



Characterization of beef cattle farming and the perspective for implementation of traceability

Diego Helcias Cavalcante¹, José Elivalto Guimarães Campelo¹, Natanael Pereira da Silva Santos², Raimundo Ribeiro Ferreira³, Wéverton José Lima Fonseca^{4*} and Amauri Felipe Evangelista⁵

¹Universidade Federal do Piauí, Teresina, Piauí, Brazil. ²Universidade Federal do Piauí, Bom Jesus, Piauí, Brazil. ³Universidade Federal da Paraíba, Areia, Paraíba, Brazil. ⁴Universidade Estadual do Sudoeste da Bahia, Itapetinga, Bahia, Brazil. ⁵Universidade Federal do Paraná, Curitiba, Paraná, Brazil. *Author for correspondence. E-mail: wevertonrbz@gmail.com

ABSTRACT. The objective of this study was to characterize the beef cattle farming profile in the State of Piauí for inference about the zootechnical record of animals for insertion into a traceability system. Data were collected through a semi-structured multiple choice questionnaire applied to 400 cattle breeders in all microregions of the state, in May and November 2012. The questions contained the following indicators: profile of the property and the breeder, herd conditions and technical conditions on herd registration. The cattle-raising scenario is predominantly characterized by family activity, with the majority of producers over 50 years of age, who are without great prospects for technological innovation, inserted in an environment where human resource renewal faces difficulties. Data analysis verified the prevalence of herds with up to 50 cattle farmed on properties with up to 50 ha, without individual identification of the animals. These results, coupled with the fact that the cattle breeders are technically unaware of the importance of the zootechnical record and the traceability, indicate the low probability of the activity to be inserted in a computerized environment.

Keywords: animal identification, family farming, cattle.

Da bovinocultura de corte e a perspectiva para implantação da rastreabilidade

RESUMO. Objetivou-se caracterizar o perfil da pecuária de corte no Estado do Piauí para inferência acerca do registro zootécnico dos animais para inserção em sistema de rastreabilidade. Os dados foram coletados por meio da aplicação de questionário semiestruturado de múltipla escolha a 400 pecuaristas em todas as microrregiões do estado, nos meses de maio e novembro de 2012. As perguntas continham os seguintes direcionadores: perfil da propriedade e dos produtores, condições zootécnicas dos rebanhos e condições técnicas no tocante ao registro zootécnico. O cenário da pecuária bovina é caracterizado predominantemente pela atividade familiar, com a maioria dos produtores apresentando idade superior a 50 anos, que se encontram sem grandes perspectivas de inovação tecnológica, inseridos num ambiente onde a renovação de recursos humanos enfrenta dificuldades. A análise dos dados constatou a prevalência de rebanhos com até 50 bovinos explorados em propriedades com até 50 ha, sem identificação individual dos animais. Esses resultados, aliados ao fato do pecuarista desconhecer tecnicamente a importância do registro zootécnico e da rastreabilidade, indicam a baixa capacidade da atividade ser inserida em um ambiente informatizado.

Palavras-chave: identificação animal, pecuária familiar, bovinos.

Introduction

The socioeconomic and institutional environment of Brazil requires that the rural sector adapt to the changes that are taking place in the world, pressing the producer to assume business attitudes. As a result, adaptations in rural properties have been taking place, with management rules changing to meet demanding markets, as with beef cattle in terms of sanity and traceability (Machado & Nantes, 2008).

Traceability in beef production chain has already been a reality in the last decade in Brazil, but is practiced only by the slaughterhouses that export meat. However, this same food safety practice must be made available to the Brazilian consumer, despite the difficulties in implementing a single national system (Lopes et al., 2012). In the case of family livestock production, a difficulty to be faced is the fact that individual identification of the animals may imply high cost, depending on the method to be used (Lopes, Ferrazza, Bruhn, & Demeu, 2013).

