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Intensive dairy farming systems from Holland and Brazil: SWOT analyse comparison

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ABSTRACT. Intensive systems of milk production in Brazil and Holland are compared by SWOT analysis. Twenty-one farms, 10 in Wageningen, central region of Holland, and 11 in Castro, central-eastern region of the state of Paraná, Brazil, were sampled. Data were retrieved from semi-structured interviews with the owners or people responsible for dairy activities, using a questionnaire guide and a digital recorder. After results were analysed, a table was elaborated representing the strengths, weaknesses, opportunities and risks for each country. Dairy farms in Holland were uniform, or rather, small and medium-sized farms with high production. It has also been observed that Dutch farms have several problems due to high intensification, for example, hoof diseases with great economic loss. In the case of Brazilian dairy farms, several types of systems and degrees were detected. Brazilian production in the region analysed features a higher quantity than that in Holland, with less intensity when compared to that on Dutch farms.

Keywords: Brazilian, dairy cow, Dutch, production system, milk

Sistemas intensivos de produção leiteira na Holanda e no Brasil: comparação pela análise SWOT

RESUMO. Este estudo foi realizado para comparar sistemas intensivos de produção de leite no Brasil e na Holanda por meio da análise SWOT. Foram amostradas 21 propriedades, sendo 10 na região central da Holanda, na cidade de Wageningen e 11 no Brasil, na região centro oriental do estado do Paraná, na cidade de Castro. A aquisição das informações foi baseada em entrevistas semiestruturadas, realizadas com os proprietários ou responsáveis pela atividade, utilizando um questionário guia e um gravador digital. Após a análise dos resultados, foi montada uma tabela representando os pontos fortes e pontos fracos, a oportunidade e os riscos de cada país. As propriedades da Holanda apresentaram uma regularidade entre si: serem de pequeno e médio porte, com alta intensificação da produção. Observou-se também que as propriedades holandesas vêm sendo acometidas com diversos problemas ocasionados por essa alta intensificação como, por exemplo, doenças de casco, que representam grande perda econômica. As propriedades brasileiras apresentaram diversos tipos de sistemas e escalas de produção. Observou-se que a produção das propriedades brasileiras desta região é superior em quantidade em relação às da Holanda; entretanto apresentou menor intensificação quando comparada às propriedades holandesas.

Palavras-chave: Brasileiro, vacas leiteiras, holandês, sistema de produção, leite

Introduction

The characterization of dairy farming systems is important to identify the main impairments in the production sector and in the implementation of projects within regional development (Assis et al., 2005; Godinho, & Carvalho, 2013). Comparing the characteristics of Brazilian dairy farms with well-structured production systems, such as those in Holland, contributes towards the development of the sector in Brazil.

Dairy farming systems in Holland are characterized as a family production, involving high technology (Thomassen, van Calker, Smits, Iepema, & de Boer, 2008). The cost of labor is relatively high and the use of modern machines such as cleaning robots for stables, robotic milking, tractors, seeders and harvesters to optimize system productivity are more viable (Wade, van Asseldonk, Berentsen, Ouweltjes, & Hogeveen, 2004).

According to a survey conducted by Wageningen University, Dutch dairy farms are characterized as intensive. As a rule, Dutch farms average 78 lactating animals in the herd, producing more than 8,000 kg of milk per cow^{-1} year^{-1} in small 51-hectare farms

where 38 hectares are reserved for the production of grass silage and 8 ha for maize silage. The animals are housed in a free-stall system where the animals remain grouped, but with free access to bed and individual feeders.

On the other hand, there is a great difference between extensive and intensive dairy farm systems in the state of Paraná (Lopes Junior et al., 2012; Silva, Moraes, Hack, & Faccio, 2008). Extensive production systems are characterized by the use of non-selected animals, with an average production of less than 4000 kg cow^{-1} $year^{-1}$, low usage of concentrated and preserved forage for the dry season and manual milking (De La Ossa, Lana, Gutierrez, & Márcio, 2013).

