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ASSESSMENT OF THE SUSTAINABLE AMAZONIAN SHEEP MODULE USING PRODUCTION EFFICIENCY INDICATORS

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ABSTRACT: *The objective was to evaluate a Sustainable Amazonian Sheep Module (MOAS by its Spanish acronym) through productive efficiency indicators with two breeds adapted to the Ecuadorian Amazon. The Sustainable Amazonian Sheep Module (MOAS) was implemented at the Center for Amazonian Research, Postgraduate and Conservation (CIPCA) Equator. The work was carried out between October 2018 and October 2019. A total of 33 multiparous females from 36 to 60 months of age were used—of the Blackbelly breed (Group BB): 2 males and 18 females, with an average weight and standard deviation of 30 ± 1.8 kg; and of the Pelibuey breed (Group P): 15 females and 1 male, with an average weight and standard deviation of 40 ± 2 kg. Each breed occupied one hectare where they rotated throughout the evaluated year. The results obtained showed that Group BB maintained an average annual stocking rate of 20 animals and 541.1 kg ha-1, produced 176.8 kg of sheep meat/ha/year, with a stocking efficiency of 27.4%. Group P had an average annual stocking rate of 16 animals and 605.40 kg, produced 219.3 kg of sheep meat/ha/year, with a stocking efficiency of 35.5%. It is concluded that the Sustainable Amazonian Sheep Module evaluated through productive efficiency indicators was shown to be a promising complementary system to be replicated within the Amazonian agricultural systems of Ecuador.*

KEYWORDS: Blackbelly; Pelibuey; Family economy; Sustainability; Biodiversity.

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INTRODUCTION

Agricultural activity is a feasible alternative to develop in the Ecuadorian Amazon without affecting the natural forests. For this to occur efficiently, it is essential to apply input and process technologies that generate social, environmental and economic-productive benefits, without harming the sustainability of the system (Moyano et al., 2019). Sarandón (2002) defines sustainability as a complex and interdisciplinary concept, for which there are no universal or common parameters or criteria for evaluation. Marini and Di Masso (2018) point out the need to simplify its complexity through obtaining clear, particular and general values, known as indicators, in such a way that abstract concepts are transformed into operational terms. In Ecuador, there are 12.2 million total hectares, of which 6.03 million hectares (ha) are destined for agricultural activity and 6.16 million ha correspond to conservation (MAG-SIPA, 2018). The Ecuadorian Amazon has 3.80 million ha conformed mainly by the provinces of Sucumbios, Napo, Orellana, Pastaza, Morona Santiago and Zamora Chinchipe, and maintained as of 2019 some 1 044 ha suitable for agriculture; 59.4% of this area corresponds to improved and natural pastures, being an area where production can be enhanced based on silvopastoralism systems with forage diet in minor ruminants. In the Ecuadorian Amazon, 82% of the area under agricultural use is dedicated to pasture, which shows that cattle ranching is one of the most important areas for the rural economy (Nieto & Caicedo, 2012). In recent decades, cattle ranching (milk and meat) has had an enormous growth in the Ecuadorian Amazon, which has resulted in an increase in deforestation and the agricultural frontier with negative consequences on the ecosystem (Alemán-Pérez et al., 2018).

The development of sheep farming has been slow in Ecuador and even more so in the Ecuadorian Amazon; this field offers an enormous and diverse potential for implementing sheep meat production systems.

However, although sheep production offers a promising and diverse potential for the implementation of a sustainable protein production system, its development in the region has been slow with 12 285 sheep existing in the Amazon out of 355 897 at the national level (MAG-SIPA, 2018).