The public power of each state, through the Agriculture and Livestock Defense Agencies, charges the producers for the registration of the number of animals on the properties, but without the identification of the animal. This identification without individual characterization of the animal greatly limits the quality of the generated database, which is generally restricted to quantitative aspects of the herd.

Knowledge of the profile and difficulties faced by the small cattle farmers to trace their products can contribute to the definition of strategies capable of remedying such limitations, which should contemplate the inclusion into an environment with computer technology, since it comprises a segment of socioeconomic importance in each region, which presents peculiarities, but should not be excluded from this process or treated as an obstacle to the implementation of efficient programs of sanitary and zootechnical traceability in the country. According to Miguel et al. (2007), the adequate characterization of beef cattle production is necessary for any intervention action, both at the level of the farmers and at the level of the establishment of policies for the sector. It should be emphasized that the conditions for the different production systems can be cultural, ecological (determinants of the physical environment and climate), or even conjunctural (prices and markets).

Diverse studies were conducted on the characterization of cattle breeding in Brazil (Miguel et al., 2007; Moura et al., 2010; Silva et al., 2010), however, without a standardization in the methodology of characterization of the productive systems, where the characteristics analyzed may be broader or narrower, depending on the purpose of the research.

Therefore, the goal of this study was to characterize the profile of the cattle rancher and cattle production in the State of Piauí regarding the use of zootechnical records as a means to implement traceability.

Material and methods

We used information from 430 questionnaires applied to cattle breeders during the certification periods of vaccination against foot-and-mouth disease in the State of Piauí.

The questionnaires were randomly applied to breeders who attended the Animal and Plant Health Units (USAV) during the certification of vaccination against foot-and-mouth disease, carried out in two stages (May and November) in 2012.

The site was chosen because it is an institution that shows capillarity throughout the state and is the main point of convergence of cattle farmers in the period.

The mesoregions of the state and the frequency of properties sampled were: North (42), Center-North (179), Southeast (80) and Southwest (129), as shown in Figure 1.

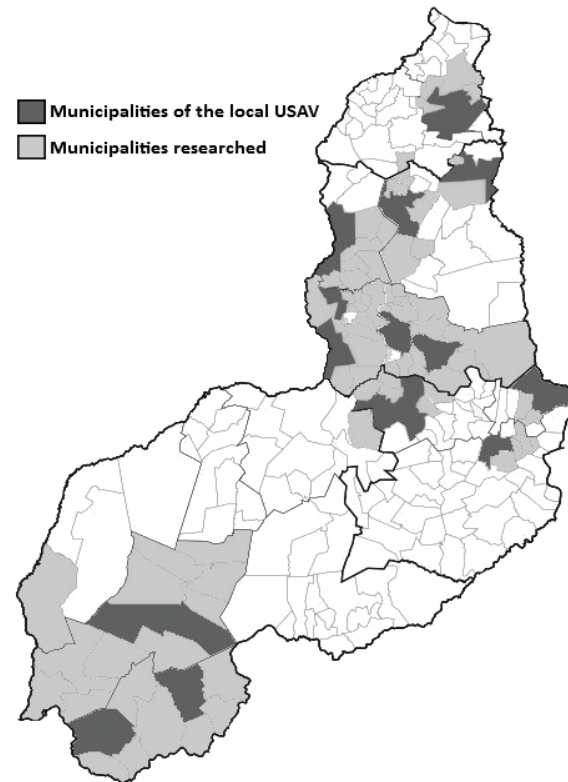


Figure 1. Location of the Animal and Plant Health Units - USAV in the State of Piauí and the municipalities where the questionnaires were applied to cattle breeders, in the northeast of Brazil.

The questionnaire was semi-structured divided into four sections (information of the cattle breeder, production system, technological knowledge and opinion on traceability), for analysis with descriptive statistics.

The sample size required for the study was calculated according to the formula of Barbetta (2008):

$$n_n = \frac{1}{E\alpha^2} n = \frac{N * n_0}{N + n_0}$$

where,

n_0 = An approximation of the sample size.