In intensive systems, specialized animals are housed in a free-stall system, fed on high quality forages, such as alfalfa and corn silage, and animals are milked in automatic milking parlors (Lopes, Santos, & Carvalho, 2012). These specialized farms producing over 6000 cow^{-1} $year^{-1}$ on average are mainly concentrated in the middle region of the central-eastern section of the state of Paraná, in the municipalities of Castro, Arapoti and Carambeí (Paula, Martins, & Silva, 2009).

The town of Castro in the state of Paraná, Brazil, with strong Dutch influence, has a potential to produce winter grasses as in Holland. The animals bred in the region are from the same stock as those used by Dutch farmers, surmising that the dairy production of the Brazilian town of Castro would equal or exceeds Dutch milk production (Fagan, Jobim, Júnior, Silva, & Santos, 2010). So that such a comparison may be undertaken, specific tools are required to assess the farm qualities of each region.

Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis is a strategic planning tool used to provide information on different productive sectors. So that the intrinsic and extrinsic aspects of Dutch and Brazilian farms could be identified, the SWOT matrix organizes the internal environment of the farm with regard to its strengths and weaknesses, as well as its external environment property with regard to opportunities and risks. In fact, SWOT analysis has already been applied as a tool to assess the impact of strategic planning in a small company dedicated to milk production (Marion & Segatti, 2006).

Current study determines the main characteristics of intensive dairy production system in the state of Paraná, Brazil, represented by Castro and the neighboring region, and that of Holland, represented by Wageningen and its surrounding region. More specifically, current research investigates the strengths and weaknesses detected in both systems, coupled to the external factors that exert their influence in Brazil and in Holland.

Material and methods

Current study comprised the comparative evaluation of Dutch and Brazilian intensive dairy farming systems represented by Wageningen and Castro, respectively located in the central and southern region of each country.

For data collection, 21 farm owners were interviewed, 10 in Wageningen, between June and July, 2013, and 11 in Castro, between September and October, 2013. The selection of the farms was discussed with professionals from the region and dairy milk experts representing the intensive dairy farming systems of each region.

Information was based on semi-structured interviews with the owners or those responsible for the activities, using a questionnaire guide and a digital voice recorder (Foddy, 1994).

So that the farms could be properly characterized, data were collected on production index by several questions on the number of persons employed; total area of the farm; total milk production; number of lactating cows; cow production day^{-1}; fat and protein percentage; Somatic Cell Count (SCC); price paid for milk; concentrate efficiency; replacement rate; age at first calving and duration of the dry period; data on the general characteristics of the farms were collected by qualitative questions on rearing system; feeding system; forage used; major problems and criteria for animal selection.

Data from the answers of the questionnaires were tabulated (Excel 2007 and SPSS Statistic 19) and analyzed, based on frequency distribution of calculations to characterize the systems of the two countries. Dutch and Brazilian production systems were compared by SWOT analysis (Marion & Segatti, 2006).

The strengths, weaknesses, opportunities and threats of the farms from each country were analyzed by data collected from the interviews and from a review of the literature.

Results and discussion

The Boxes 1 and 2 show the Strengths, Weakness, Opportunities and Threats from the SWOT analyses of dairy farms interviewed from Wageningen, Holland, and Castro, Brazil.

Strengths	**Weakness**
Labour efficiency	Land usage restrictions
Structured milk production	Hoof disease
High production and quality of milk	
Good production index	
Opportunities	**Threats**
Abolishment of quotas	Criteria for animal selection
Strategic grazing.	

Box 1. SWOT analysis of dairy farms from Wageningen.

Strengths	**Weakness**
High production and quality of milk	Low milk production / ha
Good reproductive index	Low labour efficiency
Good usage of natural resources	
Opportunities	**Threats**
Criteria for animal selection	Mastitis
Increase solids in milk	High dependency of concentrates

Box 2. SWOT analysis of dairy farms from Castro

Strengths

Dutch farms

The dairy farms in Holland are small and medium-sized, with few employees, since production has a familial feature. The number of workers on the farms surveyed did not exceed two since the owners themselves administered the farm (Table 1). The cost of labour in Europe is relatively high, making the production system inefficient when several people are hired (Ciolos, 2010).

