{-1}$), cost.ha^{-1}, benefit.cost^{-1} ratio, gross margin.animal^{-1}, gross income and profitability. The American dollar was used as monetary pattern. The satisfactory economic indicators were registered for both cycles in the association. The second cycle showed the best result with a benefit.cost ratio^{-1} of 1.15. The monoculture showed economic losses. All financial indicators were positive in the association, though its benefits were corroborated on incorporating the females to reproduction at 19 months of age. Results from this experiment evidenced the economic advantages of silvograzing for rearing replacement cows of the Charolais genotype as a sustainable alternative for tropical cattle production.

Key words: *cows, cattle rearing, silvograzing, economy*

The replacement bovine female is a main link of the productive cattle rearing chain. It represents the future of a herd, but it concerns an animal that requires expenses without immediate monetary return and its rearing is a long-term financial investment for the breeder. The annual replacement has a high incidence in the livestock rearing profitability of the enterprise. According to López (2010) it constitutes an important economic expense demanding between 15 and 20 % of the total costs of the cattle farmer, mainly by animal feeding and management costs. The financial and climatic restrictions affect the rearing of the growing female under grazing in Cuba and in other tropical zones. Even though its main objective is to attain a satisfactory growth at the least possible cost (Matías and Parreño 2011), live weight gains (LW) are moderate, between 350 and 600 g.animal.d^{-1} and are only higher in intensive systems with supplementation (Vega 2012).

The application of rearing systems guaranteeing healthy and apt breeding animals for the effective replacement of the herds is of great importance from the economical point of view. Vélez (2011) stated that the sustainability and strength of cattle production at medium and long -term will be only possible with technological solutions attaining to increase the profitability and competitiveness of the activity.

Presently, special interest is given to the contribution of the tree component, associated to pastures, as improving element of the productive conditions. Silvopastoral systems represent, according to Villanueva and Ibrahim (2011), a strategy to improve the economic, social and environmental indicators of the cattle farms. Promising results are recorded today with the application of tropical grass associations-*Leucaena leucocephala*, even though its use at larger scale hardly starts to be extended to countries such as Mexico (Xóchilt and Solorio Sánchez 2011 and Flores *et al.* 2011), Colombia (Murgueito 2011 and Córdova *et al.* 2011) and Cuba (Díaz 2008, Iglesias *et al.* 2009, Benítez *et al.* 2009, Soca 2009, Alonso 2011, Vega 2012 and Iraola 2013).

The specialized Charolais cattle are a genotype of interest, because of its precocity, high growth rate under grazing and carcass yield, in females and males (López *et al.* 1977 and Díaz 2008). The use of silvopastoral grazing with Leucaena for the rearing of females of this genotype could guarantee favorable economic and financial results under the edaphoclimatic conditions of the Eastern region of Cuba.

This investigation, in view of its interest, was aimed at evaluating the economic feasibility of the rearing of the replacement Charolais cow, in a grazing system with *Leucaena leucocephala*, associated with *Cynodon nlemfuensis*, as alternative to a grazing system of *Cynodon nlemfuensis* in the Cattle Breeding and Rearing Enterprise "Manuel Fajardo", Granma province, in Cuba.

Materials and Methods

Data were taken from the productive assessment carried out in the Cattle Breeding and Rearing Enterprise "Manuel Fajardo", Granma province (Vega 2012) (table 1). The study was realized with 120 replacement Charolais females using two alternatives: a) silvopastoral grazing of *Leucaena leucocephala* and star grass (*Cynodon nlemfuensis*) and b) star grass monoculture in two successive grazing cycles for three years (March, 2008 to December, 2010).

Table 1. Original data of the system evaluated

Indicators	Association		Monoculture	
	Cycle I	Cycle II	Cycle I	Cycle II
Initial age (IA), d	281	235	287	213
Initial live weight (initial LW), kg	173	155	168	155
Final live weight (final LW), kg	325	310	265	307
Cycle length, d	366	273	578	548
Average daily gain, (ADG), g/d	416	567	241	278
Animals (#)	120			
Stocking rate (animals.ha^{-1})	1			
Mineral supplementation (g.animal^{-1}.d^{-1})	50			

Source: Vega (2012)