N = Number of rural properties in Piauí.

n = Number of elements in the sample.

E_0 = Tolerable sampling error.

The number of rural properties in the state was 64,067, according to information taken from the database of the Agriculture and Livestock Defense Agency of the State of Piauí - ADAPI (2013). Considering that the size of the sample with a statistical error of 5% is approximately 398 questionnaires, it is considered that the quantity used (430) was statistically adequate.

Additional information provided by ADAPI regarding the cattle herd of Piauí, corresponding to the period from 2009 to 2012, was also used.

The information collected was tabulated in electronic spreadsheets and analyzed with descriptive statistics, using cross-frequency analysis, with data stratified by mesoregion: North, Center-North, Southeast and Southwest. The Chi-square test was applied using the statistical software SPSS 17.0, to verify the significance of the effects of the factors tested at 5% probability.

Results and discussion

Table 1 presents the relationship between the number of animals and the area of the property (ha) where they are farmed. The values obtained show the prevalence of small farms involved in cattle breeding, since 54.2% reported having up to 50 animals reared on farms with up to 50 ha, which differed significantly from the other combinations tested ($p < 0.05$). Studying the activity of beef verified farming in southern Piauí, Bezerra et al. (2013) found similar results, since they found that 66.3% of the interviewed ranchers carried out the activity in small properties of up to 50 ha and only 11.5% in properties above 200 ha.

This percentage increases to 73.4% if considered properties with up to 100 ha. Therefore, there is a direct relationship between the area of the property

and the number of animals of the herd, but with the prevalence of the exploitation of few animals in small areas.

According to Table 2, the beef cattle herd of Piauí presented continuous growth in the period, with a higher prevalence of female animals, mainly older than 12 months, probably because the females are kept for breeding and the young males unfit for breeding are discarded from the herd, for sale or slaughter.

In relation to the usefulness or quality of this information (Table 2) for sanitary tracing, it has a relatively limited potential for not containing individualized information of animals for tracing, as required by the European Community and regulated by the Ministry of Agriculture in establishing the Traceability of the Productive Chain of Cattle and Buffaloes - SISBOV, according to Lopes et al. (2012).

For the more detailed characterization of the sampled rural environment, in order to make it useful to infer about the difficulties for the implementation of traceability in family agriculture and livestock activities, Table 3 presents information related to the socioeconomic profile of cattle farming in the State of Piauí, stratified by mesoregions.

Regarding the age of the cattle breeder, it can be observed that cattle breeding does not show signs of renewal with the inclusion of young people, since the number of breeders interviewed who reported being over 50 years old corresponds to 57.9% of the total, with significant difference between mesoregions ($p < 0.05$), with emphasis on the north of the State, which presented a value of 78.6%, while in the southeast mesoregion, the problem is less severe, where 40.0% is between 31 and 50 years (Table 3).

Table 1. Percentage of properties estimated by the cross-frequency of the number of cattle in relation to the area of the property.

Number of animals in the property	Size of the property (ha)				Total (%)
	Up to 50	Between 50 and 100	Between 100 and 200	Over 200	
Up to 50	54.2a	19.2b	15.5b	11.1b	100
Between 50 and 100	10.9c	27.3b	23.6b	38.2a	100
Between 100 and 200	6.9c	20.7b	17.2b	55.2a	100
Over 200	0.0c	13.0b	8.7bc	78.3a	100

Means in a row followed by different letters are different $p < 0.05$.

Table 2. Effective cattle herd, stratified by sex and age group, extracted from the database of the State Health Agency of the State of Piauí - ADAPI, in the period from 2009 to 2012.