Table 1. Farm structure and production index of Dutch and Brazilian dairy farming systems

	Holland		Brazil	
	Mean	SD	Mean	SD
Number of employees	1	0.0	7	6.4
Area of the farm (ha)	54	9.8	137	120.9
Total milk production (kg day^{-1})	2506	862.5	5708	6800.9
Number of lactating cows	90	24.4	171	174.4
Milk production (animal day^{-1})	28.10	3.09	30.06	5.50
Fat (%)	4.35	0.22	3.69	0.51
Protein (%)	3.51	0.11	3.22	0.26
Somatic Cell Count (SCC)	138.40	66.99	164.45	71.486
Price of milk (R$)	1.09	0.80	1.14	0.70
Concentrate efficiency (%)	22.00	5.06	29.00	7.25
Replacement(%)	23.00	5.90	20.00	6.30
First calving age (months)	23	1.00	24.00	1.00
Dry period (weeks)	5.50	0.50	8.00	0.10

Current study showed that Dutch farms averaged 54 ha (Table 1), similar to rates reported by Wageningen University in 2012. According to the European Commission - Agriculture and Rural Development (Ciolos, 2010), farms are entitled to receive a government subsidy according to their size, provided they adopt food safety standards and animal welfare. The subsidy paid by the government not only enhances a more competitive production but also encourages and maintains the population in agricultural activities. In fact, farmers provide an ecological service by taking care of the forest and water reserves. It is very common to find several small farmers throughout Holland demanding the grant.

Besides high milk production rates, high amounts of fat (4.4%) and protein (3.5%) in the milk produced on Dutch farms are reported (Table 1) The protein content is similar to rates (3.5%) recorded by De Marchi, Bittante, Dal Zotto, Dalvit, and Cassandro (2008), although fat contents reported by the authors of the above study were lower than those observed in current one. The difference is due to the fact that the concentration in milk fat varies more easily than protein, mainly influenced by the diet of animals. Animals fed on higher availability of effective fiber in the diet have a higher formation of acetic acid in the rumen, which is the precursor of milk fat.

Somatic cell count (SCC) is indicative of the health of the mammary gland and therefore herd management. An increase in SCC may be caused by various factors such as udder inflammation, mastitis, metabolic diseases, such as acidosis, ketosis and laminitis, which increase the number of antibodies in the blood conveyed into the milk. SCC is also due to the animal´s intrinsic factors. Older cows have an increased desquamation of epithelial cells resulting in an increased amount of expressed somatic cells in milk. In 2011, the United States Department of Agriculture established as requirements for the milk quality and health program that the amount of SCC in tanks must not be higher than 400,000 cells mL^{-1} (USDA, 2011). Since an average of 138,400 cells mL^{-1} (Table 1) was reported for farms surveyed in Holland, the milk produced proved to be of very high quality and safety for human consumption.

Milk production is dependent on the herds´ reproductive features since there is an inverse proportion between milk production and reproduction. Table 1 shows the reproductive parameters analyzed: the average age of heifers at first calving (23 months) and the duration of the dry period of the animals (5.5 weeks). The age at first calving is in part influenced by genetics and by feeding management during rearing since the animals may be first mated after reaching 360 kg live weight (Silva et al., 1998). Heifer diets which meet these demands gain weight faster and consequently reach sexual maturity earlier. With regards to the dry period, two factors affect its duration: the lactation cycle and the fecundation of cows. In Holland, the milk production cycle is 305 days, with a quick return to oestrus and insemination 42 days after calving. A fast return increases the efficiency and economic return of milk production. However, it is important to observe that cows that produce a lot of milk have greater difficulties to return to the reproductive cycle due to the high nutrient demand required for lactation.

Dutch farms adopt the free-stall system in which animals remain stabled throughout the year and feed on total mixed ration (TMR), in groups or individually, when robotic milking is practised (Figure 1).

