Journal of Animal Production, *29* (2), 14-24, 2017

Characterization of Mountainous Production Systems in Quimiag Parrish, Chimborazo province, Ecuador

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ABSTRACT

This study characterizes and typifies dairy areas in the Quimiag parish, Ecuador, using quantitative and qualitative information simultaneously, of production indicators, current technological development, management of dairy cows and the human resources employed. A total of 291 dairy areas were analyzed with three different techniques of multivariate statistical analysis: Principal Component Analysis (PCA), Multiple Correspondence Analysis (MCA), and Cluster Analysis (CA). Three production groups or systems were observed to have different efficiency responses. System number three was characterized by having more intensive production systems on average, along with a more advanced technological development than systems one and two.

Key words: *dairy systems, cattle, multiple correspondence analysis, cluster analysis*

INTRODUCTION

Magaña (2011) defined animal production systems as a set of plants and animals in a given soil or climate that are managed by man through proper techniques and tools to achieve certain productions. According to FAO (2007), animal production systems are constantly evolving. This dynamics stresses the need for alternatives to manage such systems for sustainable use of related genetic resources, today and in the future.

The promotion of agricultural activities requires true information about the sector; the opposite will but hinder public policies that can provide solutions to problems. This situation not only affects governments, but also research and training institutions of both professionals and farmers, since their demands, potentials and limitations in the sector are not clearly set (Requelme and Bonifaz, 2012).

Moreover, the heterogeneous geography of natural Ecuadoran regions offers several natural, climate and microclimate scenarios, which call for more diverse land use practices. This sector has complex and diverse characteristics whose study necessarily implies overcoming challenges (MAGAP, 2011).

To interpret such agricultural diversity, a set of multivariate statistical methodologies were applied. They will help create dairy farms according to a set of previously defined variables (Escofier and Pagés, 1992; Hair *et al*., 1992). These methodologies are mainly used as a starting point to implement other more specific techniques, designed as axes. For instance, econometric analysis or case studies (Smith *et al*., 2002). The aim of this study is to characterize and typify dairy systems in the mountains of parish Quimiag, province of Chimborazo, Ecuador.

MATERIALS AND METHODS

To get information on production, the farm owners and administrators were interviewed regarding the quantitative and qualitative nature of dairy farms in Quimiag communities.

The sample size was determined from reviewing lists of farmers provided by the Office of the Ecuadoran Agency of Quality Assurance (AGROCALIDAD, 2013). The population in the study included 1 082 dairy farmers from Quimiag. Out of them, 291 farmers were chosen and stratified depending on the population of each community. The number of farmers to be surveyed was determined according to the following formula:

$$n = \frac{N(p)(q)}{(N-1)D + pq}$$

Where:

n = number of samples

N = size of the population

p = occurrence probability

q = non-occurrence probability
D = β2/4.
β = estimation error limit (5 %)

SPSS 21 was used for statistical analysis. The quantitative variables were chosen, according to their discriminating capacity, with a variance coefficient ≥ 50 (Berdegué and Escobar, 1990; Paz *et al*., 2004), cited by Cabrera *et al*. (2004). They were,

- Total area[ha]: it refers to the total area of the farm measured in hectares;
- Animal unit [AU Farm-1]: number of animals on each farm, before changing the animal category to animal units (Arévalo, 2006);
- Animal stocking rate [AU ha-1]: animal units divided by the surface used for grasslands and forages;
- Production/cow [L cow-1 day-1]: daily milk production per cow;
- Production/cow [L cow-1 year-1]: production per cow population;
- Milk production per farm: (L ha-1 year-1)
- Production/grasslands [L ha-1 year-1]: milk production divided by the surface of grasslands used for enhanced and native pastures
- Production/labor [L man-1 year-1]: relation between production and the number of dairy workers employed annually;
- Enhanced pasture (%): percent of land filled with enhanced pastures;
- Natural pasture (%): percent of land filled with natural pastures.

The qualitative variables indicated the technological level, dairy cow management, and human resources (González, 2007), and included,

- Education: elementary (full or incomplete), high school (full or incomplete), higher education (full or incomplete).
- Family burden: 1-3 children, more than 3 children, no children
- Occupation: agricultural production, others
- Profitable activities: livestock, agriculture
- Breed: High-quality crossbreds (Holstein, Brown Swiss, Jersey), Criollo (Criollo locally developed from *Bos taurus*) and Crossbreds (mostly Holstein X Jersey, Brown Swiss X Jersey)
- Breeding type: natural mating, artificial insemination, natural-artificial insemination
- Grazing: electric wires and tether
- Milking type: hand, mechanical
- Records: manage, don´t manage
- Milk storage: plastic, aluminum, stainless steel, glass and cool tank
- Sanity: sanitary calendar, no sanitary calendar
- Institutional support: receive, don´t receive.