Vaccination step	0 to 12 months		13 to 24 months		25 to 36 months		> 36 months		Total
	F	M	F	M	F	M	F	M	
May 09	134.968	133.023	172.086	139.917	231.448	106.975	615.947	110.819	1.645.183
Nov 09	139.058	140.207	164.484	138.108	227.585	111.755	634.546	116.479	1.672.222
May 10	135.795	138.999	161.869	135.512	229.522	112.031	654.039	126.322	1.694.089
Nov 10	139.385	143.963	160.536	136.242	219.359	109.843	667.296	132.296	1.708.920
May 11	138.108	144.019	158.995	138.238	209.629	111.359	685.876	144.591	1.730.815
Nov 11	141.924	148.081	165.216	141.849	205.343	110.002	696.686	148.254	1.757.355
May 12	143.531	145.738	167.705	139.075	208.835	108.795	708.836	155.458	1.777.973

Source: Data provided by ADAPI (2013).

Table 3. Information related to the socioeconomic profile of cattle farming (in %), stratified by mesoregion in the State of Piauí.

Parameter	Parameter detail	Mesoregion of the State				Total (%)
		North (%)	Center (%)	Southeast (%)	Southwest (%)	
Owner's age (years)	Up to 30 years	2.4c	4.5 c	8.7 c	6.2 c	5.6 c
	From 31 to 50	19.0b	37.4 b	40.0 b	38.8 b	36.5 b
	Over 50 years	78.6a	58.1 a	51.3 a	55.0 a	57.9 a
Property size (ha)	Up to 50 ha	35.7a	41.4 a	62.5 a	34.1 a	42.6 a
	From 51 to 100	21.4 b	18.4 b	20.0 b	21.7b	20.0 b
	From 101 to 200	21.5 b	17.9 b	15.0 b	13.2 c	16.2 b
	Over 200	21.4 b	22.3 b	2.50c	31.0a	21.2 b
Fenced area in the property	100% fenced	64.3a	72.6a	52.0a	54.3 ^a	62.3 a
	More than 50%	9.5b	15.1b	20.0b	27.1b	19.1 b
	Less than 50%	21.4b	11.7b	26.0b	18.6b	17.7 b
Infrastructure available in the property	Not fenced	4.8b	0.6b	2.0b	0.0	0.9 c
	Electricity	95.2	74.3	76.3	82.9	79.3
	Cell phone signal	64.3	55.9	65.0	69.0	62.3
	Tv	90.5	55.3	52.3	62.8	60.5
Exploited crops	Piped water	50.0	65.4	38.8	38.8	50.9
	Grains	73.8	52.5	57.5	66.7	59.8
	Pasture	90.5	62.0	61.3	59.7	64.0

Means in a row followed by different letters are different $p < 0.05$.

As the observed percentage of breeders with up to 30 years did not exceed 8.7%, it is a strong indication that there is no tendency to renew human resources in this rural activity, with the prospect of becoming worse in the north of the State. In the southern portion, the situation tends to be less serious; it is possible that soybean agribusiness is influencing this behavior, because according to Macedo (2006), there was an intense change in the distribution of the national herd, mainly due to the expansion of this crop.

In relation to the size of the property and the system of exploitation of the animals, 42.6% of the interviewees reported ownership of an area of up to 50 ha, and 62.3% said they managed the animals in 100% fenced area. The farming conducted in small areas and totally fenced is favorable to the use of zootechnical control by the breeder for greater ease of production management. Nevertheless, it should be considered that 17.7% reported having less than 50% fenced area, and this limits the control of mating and, consequently, the zootechnical record, which is the basis of every traceability system (Lirani, 2008).

When considering the available infrastructure in the property, it is observed that 79.3% reported having electricity in the property and 50.9% have a water source. As for access to media or information, only 62.3% and 60.5% reported having access to mobile phone and television signal, respectively. Thus, this situation shows an initial dimension of the difficulties to be faced, since the low access to information makes it difficult to change from the traditional mode of production to a system of better management of the inputs with greater connectivity among the actors of the productive chain. That is, access to information allows the more conscious use of available resources when compared to productive activity conducted by the family tradition.