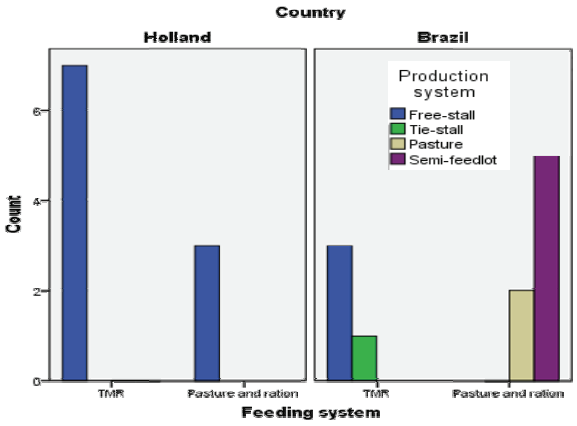

Figure 1. Production and feeding farming systems from Brazil and Holland. TMR = Total Mixed Ration

According to Reijs, Daatselaar, Helming, Jager, and Beldman (2013), production systems with confined animals exhibit greater efficiency in milk production because they prevent food waste caused by grazing, they are less subject to the influence of climate on food production and they have a greater control on diet to meet the animals´ requirements. However, about 30% of the surveyed farms release the animals on pastureland during the spring due to a subsidy paid to dairy farmers who invest in the environment and animal welfare (Figure 1).

Brazilian farms

The production system in Castro comprises the semi-feedlot which resembles the free-stall system with restricted grazing in the spring used by Dutch farmers (Figure 1). However, milk production in Castro was slightly higher than that in Wageningen, or rather, 6.7% more milk per cow^{-1} day^{-1}, with SCC levels accepted by the European Union (USDA, 2011) (Table 1). The reproductive efficiency of Castro's dairy herd may be considered appropriate, aged 24 months old at first calving. As a rule, the age of Holstein heifers at first calving lies between 22 and 26 months (Silva et al., 1998). The above authors also emphasize the economic importance of age at first calving, providing the adequacy of productivity and body development over animal life. Moreover, the annual replacement rate of Brazilian herds was 20%, considered the best (Sol, Stelwagen, & Dijkhuizen, 1984).

The semi-feedlot (Figure 1) takes advantage of the weather of the Castro region since it allows the production of forage for grazing, the production of preserved foods as corn silage, and pre-dried oatmeal (Lopes et al., 2012). When feed-lot and the semi-feedlot dairy farming system in the state of Minas Gerais, Brazil, are compared, a lower production of 6.6 kg of milk cow^{-1} day^{-1} in semi-feedlot systems was reported (Lopes et al., 2012). However, in this study the semi-feedlot farms did not use specialized breeds for milk production, or rather, the opposite of the practice in the Castro region, where Holstein cows comprised the main broodstocks.

Further, most Brazilian dairy farms used more than one kind of forage for feeding (Figure 2).

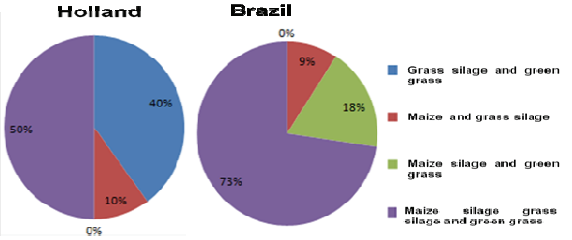

Figure 2. Type of forage of dairy farming system from Holland and Brazil

Average temperature in the Castro region lies between 10 and 15°C (IBGE, 2011) enabling the production of temperate forage during the winter and tropical forage in the summer. According to the farmers, the main crops grown were the perennial tropical grasses, such as Tifton 85, annual tropical grasses, such as maize for silage, and annual winter grasses, such as ryegrass used for grazing and food production maintained in months of inadequate climate. Due to the favourable environment for the development of tropical and temperate grasses, the rotation of these cultures is a positive characteristic of the farms which have a larger variety of food supply than that used by Dutch farmers.