Characterization and typification of farms

The methodology suggested by Cabrera *et al*., (2004) was used to characterize and typify the different dairy productive systems; it has the following structure,

1. Description of the population to study.
2. Selection of samples and design of information collection tools.
3. Information processing (data base, classification and description of variables).
4. Variable reviewing and selection.
5. Application of multivariate statistical techniques.
6. Determination of subsystem types.
7. Description of types and groups.

Statistical analysis

The statistical analysis for characterization and typification of dairy farms comprised three multivariate statistical techniques: Principal Component Analysis (PCA), Multiple Correspondence Analysis (MCA), and Cluster analysis (CA) (Sraïri and Lyoubi, 2003).

The quantitative variables were analyzed through PCA, in which the auto value components higher than one were removed (Hair *et al*., 1992). The components taken were considered new variables and were used for cluster analysis; whereas the qualitative variables were analyzed through MCA. It was also used to take the components that accounted for more than 50% of data variability (Llopis, 2013). The components extracted were also considered new variables and were used in CA to set up groups of systems with similar features or typologies.

Hierarchic cluster analysis (Cabrera *et al*., 2004) was used to form clusters through the Ward method. Distance was measured by quadratic Euclidian metrics (Sepúlveda *et al*., 2014). The variables that made up the components generated by PCA and MCA were used as input variables for CA, and the coordinates of every dairy farm in the 6 components were used as summary of the characteristics of each individual to create the groups, and replace the original matrix (22 variables X 291 observations).

Each group made was represented by descriptive statistics, summarizing the information included in the sample. However, the qualitative information was represented as percent values.

RESULTS AND DISCUSSION

Identification of quantitative variables that determine system heterogeneity

PCA was used to create a new set of synthetic variables (components). Each component derived from linear combination of quantitative variables, considered active; where the first and second components accounted for the greatest percent of data variability.

The first component accounted for 38.11% of total variation of the systems chosen. The variables with the highest contribution were associated to agricultural production, coinciding with Guevara *et al*. (2005) in dairy systems, in the province of Camaguey, Cuba. This component is mostly associated to animal stocking rate variables, production/cow/ per day, per year, milk production per farm, production/grasslands, production labor force and enhanced pastures. In that sense, Cásares (2000) found that the variables with the best production behavior in dairy systems of Socopó, Venezuela, were productivity per stocking rate surface, and animal stocking rate.

Therefore, the first component discriminated between dairy farms, especially in terms of production intensification.

The second principal component accounted for 22.95% of total variation. The greatest contribution of the component was made by total area, animal unit and production/labor force. This component discriminated the size of areas in particular.

Regarding component 2, Vargas *et al*. (2011) indicated that the area surface and land slope can also be considered essential, especially in scenarios where the latter is a factor to be considered when deciding on land use.

The third significant component accounted for 15.28% of total variation. The component was made of variables like percent of enhanced pasture, and the percent of native pastures; the latter with a negative correlation. Therefore, this component discriminated the quality of forage. According to Basurto (2011), diet in intensive grazing systems is based on forage from grasslands, or enhanced grasslands. However, to meet higher milk demands, supplementation must be carried out, according to the animal needs; or else, balanced feed supplementation, based on the deficiencies of pasture.

Identification of quantitative variables that determine system heterogeneity

MCA included all the information from the frequency charts made with the different levels of each qualitative variable on every farm (the frequency summary per parish can be seen in Table 1.

The main focus was then placed on the first two analysis factors. They completed the multivariate description of the facts examined, though interrelations of variable modalities were also important. Overtime, MCA and PCA tended to summarize the great amount of gross data into an easily read graph (Escofier and Pagés, 1992).

Typification of milk production systems in Químiac

Cluster analysis generated three groups of productive systems, named PS1, PS2, and PS3. The average characteristics of qualitative variables for the three systems are shown in Table 2. The qualitative characteristics expressed in every modality percent for each variable in each productive system, are shown in Table 3. Additionally, size variables, like annual production (L) and number of cows (units) were included for the quantitative characteristics.