Another factor that is limited in the traditional production system is food security, which should be a priority, and untracked products will tend to lose market space (Lopes, Santos, & Amado, 2008). In addition, according to Rigueira, Lopes, Bruhn, Rodrigues and Faria (2014), who evaluated attributes that influence decision making for the purchase of beef, reported the consumer willingness to pay more for meat with certification of origin.

In Brazil, among the four methods used to identify the animals, the most commonly used by cattle breeders, according to Lopes et al. (2012) were: the earring and button (90%); earring and branding (6%); earring and tattooing (3%); earring and electronic device - ear implant (1%), and 78% of breeders considered these identification devices efficient and the use of two at the same time guarantees more safety in case of loss of an identifier.

It is confirmed that more than half of the interviewees do not have the practice of recording data on health or zootechnical control in the herd in each mesoregion (Table 4), with the exception of breeders in the southwest of the state, which is worrisome, since the zootechnical record is the basis for animal tracing, a legal requirement of the Ministry of Agriculture that is difficult to be met throughout the country (Barcellos, Abicht, Brandão, Canozzi, & Collares, 2012).

As for the information storage, only in the southeast mesoregion there is reference that 2.50% use the computational resource and this is closely related to the way of identification of the animals. However, the quality of a traceability system does not depend on the type of identification device employed (Lirani, 2008), provided that it is done frequently and systematically, but the lack of computer resources to catalog and generate data as a whole, compromises the effectiveness of the system (Machado & Nantes, 2008).

Table 4. Information related to the use of zootechnical record in the beef cattle herd, stratified by mesoregion in the State of Piauí.

Question asked	Question detail	Mesoregion of the State*				Total (%)
		North (%)	Center (%)	North (%)	Center (%)	
How do you identify the animals on the property?	Branding iron	85.7a	67.0a	82.5a	98.4a	81.2a
	Earring or similar	14.3b	8.4c	8.8b	0.0b	6.50b
What kind of mark do you use in the herd?	Both	0.0c	19.6b	5.0b	0.8b	12.3b
	Owner identifier	92.9a	75.4a	93.8a	86.8a	84.0a
	Number of the animal	7.1b	24.6b	6.2b	13.2b	16.0b
How do you record information about the herd?	On occurrence records	21.4b	35.2b	21.3b	55.0a	37.2b
	Computer	0.00c	0.00c	2.50c	0.00c	0.50c
	Do not record	78.60a	64.80a	76.20a	45.00b	62.30a

Means in a row followed by different letters are different $p < 0.05$.

It is observed that there is no awareness of the cattle breeder to use the marking of animals for the purpose of traceability, even considering that they mark each animal, which is the basis of any zootechnical traceability system (Bass, Pendel, & Morris, 2008), since there is no individual identification of the animal by sequenced numbers, year of birth, or other marking method that aims to make the specific record tending towards a single marking. It is also important to take into account the fact that the identification of the animal prevails with the use of hot branding, which is allowed in Brazil (Lopes et al., 2012), but the use of identification only of the owner prevails regardless of the mesoregion, which is a standard of traditional livestock farming in the Northeast Brazil.

The identification process can be improved if the compulsory certification of vaccination of the herd against foot-and-mouth disease, for example, is linked to the imposition of registering the individual information of the animal, provided that it is inserted in a process capable of being computerized, without entailing costs to the breeder or his direct contact with the computer or softwares, so that the motivation of use breaks the view that the individual identification of the animals in the herd is only one more obstacle.

Considering the possibilities of inclusion of Information Technology in a scenario like this, Machado and Nantes (2008) called attention to the great contribution of informatics as a tool to support the implementation of traceability, since the use of the computer has advantages such as generating data reliability, speed of information and ease of communication, inside and out of the property. In this respect, the use of the Internet to advise livestock activities is among the main services possible, and in relation to the use of softwares in the Brazilian agriculture and livestock production, it is higher in animal production than in plant production (Cócaro, Lopes, & Campos, 2005).