The usual reductionist approach in agricultural production focuses on a few disaggregated variables in sheep (daily weight gain, weaning weight, offspring per lambing, birth weight, etc.). The application of the systems approach represents an integrative and macroscopic vision, which implies the recognition of the interactions between its elements. A systemic view makes it possible to understand the mechanisms associated with the productivity and efficiency of the whole, as well as the dynamics of its properties over time (Marini & Di Masso, 2018). The Blackbelly and Pelibuey breeds are of utmost relevance in meat production in the Ecuadorian Amazon region, since they adapted to extreme conditions without affecting the native flora and fauna despite being an introduced species, not endemic to eastern Ecuador. However, beyond adaptation to the environment, the animals need balanced and adequate levels of all nutrients for their animal health and for production at any physiological stage (Barakat et al., 2013). The ewes used have been at CIPCA since 2016; they showed an adaptation to the system since they lambed regularly and they have between five and six lambing’s each. It should be noted that reproduction and longevity have been deteriorating in production animals despite their importance for the viability of the enterprise as such (Rauw et al., 1998). In the last 60 years, the selection process has been moving away from its natural course (choosing those with the highest survival and fertility), accelerating and intensifying as human needs associated with the

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development, consolidation and expansion of the biotechnology industry have allowed (Camargo, 2012).

To reverse this fact, it is essential to apply innovation and low-input technologies and processes that generate social, environmental and economic-productive benefits, without harming the sustainability of the current system. For this purpose, a specific technological package was created for the Ecuadorian Amazon, thinking about the four elements that define sustainability: production, economic income, environment and producers (Marini, 2019). The Sustainable Amazonian Sheep Module (MOAS) works within a scheme of productive diversity in the typical systems of the Ecuadorian Amazon (cocoa, coffee, banana, pigs, cattle for meat or milk, Chinese potato, etc.). The purpose for the Amazonian producer is an additional income to the family economy, with a significant environmental and social impact, maintaining the source of animal protein, reducing the use of native forest areas and allowing the development of other members of the family.

The advantages of MOAS can be summarized as: high feed conversion rate, high percentage of reproduction and better use of local food resources. This system does not require large areas for maintenance. In addition, it does not require high technology for its implementation, and a greater amount of meat produced per area is obtained with products of high commercial value (Marini, 2019).

The objective of this study was to evaluate the Sustainable Amazonian Sheep Module through productive efficiency indicators with two breeds adapted to the Ecuadorian Amazon.

MATERIALS AND METHODS

The Sustainable Amazonian Sheep Module (MOAS) was conceived in 2016 and implemented in 2018 at the Center for Amazonian Research, Postgraduate and Conservation (CIPCA). This model was born from a need to complement the traditional production systems in the Ecuadorian Amazon, becoming an alternative production system with low investment and high profitability (Marini, 2019). CIPCA is located in the Arosemena Tola canton of the Napo province (Ecuador) at kilometer 44 via Puyo-Tena (coordinates: S 01° 14.325'; W077° 53.134'). In a tropical environment where the annual rainfall reaches 4500 mm, the relative humidity is 80% and the temperature varies between 15 to 35 °C. Its topography is characterized by slightly undulating relief without steep slopes, distributed in natural plateaus of great extension; the altitude varies between 580 and 990 meters above sea level.

The work was carried out between October 2018 and October 2019, using a total of 33 multiparous females from 36 to 60 months of age and three males:

1. Blackbelly Group (BB): Eighteen (18) females with an average weight and standard deviation of 30±1.8 kg and 2 Blackbelly males (BB Group) one of them still bighorn.

2. Pelibuey Group (P): Fifteen (15) females with an average weight and standard deviation of 40±2 kg, and 1 male of Pelibuey breed, each of the Group's BB and P occupied 1 (one) hectare (ha) where they rotated throughout the evaluated year.

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Each hectare was divided into four 2500 m² lots that had a grazing time of 15.2±1.3 days and 45.6±1.8 days of rest; the ewes in the year passed seven times through each paddock.

In each flock, forage supply was measured before the animals entered and the remainder when they left the flock. Once the grazing was finished, the flocks were equalized with a mechanical weeder as a routine. All the flocks had drinking troughs and stalls where mineral salts were offered. The sheep remained in free grazing from 7:00 a.m. to 18:00 p.m., being stabled during the night.

The mother ewes and their offspring were weighed every time they entered the grazing lots at the same time and with a calibrated 100 kg silverline mechanical scale.

The sheep flock under study was fed on pastures based on Dallis grass (*Brachiaria decumbens*) and fodder peanuts (*Arachis Pintoi*), and there were also scattered trees of coral tree (Erythrina) and Guava (*Psidium*) in the lots (Table I).