Cost records by cycle were prepared from the technological data and the cost elements involved in the rearing of the females in the two alternatives. Fixed (grassland depreciation, fences, water troughs, among others), variable (feeding, salaries, medicaments), indirect costs (5 % of the variables) and investments (purchase of animals) were considered for evaluating the indicators. The economical indicators: economic profit or loss, total cost, production value, cost. animal^{-1}, cost.animal^{-1}.d^{-1}, cost.ha^{-1}, cost.kg^{-1} of LW and benefit.cost^{-1} ratio were estimated. The calculation of the financial analysis included: gross margin.ha^{-1} (GM = gross incomes.ha^{-1} – direct costs. ha^{-1}) and economic profitability (EP = gross margin.ha^{-1}/gross income.ha^{-1}), according to the methodology of Gargano *et al.* (1997) and Peretti *et al.* (2006).

The American dollar (USD) was selected as monetary unit due to the possibility of applying these systems in other tropical areas. Cattle purchase-sale prices were taken from the Liniers Market (2013). Operation costs of agricultural machinery and of salaries come from IEA (2013). Costs of feeds, seeds and different agricultural supplies were taken from INFOASERCA (2013). The investment was made from the present money exchange rate to USD.

Results and Discussion

Results from the analysis of the economic indicators (table 2) show that rearing with the option of monoculture with star grass registered, in both cycles, economic losses. These unfavorable indicators were conditioned by the cost increase, owing to the lower animal growth rate, with a rearing duration higher than 300 d.

The production cost of the replacement animal is determined not only by the availability of animals for guaranteeing the incomes, but mainly, by the length of the rearing stage (Anon 2013). Also, it is important to take into account the need of a higher contribution of nutrients assuring greater average daily gain (ADG), according to Díaz (2008).

Costs per animal were lower to those reported by Osnaya (2005). This author indicated that the average investment cost in the traditional rearing systems of replacement cows is of 1200 USD per female from birth to two years of age. Monthly estimated costs of 50-60 USD/heifer have been reported after 24 months (Anon 2009). This situation affects the economic return of the investment in the productive systems of the development bovine female (Anon 2011).

The lower length in cycle II of silvopastoral grazing determined a more favorable performance of the indicators regarding cycle I. This was due to the fact that in the second year of the study, the silvopastoral system was completely established and the animals had access to a greater availability and quality of pastures (Vega *et al.* 2013). In that regard, Cruz (2003) stated that the economic results of the replacement rearing is determined not only by the level of the fixed and variable costs and the number of animals necessary for guaranteeing incomes, but also by the duration of the rearing stage for attaining the required parameters for the incorporation of the female to the breeding cycle.

Heinrich (2011) emphasized the high cost levels owing to the delay in the incorporation of the replacement female to the reproductive life, due to the deficient rearing systems in this category. The utilization of the Leucaena-grass associated system propitiated greater economic viability, with final incorporation LW higher than 300 kg, in an age range between 18-21 months, which surpassed the results of Hernández *et al.* (2013), with 285 kg and 22 months of age, under Cuban commercial conditions.

Mejías (2008) reported similar results with commercial Zebu females and Díaz (2008) with growing Charolais males. These authors corroborated the benefits of the silvopastoral grazing with Leucaena, not only from the economical point of view, but also in its ecological and productive contribution, provided there is adequate management and the fulfillment of the technological discipline is guaranteed (Vega 2012).

Benítez *et al.* (2010) also underlined the importance of the application of the agroforestry systems for the rearing of bovine replacement since, in some cases, the productive systems of livestock production are not

Table 2. Analysis of the main economic indicators, USD

Indicators	Silvograzing		Monoculture	
	Cycle I	Cycle II	Cycle I	Cycle II
Cost.animal^{-1}	700.69	591.58	875.01	781.20
Cost.animal^{-1}.d^{-1}	1.91	2.17	1.51	1.23
Cost.kg LW^{-1}	2.15	1.91	3.29	2.54
Cost.ha^{-1}	700.69	591.58	875.01	781.20
Cost. $ produced^{-1}	0.98	0.87	1.50	1.16
Benefit.cost^{-1}	1.02	1.15	0.67	0.86
Total cost	84083.34	70990.70	105002.33	93744.00
Production value	85879.20	81866.40	70144.80	81074.40
Economic gain or loss	1795.86	10875.70	(34857.53)	(12669.60)

adjusted to the adequate use of the available resources and to the environment characteristics.