The main difficulties presented by breeders in the use of zootechnical records in herds are: not knowing their meaning (43.5%), which indicates culturally that the custom of systematically recording animal information is not part of the daily life; the lack of a standard model of zootechnical record (23.5%) and not

being able to read/write (12.3%) (Table 5). Thus, there is a need to adopt public policies that aim at training in the rural environment so that it can value actions such as this, so that the breeders see the usefulness of this practice. Nonetheless, in relation to informing how much he has, Lirani (2008) calls attention to some resistance on the part of the cattle rancher.

Table 5. Difficulties for the accomplishment of zootechnical record in the beef cattle herd, stratified by mesoregion in the State of Piauí.

Difficulties in conducting a zootechnical record	Mesoregion*				
	North (%)	Center (%)	Southeast (%)	Southwest (%)	Mean (%)
Can not read / write	28.6b	6.7d	26.3b	6.2d	12.3c
Lack of a standard model	23.8c	29.1b	18.8c	18.6c	23.5b
Do not know zootechnical record	45.2a	48.0a	51.3a	31.8b	43.5a
Do not see difficulty	2.4d	16.2c	3.6d	43.4a	20.7b

Means in a row followed by different letters are different $p < 0.05$.

The lack of knowledge of what is a zootechnical record, the small number of animals in the herd and the old age of the rural owners, stand out as factors that contribute to the non-use of a systematic process of identification of the animals in the farm, perpetuating the misinformation about the quality of the cattle production in the activity carried out with a family activity profile. This is why the traceability will depend on the availability of protocol or specific product capable of overcoming these difficulties, which can be linked to the obligation of individual registration of the animal.

In order to infer the theme for this scenario, it should be considered that the implementation of a traceability system in Brazil has undergone changes, making it difficult for it to become effective in agribusiness, yet many cattle breeders consider it important and believe in its future (Lopes et al., 2012), mainly because Brazil competes with Australia in the export of meat, and this country stands out as one of the most advanced in traceability, with production systems based on individual animal identification (Cavalcante, Pinheiro, & Ribeiro, 2015).

Out of the difficulties mentioned by the cattle breeders who have already joined the SISBOV, the following should be highlighted: the inadequate

remuneration of traced animals (68%); followed by the high cost of certification (49%); bureaucracy in the purchase and sale of animals (45%); deficiency in manpower for records in the field book (45%), which shows the importance of investing in the qualification of the rural man (Lopes et al., 2012). Thus, if this occurred in the meat industry, the prospects are not encouraging, and may imply that cattle farming as family activity is seen as a segment of animal production to be discriminated against because it does not meet the requirements of the meat market, in terms of product traceability.

Conclusion

Cattle farming in the State of Piauí represent an activity practiced with a family structure, with few animals in small areas, without systematic process for individual identification of animals, without great prospects of human resource renewal in the activity, consequently, with low potential for insertion of the activity into an environment with computer technology or in a zootechnical traceability system.

The lack of knowledge about the importance and about how to use zootechnical records in the herd, among other factors, are obstacles that impede the implementation of zootechnical traceability in beef cattle farming with, practiced with a family activity profile.

Acknowledgements

To the Agriculture and Livestock Defense Agency of Piauí - ADAPI for the partnership in this research. To CAPES for the scholarship.