Weakness

Dutch farms

Land use in Holland follows several environmental guidelines. Fertilization is one of the current problems faced by Dutch farmers, due to several impediments in the use of manure. According to Council Directive 91/676/EEC (1991), poorly planned usage of organic fertilizers would contaminate groundwater with phosphorus and nitrogen. Leaching is influenced by the type of culture. Corn is a summer crop extensively used in the production of silage due to its chemical composition to produce silage: dry matter between 30% and 35% carbohydrate content, less than 3% soluble in natural matter and low buffering capacity

(Jaremtchuk et al., 2005). However, 60% of the interviewed Dutch farmers report using maize silage (Figure 2). Although 170 kg of organic fertilizer per ha $year^{-1}$ may be applied in Holland, if a farm has 70% of its area covered with pasture, it may apply up to 250 kg of organic fertilizer per ha^{-1} $year^{-1}$. Low amounts of the fertilizer are allowed since maize absorbs fewer nutrients when close to harvest time, increasing the leaching of soil nutrients.

Dutch farmers identified hoof disease as their main problem (Figure 3). Lame cows consume less since interest in seeking food is decreased due to the discomfort in locomotion. Reduction of consumption is accompanied by a reduction in milk production (Warnick, Janssen, Guard, & Gröhn, 2001). The same authors observed that lame cows presented a 1.5 kg^{-1} day^{-1} reduction in milk production. Lame cows produce 360 kg of milk less than healthy cows during the lactation period (Green, Hedges, Schukken, Blowey, & Packington, 2002). Among the hoof diseases, several other infectious diseases, such as digital dermatitis, have been on the increase in Holland due to high load of microorganisms present in the animals´ environment (Somers, Frankena, Noordhuizen-Stassen, & Metz, 2003).

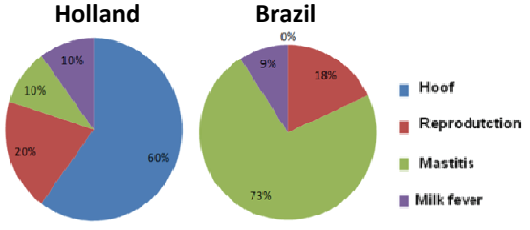

Figure 3. Principals cause of problems described by Dutch and Brazilian farmers.

In the free-stall system the animals are densely confined and thus more susceptible to transmit contagious diseases since they are in greater contact with contaminated faeces. Although slatted floors make easier the cleaning of stables, it may cause greater hoof wear and thus a greater discomfort to the animals, due to its rigid structure. Flexible materials on stable floors reduce the pressure on the hooves and their wear since they become less slippery. Falls contribute towards the onset of hoof disease since the wounds favour the entrance of microorganisms.

Antibiotics in animal production have three functions: treatment of several diseases, prophylaxis and growth promoter (Barton, 2000). However, the use of antibiotics has been increasingly restricted due to the increase in bacterial resistance (Ipharraguerre & Clark, 2003). Currently, the European Union is developing practices to reduce the use of antibiotics in animal production. One practice comprises the discarding of the treatment of animals with infectious diseases, such as those affecting hooves and udders, consigning them to slaughter. In current study, there was an average of 23% discarded cows (Table 1), higher than the rate proposed by Sol et al. (1984) who suggested that the ideal replacement in dairy herds must be less than or equal to 20% and no more than 25% of the herd.

Brazilian farms

Although the Brazilian farms surveyed had a high milk production, their efficiency was low. The structure and size of farms (medium to large) in the Castro region vary a lot, with many employees to manage and administrate them (Table 1). Thus, when the amount of milk produced is related with the number of employees, Brazilian efficiency rates are lower than Dutch efficiency ones. The proportion of lactating animals per employees working on Brazilian farms was approximately 25 cows per person. On the other hand, a ratio of 90 cows per person occurred on Dutch farms.