The analysis of the costs. Cuban peso produced[1] and the benefit.cost ratio confirmed the economic loss of the system with grass monoculture. The profit margin attained in the associated system is not high, but in this animal category expenses are accumulated until calving, when the animal starts to generate incomes. For this reason diverse authors consider that the growing female is one of the more risky categories in the livestock production activity.

Charolais animals attained gains higher than 500 g.animal.d^{-1}, in both cycles, without the utilization of fertilizers or supplements. Guevara *et al.* (2012) and Depablos *et al.* (2012) reported daily gains between 450-480 g in rearing systems with fertilized grasses. This specialized genotype requires feeding and management systems of medium to high inputs for expressing its production potential. However, under the edaphoclimatic conditions of Granma province, the silvopastoral system demonstrated to be a promissory alternative.

Direct cost.ha^{-1} (table 3) was lower in the association regarding the monoculture. This indicated greater efficiency in the utilization of the variable costs, since it required lower investment level of resources for its exploitation. In that respect, Espinosa and Wiggins (2003) underlined the importance of this indicator, on pointing out that livestock production is more determined by direct costs than by the total production volume.

The association presented higher gross margins.ha^{-1}, an indicator of great interest since it is an objective to be attained by the breeder of replacement animals, taking into account the economic importance of the fixed costs that, at short term do not vary and have as main function the measurement of the possible economic benefit of the activity (Cino *et al.* 2011 and Borja and Zehender 2013). In the system with monoculture the economic loss was confirmed.

The gross income.animal^{-1} was favorable to the alternative with Leucaena. However, the highest level was evidenced in cycle I, that attained higher live weights, since the animals entered to grazing with higher weights and, on the other hand, longer cycle duration was registered. It must be indicated that this study was carried out under production conditions. In that regard, Díaz (2008) reported that the variability in live weights is higher in bovines in grazing systems of production areas.

Profitability was favorable under the present productive conditions for the associated system and negative in the monoculture. Nonetheless, it is important to work for increasing its present level since this indicator reflects the benefits over the capital invested plus the production costs incurred and has as objective the recovery of the money invested in the rearing of the heifer (Schneider *et al.* 2013).

The improvement observed in the second cycle of the monoculture, regarding the gross margin and the profitability, is conditioned by the fact of existing greater feed availability, because the system was completely established (Vega 2012). In the same way, higher daily weight gain was registered and higher contribution of final LW in a lower period of time, resulting though positive both indicators.

Results from the economic and financial analysis indicated the potentialities of the use of *Leucaena*

Table 3. Results of the main financial indicators, USD

Indicators	Silvograzing		Monoculture	
	Cycle I	Cycle II	Cycle I	Cycle II
Direct costs.animal^{-1}	565.00	490.38	662.01	579.26
Gross incomes.animal^{-1}	715.66	682.22	584.64	675.62
Gross margin.animal^{-1}	150.66	191.84	(77.47)	96.36
Profitability, %	21.00	28.00	(13.00)	14.00

leucocephala associated with tropical grasses (*Cynodon nlemfuensis*) for the rearing of replacement Charolais cows under grazing regarding the traditional commercial system based on the monoculture of grasses that did not result economically viable for this specialized genotype in the Cattle Breeding Enterprise "Manuel Fajardo".

References

Alonso, J. 2011. Silvopastoral systems and their contribution to the environment. Cuban J. Agric. Sci. 45:107

Anon 2009. Resultados de la empresa ganadera. In: Resultados económicos y sistemas de gestión en ganadería. Cap. VI. Parte II. Available: http:www.uco.es/dptos/prod.animal/apoyodoc/libro%20 gestión/cap6.pdf. [Consulted: 5/4/2013]

Anon 2011. Novillas en relación al hato lechero. Available: http:/www.ugrj.org.mx/index2.php?option=com_content&do_pdf=id=394.[Consulted: 5/5/2013]

Anon 2013. Novillas en relación al hato lechero. Available: http:www.ugrj.org.mx/index2.php?optio=com_content&do_pdf=1&id=394. [Consulted: 22/4/2013]