Production system (PS1)

The animal stocking rate had a mean of 1.96 AU ha-1. This variable has a significant role in grazing dairy systems. Accordingly, Roca and González (2014) claimed that keeping a proper animal stocking rate is the most critical point to achieve increased nutrient administration, by growing quality pastures and meeting most nutritional needs during animal lactation.

Martínez (2006) stressed that the application of lower stocking rates determined grass underutilization. On the contrary, if the stocking rate is high, grass consumption will be higher during times of plenty. However, feed availability will be reduced to cover the year´s requirements, which may be caused by overgrazing. This group´s average annual production is 3 738.40 L (mean 2 920 L), and only 25% of dairy farms have productions of 4 300 L year-1. The usual is that production stabilizes between 2 190 and 4 380 L year-1.

The number of cows averaged 2.12 units (range 1-8), and the average surface of farmlands was 2.58 ha. This was lower than 15 ha, on average, reported nationally for agricultural production units (UPA), and the average 6 ha found for UPA, in Chimborazo (INEC, 2010). This situation might be explained thanks to recent farm splitting, mainly caused by granting public lands and inheritance (Hidalgo *et al*., 2011).

The productive indexes per cow had mean values of 6.10 L cow-1 day-1 and 2 227.99 L cow-1 year-1, frequently observed in crossbreds.

The milk produced per grassland hectare was 2 967.48 L ha-1 year-1, on average (mean 2 555 L ha-1 year-1), the lowest of the three systems, probably because the farms had a lower animal stocking rate. Álvarez *et al*. (2006) stated that a lower animal stocking rate reduced pasture use efficiency and production per hectare. Pasture supply and animal stocking rate might be thought of as having critical effects on the productivity of the systems studied (López, 2013), which must be related to forage use with higher efficiency.

On average, 63.83% of grasslands are enhanced; 36.17% accounted for low-productivity, low yielding native grass (Lima, 2011). Production per labor force is about 1 884.17 L man-1 year-1.

The milking procedure was 100% manual. It was a limiting factor to have efficient dairies and accomplish high quality products (Quiroz, 2009).

The education standard of farmers was mostly elementary (90.63%); high school education was 9.38%; and institutional support was barely 17.97%. Accordingly, Smith *et al*. (2002), pointed out that poor education of farmers hindered the acquisition of technology to increase production and efficiency. In that sense, Avilés *et al*. (2010) remarked that individuals with higher education were more flexible in terms of embracing new technologies.

Many of those owners (89.06 %) relied on mixed production systems in their farmlands (crops and livestock). Apart from dairy animals, they grow potatoes, beans, corn, onions, fruit and greens; whereas only 10.94% are engaged in activities other than agriculture (construction and sales). Dairy production is only a side labor.

The management of cow breeding is mostly natural mating (93.75%), and all of them do not have a sanitary schedule. Production and breeding records are inexistent on most farms (96.88%). Genoud (2012), commented on the importance of preventive measures to ward off disease and other ailments, especially the application of a permanent annual sanitary program. Furthermore, in order to achieve better results, it is important to record the main dairy-related activities (Guevara *et al*., 2009).

Concerning milk storage, 98.44% of the farms use plastic containers, and 1.56%, stainless steel. Reimer *et al*. (2009) and Salas (2010), claimed that milk containers must be made of one-piece stainless steel, to ensure proper washing and disinfection.

Production system (SP2)

The average animal stocking rate was 2.35 AU ha-1. Considering that the natural resources were mostly the same for all the farms in the study, this indicator favored the farms in the group, though Senra (2004) highlighted the importance of animal stocking rate and constant farmer attention. It was very difficult to predict or calculate, because it depended on several factors, like soil, grass, animal, and climate. Therefore, no particular recommendations for implementation must be made on the stocking rate.

The increase of production based on genetic features, a more suitable diet, greater use of concentrated feeds and dehydrated forages (Díaz, 2010), averaged 10 185.44 L, annually. They were often found on farms with less than 6 205 L, and others reaching more than 12 700 L every year. The average number of cows was 4.67, though some farms only had 1 unit and others 6 animals. The surface of the dairy farms in the group averaged 3.76 ha.

The mean production per cow was 7.73 L cow day-1, above the national and provincial averages (5.38 and 5.52 L cow-1 day-1, respectively) (INEC, 2010). Besides, it was slightly lower than the results of the study made by Quiroz *et al*., 2011, who reported 7.1 L cow-1 day-1 in the parish. In this group, production relied mainly on crossbreds (81.06%) and high quality breeds (10.61%), like Jersey, Brown Swiss and Holstein.