The milking method is one of the major factors that determine the number of employees needed to perform activities on a dairy farm. Further, the double herringbone milking parlour, requiring two persons, is predominant in Brazil (64% of respondents). Moreover, as the breeding system consists of semi-feedlots (Figure 1), it demands more people to handle the animals, for example, bring them to the milking parlour and provide food. Another feature is the need of a manager to run the farm since many owners are normally absent. In addition, many farms in Castro region are not intended solely for milk production, featuring several purposes, such as crop production for the sale of corn and soybean, thinning the milk production per hectare of property (45 kg ha^{-1} day^{-1}) the system.

Opportunities

Dutch farms

According to the new guidelines of the European Commission - Agriculture and Rural Development (Ciolos, 2010), in 2015 the Dutch government abolished the quota system which imposed a limit in the milk production of a farm to maintain the sector´s competitiveness. The quota is not a physical unit although it may be commercialized. If producers want to increase milk production, they have to buy the quota from other farms in the same region. With the abolition of the quota system,

farmers increased their milk production. However, in Holland, the increase of production by an increase in the size of the property is complex and expensive. Consequently, farmers tended to invest in the intensification of animal husbandry systems.

In recent years there has been a reduction in the production of grazing animals in Holland. Dutch farmers rate grazing low since this productive strategy would result in lower milk production when compared to more intensive systems (Reijs et al., 2013). However, when the concentrate efficiency between Holland and Brazil is compared, one may conclude that grasses grown in Holland have a higher quality and supply a significant portion of animal requirements, because they have similar milk production (Table 1).

As a result of the intensification of dairy farming systems, the number of hoof diseases increased. An alternative to problems caused by the free-stall system would be the use of restricted pasture during the spring since it minimizes the load of microorganisms in the environment by few contacts with the faeces. Since the animals are placed on a softer floor, the pressure on the feet is lessened and hoof wear is minimized. Reducing the hoof issues means a decrease in antibiotics. Furthermore, the use of restricted grazing may increase the price paid for milk. The price of a milk litter paid to Dutch producers at the time the interviews took place was approximately R$ 1.09, which was lower than the amount received by Brazilian producers (Table 1). However, Friesland Campina, the largest Dutch dairy industry since 2011, in its line of organic products, increased the bonus of € 0.05 to € 0.50 for every 100 kg of milk produced on farms that apply restricted grazing for at least 6 hours during 120 days. The bonus system is greatly attractive to producers because, according to the company, this alternative increases the producers´ income from € 300.00 to € 3,000.00 on farms that produce approximately 600,000 kg of milk per year.

Brazilian farms

The main criterion for animal selection was milk production, followed by udder conformation, percentage of solids and leg conformation (Figure 4). It should be underscored that the production of milk per cow on the farms was high, since the Holstein breed is a specialized breed for milk production. In contrast, fat and protein production is lower when compared with the Jersey strain. Fat and protein percentage is taken into consideration in milk prices. The increased production of solid milk in Brazil is possible since the same strains are used on Brazilian and Dutch farms. However, Brazil still needs to incorporate a breeding program for the Holstein strain to select cows for the high production of solid milk.

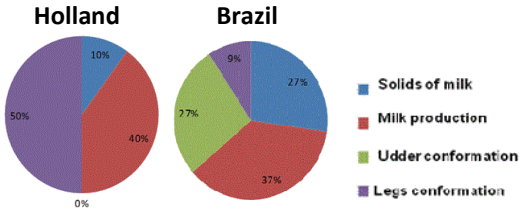

Figure 4. Criteria for animal selection described by Dutch and Brazilian farmers

Threats

Dutch farms

Due to the high incidence of hoof diseases, the main criterion for animal selection has been the conformation of legs (Figure 4). Animals which have a good conformation and structure of legs and knees have a less chance to develop lameness. The conformation of legs possesses a high negative correlation with milk production, since in the future the cows decrease their milk production potential (Klassen, Monardes, Jairath, Cue, & Hayes, 1992).