Table I: Chemical composition of forage

Forage	Kg DM/ha/year	Protein %	Phosphorous %	In vitro digestibility %
Brachiaria decumbens	17.585	10.6	0.18	44.4
Arachis Pintoi	6.212	19.4	0.21	59.2

INIAP (1997); Leonard (2015)

Sanitary management included deworming, baths against ticks and flies, vaccinations for foot and mouth disease, and prophylactic treatments with the use of antifungal and antibacterial agents.

The variables analyzed were individual weight (BW) in kg, dry matter (DM) production in kg (average between the production at entry and the finishing of each flock), stocking rate ha-1 (CA) in kg (sum of the total weight of animals per ha-1), number of animals (NA) (animals that occupied the area during the established time), kg of sheep meat/ha (kg of sheep meat/ha), the number of animals that occupied the area during the established time, the kg of sheep meat/ha/year (production per ha was obtained by dividing the annual meat production by the sheep livestock area used), and finally, the stock efficiency (SE) in %. (Stock efficiency is an estimate of the kilograms of production that are extracted from the herd per year for every 100 kg of stock. It is expressed as a percentage and is obtained by dividing the meat production by the average annual stocking rate, both expressed in kilograms per hectare: kg of sheep meat/ha/year / Stocking rate ha-1 in kg.)

A descriptive analysis of the variables analyzed was carried out. Only for live weight by breed group was it tested for significant differences by applying analysis of variance (ANOVA) to a classification criterion.

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RESULTS AND DISCUSSION

Table II shows the significant differences (p≤0.001) in individual weights, logically there being different animal loads and number of animals between the two groups compared. In fact, Group P should have had one less adult animal to equalize the weights in both groups. This raises the need to also use total kilograms to adjust the stocking rate as a tool to evaluate the carrying capacity of the flock used for grazing.

Table II: Productive traits by group of sheep analyzed

Variables	Group BlackBelly (BB)	Group Pelibuey (P)	sig
Live weight in kg	30 ± 1.8	40 ± 2	***
Animal load in kg	541.10	605.40	
Number of animals	18	15	
*** (p≤0,001)			

Stocking rate per unit area can be expressed as animals per hectare or total kilograms per hectare. It is the management aspect that largely defines herd production and the ecological and productive stability of the pastures (Luisoni, 2010).

The average dry matter (DM) production ha-1 year evaluated was 13 844 kg DM offered (with 60% utilization, 8 306 kg DM) intermediate value between 6 212 kg DM per ha of *Arachis pintoi* and 17 585 kg DM per ha of *Brachiaria decumbens* (INIAP, 1997; Leonard, 2015).

Regarding efficiency indicators, 176.8 kg of sheep meat/ha/year was obtained in Group BB and 219.3 in Group P. This index would allow establishing horizontal comparisons between two or more producers and vertical comparisons between two or more exercises in the same field. The stocking efficiency was 27.4% for Group BB and 35.5% for Group P. This index indicates what efficiency is being worked with. Stocking efficiency varies depending on the animal being worked. At equal rates of weight gain, the animal with the lowest average weight will have a higher stocking efficiency.

An animal, according to its age and condition, needs a certain amount of grass to produce 1 kg of meat (Cibils & Fernández, 2002). According to the feeding tables, it is possible to find values of 7 to 9 kg of DM in high digestibility pasture—70% digestibility, 50% neutral detergent fiber and 15% crude protein (Di Marco, 2011) to produce 1 kg of meat, between 12 and 15 kg for medium digestibility pastures, and between 18 and 22 kg for poor digestibility pastures—50% digestibility, 65% neutral detergent fiber and 8% crude protein (Di Marco, 2011). These results are unprecedented in hair sheep systems for the Ecuadorian Amazon, since it is not common to use these indicators to evaluate the system in an integral way. The results obtained show concrete and encouraging results that can be adapted to Ecuadorian Amazonian production systems. The efficiency of production can be achieved in one hectare, which leads to an alternative to survey and scale up the system, making it sustainable and sustainable over time.

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CONCLUSION

It is concluded that the Sustainable Amazonian Sheep Module, evaluated through productive efficiency indicators, was shown to be a promising complementary system to be replicated within the Amazonian agricultural systems of Ecuador.