References

- Agência de Defesa Agropecuária Do Piauí [ADAP]. (2013). *Efetivo bovino do Piauí por etapa de vacinação contra Febre Afiosa*. Recuperado em 20 de janeiro de 2013 de www.adapi.pi.gov.br/
- Barbetta, P.A. (2008) *Estatística aplicada às ciências sociais*. (7a ed.). Florianópolis, SC: UFSC.
- Barcellos, J. O., Abicht, A. M., Brandão, F. S., Canozzi, M. E. A., & Collares, F. C. (2012). Consumer perception of Brazilian traced beef. *Revista Brasileira de Zootecnia*, 41(3), 771-774.
- Bass, P. D., Pendel, D. L., & Morris, D. L. (2008). Sheep traceability systems in selected countries outside of North America. *The Professional Animal Scientist*, 24(4), 302-307.
- Bezerra, L. R., Araújo, M. J., Marques, C. A. T., Costa Torreão, J. N., Vaz, R. R., & Oliveira Neto, C. B. (2013). Caracterização de propriedades agrícolas para pecuária de corte. *Comunicata Scientiae*, 4(1), 75-84.
- Cavalcante, D. H., Pinheiro, R. E. E., & Ribeiro, M. N. (2015). A rastreabilidade animal na pecuária bovina. *Nutritime Revista Eletrônica*, 12(5), 4333-4341.
- Cócaro, H., Lopes, M. A., & Campos, F. C. A. (2005). Qualidade de software agropecuário: um estudo de caso. *Ciência e Agrotecnologia*, 29(5), 1075-1082.
- Lirani, A. C. (2008). Rastreabilidade na cadeia produtiva das carnes caprinas e ovinas. *Tecnologia & Ciência Agropecuária*, 2(3), 71-79.
- Lopes, M. A., Demeu, A. A., Ribeiro, A. D. B., Rocha, I. C. M. B. M., Bruhn, F. R. P., & Retes, P. L. (2012). Dificuldades encontradas pelos pecuaristas na implantação da rastreabilidade bovina. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, 64(6), 1621-1628.
- Lopes, M. A., Ferrazza, R. A., Bruhn, F. R. P., & Demeu, A. A. (2013). Dificuldades encontradas pelos técnicos de defesa sanitária animal na implantação da rastreabilidade na cadeia produtiva de bovinos de corte no Brasil. *Arquivos do Instituto Biológico*, 80(2), 135-144.
- Lopes, M. A., Santos, G., & Amado, G. B. (2008). Viabilidade econômica da adoção e implantação da rastreabilidade em sistemas de produção de bovinos no Estado de Minas Gerais. *Ciência e Agrotecnologia*, 32(1), 288-294.
- Macedo, L. O. B. (2006). Modernização da pecuária de corte bovina no Brasil e a importância do crédito rural. *Informações Econômicas*, 36(7), 83-95.
- Machado, J. G. C. F., & Nantes, J. F. D. (2008). Tecnologia de informação em organizações rurais: um estudo na pecuária de corte. *Informações Econômicas*, 38(10), 45-57.
- Miguel, L. A., Mieltz Netto, C. G. A., Nabinger, C., Sanguiné, E., Waquil, P. D., & Schneider, S. (2007). Caracterização socioeconômica e produtiva da bovinocultura de corte no estado do Rio Grande do Sul. *Revista Estudo e Debate*, 14(2), 95-125.
- Moura, J. F. P., Pimenta Filho, E. C., Neto, S. G., Menezes, M. P. C., Farias Leite, S. V., & Guilhermino, M. M. (2010). Caracterização dos sistemas de produção de leite bovino no Cariri. *Acta Scientiarum. Animal Sciences*, 32(3), 293-298.
- Rigueira, L. L., Lopes, M. A., Bruhn, F. R. P., Rodrigues, C. G., & Faria, P. B. (2014). Disposição dos consumidores do Distrito Federal em adquirir carne bovina com certificação de origem. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, 66(6), 1946-1950.
- Silva, R. A., Fernandes Filho, S., Oliveira, A. V. B., Santos Araújo, A., Oliveira Silva, F., & Pereira, E. M. (2010). Caracterização do sistema de produção de leite do município de Paulista-PB. *Agropecuária Científica no Semiárido*, 6(2), 31-46.

Received on March 17, 2014.

Accepted on May 24, 2017.

License information: This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.