Brazilian farms

The animal diets on Brazilian farms are highly dependent on corn production. All interviewed farm owners use corn silage and ground corn in concentrates as a source of forage. The concentrate´s efficiency is lower when compared to that used in Holland (Table 1). The interviewed milk producers in Castro required 29 kg of concentrate to produce 100 kg of milk. Droughts during the last years in the USA caused a steep rise in the price of corn. Due to the high demand for this type of food for milk productivity in the Castro region, it is closely linked to the price of corn. High fluctuating prices throughout the year is a risk factor to farmers, since drastic changes in price would result in a significant increase in animal feed costs.

Although the SCC of cows on Castro farms are within acceptable levels by European standards, many farmers answered that mastitis was the main problem (Figure 4). There are basically two types of mastitis: clinical mastitis, which is visible to the black strip plate test, and subclinical mastitis, where no clumping exists, but has an increase in somatic cells. Subclinical mastitis causes an increase in the SCC tank since cows that have lumps are separated from the herd and treated with antibiotics

Conclusion

There is no better or worse production system. However, after analyzing the characteristics of the two production systems in the Wagenigen and Castro regions, there are practices that may be used by both to increase the production and efficiency of each dairy farming system. Holland has experienced several problems due to high intensification of milk production. The practices used in more extensive systems such as semi-feedlot may reduce the problems that affect these farms especially with regard to the health of hooves. On the other hand, milk production of the Castro region is well structured even though it has to improve the efficiency and quality of the milk produced.

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References

Assis, A. G., Stock, L. A., Campos, O. F., Gomes, A. T., Zoccal, R., & Silva, M. R. (2005). *Sistemas de produção de leite no Brasil Embrapa*. Juiz de Fora, MG: Embrapa.

Barton, M. D. (2000). Antibiotic use in animal feed and its impact on human healt. *Nutrition Research Reviews*, *13*(2), 279-299.

Ciolos, D. (2010). *The future of European agricultural policy–call for a public debate* (Vol. 12). Brussels, BE: Speech to the European Parliament's Agriculture Committee.

Council Directive 91/676/EEC (1991). *Concerning the protection of waters against pollution caused by nitrates from agricultural sources*. CELEX-EUR Official Journal L 375, 31 December 1991, p. 1-8.

De La Ossa, J. E. P., Lana, R. P., Gutierrez, G. S., & Márcio, E. (2013). Formas de utilização de cana-de-acúcar e níveis de suplementação concentrada para vacas mestiças leiteiras de baixa produção. *Revista Brasileira de Agropecuária Sustentável, 3(*1), 138-150.

De Marchi, M., Bittante, G., Dal Zotto, R., Dalvit, C., Cassandro, M. (2008) Effect of Holstein Friesian and Brown Swiss breeds on quality of milk and cheese. *Journal of Dairy Science, 91*(10), 4092-4102.

Fagan, E. P., Jobim, C. C., Júnior, M. C., Silva, M. S., & Santos, G. T. (2010). Environmental and handling factors on the chemical composition of milk in dairy farms of Paraná State, Brazil. *Revista Brasileira de Zootecnia, 32*(3), 309-316.

Foddy, W. (1994) *Constructing questions for interviews and questionnaires: theory and practice in social research*. Oxford, UK: Cambridge University Press.

Godinho, R. F., & Carvalho, R. C. R. (2013). Gestão de sistemas de produção de leite. *Ciência et Praxis, 2*(3), 77-82.

Green, L. E., Hedges, V. J., Schukken, Y. H., Blowey, R. W., & Packington, A. J. (2002). The impact of clinical lameness on the milk yield of dairy cows. *Journal of Dairy Science, 85*(9), 2250-2256.

Instituto Brasileiro de Geografia e Estatística [IBGE]. (2011). *Produção da pecuáaria municipal* (Vol. 39). Rio de Janeiro, RJ: IBGE.

Ipharraguerre, I. R., & Clark, J. H. (2003). Usefulness of ionophores for lactating dairy cows: a review. *Animal Feed Science and Technology, 106(*1-4), 39-57.