The mean milk production per grassland was 4 455.40 L ha-1 year-1, higher than for PS1. This behavior was influenced by a greater stocking rate; in other words, these lands underwent more intensive use of enhanced forage species, with ensuing higher dairy yields per hectares, and better income.

The presence of enhanced species in the group was higher than for PS1, with 98.51%, whereas the native species barely accounted for 1.49%. Production per labor force is about 4 694.27 L man-1 year-1.

Regarding balanced feeds supply, Requelme and Bonifaz (2012) noted that amounts vary in the Ecuadoran range, from 0.7 to 2.0 kg/cow/day. This particular resource has repercussions on animal physiology and farm economy. On one hand, excessive consumption of balanced feeds causes a reduction of rumen pH, along with decreased capacity to use a wide range of feeds (Pérez Infante, 2010). On the other, the economic effects are given by the fact that every kg of DM consumed as concentrated feed meant that 0.5 kg of forage were replaced by the concentrated supplements, a more expensive source of nutrition.

Martínez (2004) claimed that grain consumption may be necessary to increase the animal stocking rate when pastures are insufficient, or to correct nutritional unbalances (usually lack of energy).

The use of grasslands to feed high and mid performance dairy cows, is the basis of low-cost feeding. Moreover, Mella (2008) stated that grasslands used as the only source of nutrition, do not suffice the nutritional requirements of cows; hence it is fundamental to use supplements throughout the year.

Production system (PS3)

The animal stocking rate is the highest in the area, with 4.05 AU ha-1, on average. A deeper analysis made by López (2013), concluded that when the stocking rate exceeded the capacity of the field, thus preventing any plant regrowth, the desired species were lost and replaced by other less palatable species with lower forage value. The mean annual production was above 91 000 L (54 750 on average), with dairy farms producing 9 125 L year-1, and others above 700 000 L yearly, with 25% of dairy farm areas over 102 200 L year-1. Note that although this group relied on a greater number of cow heads than for PS2 (26.90 cows on average), the average land surface per dairy was 28.94 ha.

The production per cow was the largest in the region, with mean values of 10.27 L cow-1 day-1 and 3 750 L cow-1 year-1. The results observed may be related to the use of balanced supplements by most farmers in the group, especially in milking animals.

McCarthy *et al*. (2007) considered that the productive response of cows to concentrated feeds varied, depending on the genetic potential of the animals. The North American Holstein-Friesian cows responded highly, between 0.9 and 1.15 kg of milk per concentrated feed kg.

This group was mostly composed of high-quality crossbreds, though there were also some regular crossbreds (35.48%), and no criollo breed was handled. Ballina *et al*. (2010) pointed out that when there are crossings between criollo cows and dairy bull breeds, the offspring often produced more milk than the mothers, who, in turn, passed disease resistance on to them as well. But crossings must be logically programed to prevent grading up the animals in the herd, as some blood percent must be kept to guarantee resistance and another percent to achieve high production.

A significant increase was observed by grassland, the greatest in the region (11 394.16 L ha-1 year-1), which is 155.73% higher than PS2. In that sense, Díaz (2010), highlighted that animal productivity and milk quality were directly influenced by nutrient consumption, which also depended on the nutritional value and the consumption of dry matter. Roca and González (2014) explained that ingestion was conditioned by the structure of pastures, understood as the proportion of leaves, stems and senescent material in the grass, which determines the grass quality and digestibility to produce milk based on grazing.

This production system was predominantly based on manual milking (61.29%), followed by mechanical milking (38.71%). Most owners had high school education (83.87%), and elementary education (16.13%).

The proprietor´s dedication in the group was greater to agricultural activities (87.10%); engagement in non-agricultural activities was greater than the other two systems. According to Lichtenberg *et al*. (2000) cited by Smith *et al.*

(2002), it occurred due to the high costs the employer had if workers had university education.

The institutional support increased with regards to PS1 and PS2, with 25.81%. Artificial insemination, and the combination of natural mating and artificial insemination were 25.81 and 35.84%, respectively, used as a method for upgrading, which produced the highest percents of the three groups. Sanitary schedules were followed in 35.48% of the farms, and records were implemented in 38.71% of farms. It is important to remark the use of aluminum containers to collect milk (41.94%); however, the cooling tank was used less frequency (3.23%).

CONCLUSIONS

The factors that most contributed to contrast areas and dairy farms in Químiag were related to intensification of production, size of dairy farms, quality of forages, and the production volume.