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REFERENCES

Alemán-Pérez R., Bravo-Medina C. & Chimborazo C. 2018. Propuesta de manejo agroecológico de los sistemas ganaderos en la región amazónica ecuatoriana. Cuadernos de Agroecología – Anais do VI CLAA, X CBA e V SEMDF – Vol. 13:1-5. En: https://bit.ly/3KXx6yK

Camargo O. 2012. La vaca lechera entre la eficiencia económica y la ineficiencia biológica. Arch Zootec 61: 13-29.

Cibils R. & Fernández E. 2002. Utilización de pasturas: ¿observador o gerente? Cartillas UEDY, Planagro, Uruguay. INIA La Estanzuela. En: http://www.produccion-animal.com.ar/produccion_y_manejo_pasturas/pastoreo%20sistemas/34-utilizacion_pasturas.pdf

Di Marco O. 2011. Estimación de calidad de los forrajes. Producir XXI, Bs. As., 20(240):24-30. www.produccion-animal.com.ar

Instituto Nacional Autónomo de Investigaciones Agropecuarias (INIAP). 1997. Manual de pastos tropicales para la Amazonia Ecuatoriana, Manual Nº 77, Guayaquil. En: http://repositorio.iniap.gob.ec/bitstream/41000/1622/1/Manual%20n%C2%BA%2011%20de%20pastos%20tropicales%20reducido%20ultimo.pdf

Leonard I. 2015. Recursos forrajeros autóctonos y promisorios para la ganadería en la provincia de Pastaza. Retos y posibilidades para una ganadería sostenible en la provincia de Pastaza de la Amazonía Ecuatoriana. Universidad Estatal Amazónica., chapter IV, pp. 46–69.

Luisoni H.L. 2010. Ajuste de carga animal: aspectos teóricos y recomendaciones prácticas. INTA EEA Reconquista. Centro Regional Santa Fe. En: https://inta.gob.ar/sites/default/files/script-tmp-ajuste_de_carga_animal_aspectos_tericos_y_recomendaci.pdf

MAG-SIPA. 2018. Ministerio de Agricultura y Ganadería. Sistema de Información Pública Agropecuaria. En: http://sipa.agricultura.gob.ec/index.php/cifras-agroproductivas (Consulta el 1 de marzo de 2020).

Article DOI: 10.52589/xxxxxx
DOI URL: https://doi.org/10.52589/xxxxxxxxx

Marini P.R. & Di Masso R. 2018. Evaluación histórica de indicadores productivos en vacas lecheras en sistemas a pastoreo. LA GRANJA: Revista de Ciencias de la Vida, 28(2):103-115. En: http://dx.doi.org/10.17163/lgr.n28.2018.08

Marini P.R. 2019. Módulo Ovino Amazónico Sustentable (MOAS). Jornadas Ovinas. El Universitario Amazónico. Edición 46: 4. Puyo – Pastaza- Universidad Estatal Amazónica. www.uea.edu.ec

Moyano J.C., Marini P.R. & Fischman M.L. 2019. Biological efficiency in hair sheep reared in a sustainable farming system in the ecuadorian amazon region. Dairy and Vet Sci J.; 11(4): 555820. En: https://doi.org/10.19080/JDVS.2019.11.555820

Nieto C. & Caicedo C. 2012. Análisis reflexivo sobre el desarrollo agropecuario sostenible en la Amazonía Ecuatoriana. INIAP-EECA. Publicación Miscelánea No 405, Joya de los Sachas, Ecuador. 102 p.

Rauw W.M., Kanis E., Noordhuizen-Stassen E.N. & Grommers F.J. 1998. Undesirable side effects of selection for high production efficiency in farm animals: a review. Livest Prod Sci, 56:15-33.

Sarandón S. 2002. El desarrollo y uso de indicadores para evaluar la sustentabilidad de los agroecosistemas. p. 393-414. En: Agroecología. El camino hacia una agricultura sustentable. Sarandón, S. (ed.). Ediciones Científicas Americanas, La Plata, Argentina.

Article DOI: 10.52589/xxxxxx
DOI URL: https://doi.org/10.52589/xxxxxxxxx