Jaremtchuk, A. R., Jaremtchuk, C. C., Baglioli, B., Medrado, M. T., Kozlowski, L. A., Costa, C., & Madeira, H. M. F. (2005). Características agronômicas e bromatológicas de vinte genótipos de milho (*Zea mays* L.) para silagem na região leste paranaense. *Acta Scientiarum. Animal Sciences, 27*(2), 181-188.

Klassen, D. J., Monardes, H. G., Jairath, L., Cue, R. I., & Hayes, J. F. (1992). Genetic correlations between lifetime production and linearized type in Canadian Holsteins. *Journal of Dairy Science, 75*(8), 2272-2282.

Lopes Junior, J. F., Ramos, C. E. C. O., Santos, G. T., Grande, P. A., Damasceno, J. C., & Massuda, E. M. (2012). Análise das práticas de produtores em sistemas de produção leiteiros e seus resultados na produção e qualidade do leite. *Semina: Ciências Agrárias, 33*(3), 1199-1208.

Lopes, M. A., Santos, G., & Carvalho, F. M. (2012). Comparativo de indicadores econômicos da atividade leiteira de sistemas intensivos de produção de leite no Estado de Minas Gerais. *Ceres, 59*(4), 458-465.

Marion, J. C., & Segatti, S. (2006). Sistema de gestão de custos nas pequenas propriedades leiteiras. *Custos e @gronegócios, 2*(2), 2-7.

Paula, M. C., Martins, E. N., & Silva, L. O. C. (2009). Interação genótipo× ambiente para produção de leite de bovinos da raça Holandesa entre bacias leiteiras no estado do Paraná. *Revista Brasileira de Zootecnia, 38*(3), 467-473.

Reijs, J. W., Daatselaar, C. H. G., Helming, J. F. M., Jager, J., & Beldman, A. C. G. (2013). Grazing dairy cows in north-west Europe. *LEI Report*, 1, 1-124.

Silva, H. A., Moraes, H. S. K. A., Hack, V. A. G. E., & Faccio, P. C. F. (2008). Análise da viabilidade econômica da produção de leite a pasto e com suplementos na região dos Campos Gerais-Paraná. *Ciencia Rural, 38*(2), 445-450.

Silva, M. V. G. B., Bergmann, J. A. G., Martinez, M. L., Pereira, C. S., Ferraz, J. B., & Silva, H. C. M. (1998). Associação genética, fenotípica e de ambiente entre medidas de eficiência reprodutiva e produção de leite na raça Holandesa. *Revista Brasileira de Zootecnia, 27*(6), 1115-1122.

Sol, J., Stelwagen, J., & Dijkhuizen, A. A. (1984). A three year herd health and management program on thirty Dutch dairy farms: II. Culling strategy and losses caused by forced replacement of dairy cows. *Veterinary Quarterly, 6(*3), 149-157.

Somers, J. G. C. J., Frankena, K., Noordhuizen-Stassen, E. N., & Metz, J. H. M. (2003). Prevalence of claw disorders in Dutch dairy cows exposed to several floor systems. *Journal of Dairy Science, 86*(6), 2082-2093.

Thomassen, M. A., van Calker, K. J., Smits, M. C. J., Iepema, G. L., & de Boer, I. K. (2008). Life cycle assessment of conventional and organic milk production in the Netherlands. *Agricultural Systems, 96*(1), 95-107.

United States Department of Agriculture [USDA]. (2011). *European Union Health Certification Program*. Retrieved from http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRD3636640

Wade, K. M., van Asseldonk, M. A. P. M., Berentsen, P. B. M., Ouweltjes, W., & Hogeveen, H. (2004). *Economic efficiency of automatic milking systems with specific emphasis on increases in milk production automatic milking: a better understanding.* The Netherlands: Wageningen Academic Publ.

Warnick, L. D., Janssen, D., Guard, C. L., & Gröhn, Y. T. (2001). The effect of lameness on milk production in dairy cows. *Journal of Dairy Science, 84*(9), 1988-1997.

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