Three groups of dairy production systems were typified. The first system (PS1) had the lowest technology and production levels; whereas PS3 had the best yields by farm, grassland, stocking rate and technological development. The second system (PS2) was placed between the previous systems, in terms of production and managing procedures.

REFERENCES

AGENCIA ECUATORIANA DE ASEGURAMIENTO DE CALIDAD DEL AGRO (2013). *Programa de Vacunación Fiebre Aftosa* (segunda fase). Riobamba: AGROCALIDAD. Retrieved on May 26, 2014, from http://www.agrocalidad.gob.ec.

ÁLVAREZ, H.; DICHIO, L.; MARIELA, P.; CANGIANO, C.; JANKOVIC, V. y GALLI, J. (2006). *Lechería sustentable: ¿más litros por vaca o más litros por hectárea?* Universidad Nacional de Rosario, Facultad de Ciencias Agrarias. Rosario: Unidad Integrada INTA Balcarce-UNMdP. Retrieved on October 2, 2014, fromhttp://s3.amazonaws.com/academia.edu.documents/44126431/Lechera_sustentable__ms_litros_por_vaca_20160326-30368-cs0sw4.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1497888442&Signature=2IIhvw9FgwgbNuoWqobBEh8faEg%3D&response-content-disposition=inline%3B%20filename%3DLecheria_sustentable_mas_litros_por_vaca.pdf.

AVILÉS, J. P., ESCOBAR, P., VON FABECK, G., VILLAGRAN, K., GARCÍA, F., MATAMOROS, R. y GARCÍA MARTÍNEZ, A. (2010). *Caracterización productiva de explotaciones lecheras empleando metodología de análisis multivariado*. Maracaibo: Scielo. Retrieved on August 12, 2014, from http://www.scielo.org.ve/scielo.php?script=sci_arttext&pid=S0798-22592010000100011&lng=en&nrm=iso&ignore=html.

BALLINA B, A.; HURTADO, A. y MEJÍA, L. (2010). *Manejo Sanitario Eficiente del Ganado Bovino: Principales Enfermedades*. Nicaragua: Instituto Nicaragüense de Tecnología Agropecuaria (INTA), Programa Especial para la Seguridad Alimentaria. Retrieved on June 26, 2014, from http://www.pesacentroamerica.org/biblioteca/2011/cartilla_basica1.pdf.

BASURTO K, V. (2011). *Sistemas de producción de leche en pastoreo*. Retrieved on July 22, 2014, fromhttp://www.monografias.com/trabajos15/produccion-leche/produccion-leche.shtml.

BENÍTEZ, D.; PÉREZ, B.; RAMÍREZ, A.; BLANCO, A.; CAMEJO, N.; CASTELLANOS, E. Y VEGA, A. (2007). *El Manejo de la Finca Ganadera en la Montaña*. Bayamo: IIA Jorge Dimitrov, Alfa EuropeAid.

BETANCOURT, K.; IBRAHIM, M.; VILLANUEVA, C. y VARGAS, B. (2005). *Caracterización del manejo productivo de sistemas lecheros en la cuenca del río Bulbul de Matiguás, Matagalpa, Nicaragua*. Matagalpa. Retrieved on May 28, 2014, from http://lrrd.cipav.org.co/lrrd17/7/beta17080.htm.

CABRERA, D. V.; GARCÍA, M. A.; ACERO DE LA CRUZ, R.; CASTALDO, A.; PEREA, J. M. y MARTOS P. J. (2004). *Metodología para la caracterización y tipificación de sistemas ganaderos.* Metodología, Universidad de Córdoba, Departamento de Producción Animal, Córdoba. Retrieved on May 27, 2014, from http://www.uco.es/zootecniaygestion/img/pictorex/14_19_10_sistemas2.pdf.

CÁSARES, M. (2000). *Caracterización agroeconómica de los sistemas de producción de leche en Socopó, Venezuela*. Uruguay: ALPA 2000.

ESCOFIER, B. y PAGÉS, J. (1992). *Análisis factoriales simples y múltiples: objetivos, métodos e interpretación*. País Vasco, España: Servicio Editorial de la Universidad del país Vasco. Retrieved on June 4, 2014, from http://books.google.com.ec/books?id=ub07PQAACAAJ&dq=inauthor:%22Brigitte+Escofier%22&hl=es-419&sa=X&ei=o7SPU9HeMdCBqgbcuoAg&ved=0CCoQ6AEwAA.