Benítez, D., Ricardo, J., Romero, A., Guevara, O., Torres V., Miranda, M., García, J. & Olivera, C. 2010. Alternativas sostenibles de producción de hembras de reemplazo vacuno. Notas de Cátedra Universitaria. Equipo Federal de Trabajo. Cuaderno No. 64

Benítez, D., Ricardo, J., Viamontes, M. I., Romero, A., Guevara, O., Torres, V., Miranda, M., Guerra, J. & Olivera, C. 2009.Technological alternatives for replacement cows in the Cauto Valley. Cuban J. Agric. Sci. 43:4

Borga, S. & Zehender, R. 2013. Margen Bruto Agrícola. INTARAFAELA. Available: http://rafaela.inta.gov.ar/cambiorural/mb.agricola.cr.htm. [Consulted: 21/5/2013]

Cino, D.M., Díaz, A., Castillo, E. & Hernández, J.L. 2011. Cattle fattening in *Leucaena leucocephala* grazing: some economic and financial indicators for making decisions. Cuban J. Agric. Sci. 45:7

Córdoba, C.P., Cuartas, C.A., Naranjo, J. & Murgueito, E. 2011. Producción de biomasa forrajera en diferentes sistemas intensivos en temporada de lluvia y sequía en la región del Caribe de Colombia. III Congreso sobre sistemas silvopastoriles intensivos para la ganadería sostenible del siglo XXI. Morelia. México. p. 253-254

Cruz, A. 2003. Modelo de investigación y producción de ganado bovino de carne-cría. Estación Experimental "Enrique Jiménez Núñez". Available: http://www.inta.go.cr/inta/Publicaciones/mod/ganadobovinode carne.cna.pdf. [Consulted:22/4/2013]

Depablos, L., Ordóñez, J., Godoy, S. & Chicco, C. 2012. Prácticas de suplementación de novillas de carne a pastoreo en los llanos centrales de Venezuela. R.9. Available: http://es.scribd.com/doc/8746544/Resumenes. [Consulted:7/5/2012]

Díaz, A. 2008. Producción de carne bovina en pastoreo con gramíneas y leguminosas. PhD Thesis. Instituto de Ciencia Animal. La Habana, Cuba

Espinosa, J. & Wiggins, S. 2003. Beneficios económicos potenciales de tecnologías de doble propósito en el trópico mexicano. Rev. Tec. Pecuaria. 4:19

Flores, E.M., Ávila, N.A.R. & Solorio-Sánchez, B. 2011. Modelo de concenso silvopastoril intensivo para la ganadería sostenible del trópico michoacano. Ruta silvopastoril Valle del Apatzingan. Tecaltepec. Michoacán. Ed. Produce. Morelia. México. p. 4-30

Gargano, A.O., Saldungaray, M. & Aduriz, M.A. 1997. Parámetros físicos y económicos de agrosistemas. Rev. Fac Agronomía Luz. Maracaibo. p. 689

Guevara, E., Villanueva, E., Rodríguez, I. & Blancos, C. 2012. Evaluación de los cambios de peso en novillas de levante suplementadas con *Centrosema macrocarpum* y *Cratylia argentea* en sabanas de Venezuela. Available: http://www.es.scribd.com/doc/87476544/Resumenes. Consulted: 27/4/201

Hernández, Milera. M., Simón, L., Hernández, D., Iglesias. J., Lamela, L., Toral, O., Matías, C. & Francisco, G. 2013. Avances en las investigaciones en sistemas silvopastoriles en Cuba. Available: http://www.fao.org/ag/agap/Frg/agrofor1/HERNAND4.htm. [Consulted: 29/5/2013]

Heinrichs, J. 2011. Análisis económico para reemplazo de vaquillas. In: Análisis económico para programas eficientes de reemplazo de vaquillas. Available: http:www.extension.org/pages/17587/análisis-economico-para-reemplazo-devaquillas. [Consulted: 29/5/2013]

IEA. 2013. Informaçoes estatísticas da agricultura (USD). Serie Apta. Anuario. Brasil

Iglesias, J, Simón, L. & García, R. 2009. Crianza hembras de reemplazo Holstein en sistemas asociados con árboles. Pastos y Forrajes 32:1

INFOASERCA 2013. Apoyos y Servicios a la Comercialización Agropecuaria. Available: <http://www.infoaserca.gob.mx/fisicos/sya_pci.asp>. [Consulted: /21/06/2013]

Iraola, J. 2013. Rediseño y manejo de un arreglo silvopastoril para mejorar la capacidad de carga biológica con ganado de engorde. PhD Thesis. Instituto de Ciencia Animal. La Habana. Cuba

López, C. C. 2010. Evaluación técnica y económica de un hato lechero en Tulián, Ecuador. Graduated Thesis. Available: http://digital.Zamorano.edu/bitstream/11036/606/1/T2957.pdf. [Consulted: 29/5/2013]

López, D., Ribas, M., Díaz. J. & Menéndez, A. 1977. El Charolais Cubano. Ed. Científico-Técnica. La Habana, Cuba

Matías, J. & Parreño, A. 2011. Guía técnica. Curso-Taller "Manejo integrado de ganado vacuno". Universidad Agraria de Molina. Arequipa. Perú. p. 21-26

Mejías, R. 2008. Sistema para la producción de hembras bovinas de reposición con gramíneas-leguminosas. PhD Thesis. La Habana. Cuba

Mercado de Liniers. 2013. Available: http://www.infocampo.com.ar/mercados/ganaderos/mercado-de-liniers. Consulted: 10/12/2013

Murgueito, E. 2011. Ganadería del futuro. En: III Congreso sobre Sistemas Silvopastoriles Intensivos para la Ganadería Sostenible del siglo XXI. Morelia. Michoacán. p. 1-7

Osnaya, F. 2005. Importancia de la crianza de vaquillas de reemplazo. Available: http://avalon.cuautitlanz.unam.mx/vaquillas/crianzas/importancia_crianza.pdf. [Consulted: 8/5/2013]

Peretti, M., Issaly, L., Ghilda, C. & Pizario, L. 2006. Monitoreo económico de los sistemas productivos predominantes del sector agropecuario de Córdoba. Vol IX. Ed. UNRC. Argentina

Schneider, G., Galetto, A., Alesso, J.C., Leconte, M. & Troaibert, J. 2013. Aplicaciones de la gestión en la empresa agropecuaria. Available: http://rafaela.inta.gov.ar/

cambiorural/aplicaciones.CR.htm. [Consulted:29/5/2013]

Soca, M. 2009. Los sistemas silvopastoriles en la crianza de los animales en desarrollo. Available: http://mvz.unipaz.du.co/textos/lecturas/pastos-y-forrajes/fundamentos-de-pastos-y-forrajes/lecturas/silvopastoril-en-crianza-de-bovinos-en-desarrollo.pdf. [Consulted: 22/4/2013]

ega, A.M. 2012. Crianza de hembras de reemplazo Charolais de Cuba en pastoreo con *Leucaena leucocephala* y *Cynodon nlemfuensis*. Tesis Dr. Universidad de Granma,Cuba

Vega, A.M., Herrera, R.S., Lamela, A.A. & Rodrñiguez, G.A.2013. Evaluación en silvopastoreo y monocultivo de hembras Charolaises en crecimiento en el oriente cubano. Revista Electrónica de Veterinaria. REDVET.14:2. Available: http://www.veterinaria.org/revistas/redvet. [Consulted: 29/5/2013]

Vélez, O.M. 2011. Análisis de las limitaciones nutricionales de manejo en un sistema de producción lechera en el Valle del Cauca. Master Thesis. Ciencias Agrarias. Available: http: //www.bdigital.unal/edu.co/6045/1/7409507.2011.pdf. [Consulted: 29/5/2013]

Villanueva, C., Muhamad, I., Casasola, F., Rios, N. & Sepúlveda, C. 2012. Sistemas silvopastoriles: una herramienta para la adaptación al cambio climático en las fincas ganaderas en América Central. In: Buenas prácticas para la adaptación al cambio climático. Parte 2, capítulo 6, p.103-125

Xóchilt, F.M. & Solorio-Sánchez, B. 2011. Proyecto estratégico de prioridad nacional para el establecimiento de sistemas silvopastoriles intensivos para la producción de carne y leche en diez estados de la República Mexicana. III Congreso sobre sistemas silvopastoriles intensivos para la ganadería sostenible del siglo XXI. Morelia. Michoacán. p. 32-45

Received: October 29, 2013