GENOUD, J. (2012). *Importancia de un plan sanitario. Propiedades*. Retrieved on August 21, 2014, from http://www.lanacion.com.ar/1508527-importancia-de-un-plan-sanitario.

GONZÁLEZ, J. A. (2007). *Caracterización y Tipificación de Sistemas Productivos de Leche en la Décima Región de Chile: un Análisis Multivariable.* Tesis de Licenciatura, Universidad Austral de Chile, Ciencias Agrarias, Valdivia. Rtrieved on May 28, 2014, fromde http://cybertesis.uach.cl/tesis/uach/2007/fag643c/doc/fag643c.pdf.

GUEVARA, L.; CASTILLO, E. y ROA, N. (2009). *Uso de Registros y manejo de la información en la Ganadería Doble Propósito de Venezuela*. *Engormix.* Retrieved on June 26, 2014, from http://www.engormix.com/MA-ovinos/articulos/importancia-registro-datos-t1250/p0.htm.

GUEVARA, R.; GUEVARA, G.; PEDRAZA, R.; MORALES, A. y FERNÁNDEZ, N. (2005). *Ganadería, Sustentabilidad y Desarrollo Rural.* México: Univ. Chapingo.

HAIR, J.; ANDERSON, R. y TATHAM, R. (1992). *Multivariate Data Analysis with Readings.* New York, USA: Macmillan Publishing Company. Retrieved on June 4, 2014, from http://www.jstor.org/discover/10.2307/2348783?uid=2134&uid=2482288173&uid=2&uid=2482288163&uid=70&uid=3&uid=60&sid=21104259256403.

HIDALGO, F.; ALVARADO, M.; VANDECANDELAERE, A.; CHIPANTASI, L.; PÁSTOR, C. y QUISHPE, V. (2011). *Atlas: Tenencia de la Tierra en el Ecuador* (primera ed.). Quito, Pichincha, Ecuador: Miraflores. Retrieved on May 22, 2014, from http://es.scribd.com/doc/75466967/Atlas-Tenencia-de-la-tierra-en-Ecuador.

INEC (2010). Procesador de Estadísticas Agropecuarias. *Instituto Nacional de Estadística y Censos*. Retrieved on July 21, from http://www.ecuadorencifras.gob.ec/procesador-de-estadisticas-agropecuarias-3.

LIMA, D. (2011). *Alternativas para mejorar la productividad de los pastizales naturales en Entre Ríos*. Retrieved on August 11, 2014, from http://www.eldiario.com.ar/diario/suplemento/rural/25722-alternativas-para-mejorar-la-productividad-de-los-pastizales-naturales-en-entre-rios.htm.

LLOPIS, J. (2013). *La Estadística: Una Orquesta Hecha Instrumento*. Retreived on August 17, 2014, from http://estadisticaorquestainstrumento.wordpress.com/2013/07/06/tema-27-analisis-de-correspondencias.

LÓPEZ, O. (2013). *Manejo de Pasturas y Carga Animal.* Managua: UNA. Retreived on June 14, 2014, from http://es.slideshare.net/otonielalopez/manejo-de-pasturas-y-carga-animal-otto.

MAGAP (2011). *Censo nacional agropecuario.* Informe Técnico, Ministerio de Agricultura Ganadería Acuacultura y Pesca.

MARTÍNEZ, A. (2006). *Caracterización del sistema de producción en lecherías bufalinas de la provincia de Granma.* La Habana: Instituto de Ciencia Animal.

MARTÍNEZ, J. Á. (2004). *Sistemas de Producción Agropecuaria.* Universidad de Guadalajara. Departamento de Ciencias Biológicas, Tepatitlán de Morelos, Jalisco, México.

MCCARTHY, S.; HORAN, B.; DILLON, P.; CONNOR, P.; RATH, M. y SHALLOO, L. (2007). Economic Comparison of Divergent Strains of Holstein-Friesian Cows in Various Pasture-Based Production Systems. *Journal of Dairy Science 90* (3), 1493-1505.

MELLA, C. (2008). *Suplementación de Vacas Lecheras de Alta Producción a Pastoreo.* Universidad de Chile, Facultad de Ciencias Agronómicas, Santiago. Retrieved on June 12, 2014, from http://www.produccionpecuaria.uchile.cl/downloads/Circular/2006/capitulo_4.pdf.

FAO (2007). *La Situación de los Recursos Zoogenéticos Mundiales para la Alimentación y la Agricultura.* Roma: FAO, Comisión De Recursos Genéticos para la Alimentación y la Agricultura. Retrieved on June 23, 2014, from ftp://ftp.fao.org/docrep/fao/010/a1260s/a1260s05.pdf.

PÉREZ INFANTE, F. (2010). *Ganadería Eficiente.* ACPA.

QUIROZ, A. (2009). *La explotación bovina-la producción de leche.* Colombia: Colegio Hector Jaramillo Duque, Articulacion Media Técnica, Puerto Lleras. Retrieved on June 26, 2014, from http://www.slideshare.net/guest42d31c/pasos-para-el-ordeo-presentation.

QUIROZ, H. H.; CASTILLO, M.; ERAZO, N.; DONOSO, L.; LLANGA, M.; SAMANIEGO, C. y LARA, D. (2011). *Plan de desarrollo y ordenamiento territorial de la Parroquia Quimiag 2012-20121.* Riobamba: Gobierno Autónomo Descentralizado Parroquial Rural de Quimiag. Retrieved on May 22, 2014, from http://app.sni.gob.ec/sni-link/sni/%23recycle/PDyOTs%202014/0660821990001/PDyOT/27022013_092153_PDOT%20QUIMIAG%202010%20-%202021%20VERSION%201.27.pdf.

REIMER, K.; PENNER, P.; RUANO, A. y COWO, M. (2009). *Buenas prácticas en explotaciones lecheras para Centro América, Panamá y Bélice.* San Salvador: Organismo Internacional Regional de Sanidad Agropecuaria. Retrieved on June 26, 2014, from http://www.oirsa.org/aplicaciones/subidoarchivos/

BibliotecaVirtual/MANUALEXPLOTACIONESLECHERAS.pdf.

REQUELME, N. y BONIFAZ, N. (2012). *Caracterización de sistemas de producción lechera de Ecuador.* Universidad Politécnica Salesiana, Centro de Investigación de la Leche CILEC. Cayambe. Retrieved on July 5, 2014, from http://lagranja.ups.edu.ec/documents/1317427/2484864/Art5.pdf.

ROCA, A. I. y GONZÁLEZ, A. (2014). *Ingestión de hierba y producción de leche en pastoreo. Artículos Nutrición*. Retrieved on August 30, 2014, fromhttp://albeitar.portalveterinaria.com/noticia/13372/Articulos-nutricion/Ingestion-de-hierba-y-produccion-de-leche-en-pastoreo.html.

ROCA, A. I.; GONZÁLEZ, A. y LÓPEZ, M. E. (2014). *Los recursos forrajeros en las explotaciones de vacuno de leche.* Galicia: CIAM. Retrieved on September 2, 2014, from http://albeitar.portalveterinaria.com/noticia/11757/Articulos-rumiantes-archivo/Los-recursos-forrajeros-en-las-explotaciones-de-vacuno-de-leche.html.

SALAS, Á. (2010). *Procesamiento de Lacteos*. Retrieved on Spetember 15, 2014, from http://es.slideshare.net/Marjochaves/higiene-y-manejo-de-la-leche.

SENRA, A. (2004). *Aspectos fundamentales para el manejo eficiente de los pastizales.* Doctorado grupal "Producción Animal en el Trópico", Instituto de Ciencia Animal, La Habana, Cuba.

Received: 1-12-2017
Accepted: 1-20-2017

SEPÚLVEDA, G. J.; MENESES, A. L., y GOLDENBERG, P. (2014). *Validez de Contenido: Cuestionario de Vulnerabilidad al Papillomavirus Humano.* Bogotá. Retreived on July 21, 2014, from http://revistas.um.es/eglobal/article/view/eglobal.13.3.182341.

SMITH, R.; MOREIRA, V. y LATRILLE, L. (2002). *Caracterización de sistemas productivos lecheros en la x región de Chile mediante análisis multivariable.* Universidad Austral de Chile, Ciencias Agrarias, Valdivia. Retrieved on May 28, 2014, from http://www.scielo.cl/scielo.php?pid=S0365-28072002000300004&script=sci_arttext.

SPSS (2014). *Versión 21.0. para Windows. SPSS (c) inc., 1989-2014.*

SRAÏRI, M. T. y LYOUBI, M. T. (2003). Typology of dairy farming systems in Rabat Suburban region. *Archivos de zootecnia, 52*, 47-58.

VARGAS, J. D.; BENÍTEZ, D.; TORRES, V.; VELÁZQUEZ, F. Y ERAZO, O. (2011). Tipificación de las fincas ganaderas en el piedemonte de las provincias. *Revista Cubana de Ciencia Agrícola, 38.* Retrieved on July 29, 2014, from http://www.ciencia-animal.org/revista-cubana-de-ciencia-agricola/articulos/T45-N4-A2011-P381-J-Vargas.pdf.

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Table 1. Average quantitative characteristics of dairy production systems in the parish of Químiag

Quantitative variable	Production system			X ± ES
	PS_1 (n= 128)	PS_2 (n= 132)	PS_3 (n= 31)	
Anual production [L $year^{-1}$]	3 738.4±3 151.77	10 185.4 ±5 714.6	91 921.1 ±129 931.8	16 056.8 ±49 633.1
Cows [units]	2.12 ±1.30	4.67 ±2.81	26.90 ±31.54	5.91 ±12.70
Total area (ha)	2.58 ±2.55	3.76 ±2.68	28.94 ±55.15	5.92 ±19.61
Animal unit [AU $farm^{-1}$]	3.52 ±2.23	7.10 ±3.96	40.58 ±42.45	9.09 ±17.81
Animal stocking rate [AU ha^{-1}]	1.96 ±1.40	2.35 ±1.52	4.05 ±2.79	2.36 ±1.76
Production/cow[L cow^{-1} day^{-1}]	6.10 ±1.99	7.73 ±2.87	10.27 ±2.53	7.28 ±2.79
Production/cow [L cow^{-1} $year^{-1}$].	2 227.9 ±727.50	2 819.8 ±1 047.17	3 750.09 ±922.47	2 658.60 ±1 017.93
Milk production per farm [L ha^{-1} $year^{-1}$]	1 984.9 ±1 383.49	3 389.38 ±1 885.85	9 353.52 ±6 338.08	3 406.97 ±3 357.54
Production/grasslands [L ha^{-1} $year^{-1}$].	2 967.4 ±2 120.59	4 455.40 ±2 579.25	11 394.16 ±9 265.79	4 540.10 ±4 469.08
Production/labor force [L man^{-1} $year^{-1}$].	1 884.1 ±1 385.9	4 694.2 ±4 042.41	47 259.65 ±39 450.82	7 992.67 ±18 853.9
Enhanced pastures(%).	36.17 ±20.37	98.51 ±7.57	85.16 ±32.03	69.67 ±34.83
Native pastures (%)	63.83 ±20.37	1.49 ±7.57	14.84 ±32.03	30.33 ±34.83

Table 2. Qualitative characteristics of dairy production system types in the parish of Químiag

Qualitative variable	Production system			PSTOTAL %
	PS1 %	PS2 %	PS3 %	
Education				
Elementary	90.63	78.79	16.13	77.30
High school	9.38	21.21	83.87	22.70
Family burden				
0 Children	10.94	14.39	19.35	13.40
1-3 Children	45.31	56.82	77.42	54.00
More than 3 children	43.75	28.79	3.23	32.60
Occupation				
Agricultural activity	89.06	95.45	87.10	91.80
Other activities	10.94	4.55	12.90	8.20
Most profitable activity				
Cattle income	47.66	94.70	96.77	74.20
Income from agriculture	52.34	5.30	3.23	25.80
Breed				
High quality crossbreds	2.34	10.61	64.52	12.70
Criollo	22.66	8.33		13.70
Crossbred	75.00	81.06	35.48	73.50
Breeding type				
Natural mating	93.75	81.82	38.71	82.50
Artificial insemination	1.56	3.03	25.81	4.80
MN-IA	4.69	15.15	35.48	12.70
Grazing				
Electric fence		1.52	61.29	7.20
Tether grazing	100.00	98.48	38.71	92.80
Milking type				
Manual milking	100.00	99.24	61.29	95.50
Mechanical milking		0.76	38.71	4.50
Records				
Record use	3.13	4.55	38.71	7.60
No records use	96.88	95.45	61.29	92.40
Storage				
Plastic	98.44	93.94	25.81	88.70
Aluminum			41.94	4.50
Stainless steel	1.56	6.06	29.03	6.50
Cooling tank			3.23	0.30
Sanitary schedule				
Yes		0.76	35.48	4.10
No	100.00	99.24	64.52	95.90
Institutional support				
Yes	17.97	16.67	25.81	18.20
No	82.03	83.33	74.19	81.80