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FATORES INTRÍNSECOS À PRODUÇÃO, O USO DA INSEMINAÇÃO ARTIFICIAL E OS OBJETIVOS DE SELEÇÃO NA PECUÁRIA LEITEIRA DO SUL DO BRASIL

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FATORES INTRÍNSECOS À PRODUÇÃO, O USO DA INSEMINAÇÃO ARTIFICIAL E OS OBJETIVOS DE SELEÇÃO NA PECUÁRIA LEITEIRA DO SUL DO BRASIL [1]

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Resumo – A pecuária leiteira brasileira caracteriza-se por grande heterogeneidade dos sistemas produtivos e pluralidades de fatores que constituem barreiras para o seu desenvolvimento. A região sul se destaca por possuir maior eficiência produtiva entre as regiões do país. Assim, o entendimento dos diferentes fatores que explicam esta produção torna-se importante para maximizar ainda mais esta produção e propor alternativas para o seu incremento. Objetivou-se discriminar a produção leiteira pelos fatores produtivos e ambientais; avaliar o impacto do uso da inseminação artificial; e determinar valores econômicos para características produtivas, funcionais e de fertilidade, em rebanhos leiteiros das regiões político administrativas dos Estados do Rio Grande do Sul e Santa Catarina. Para isso foram utilizadas análises univariada e multivariada e, também, modelos bioeconômicos. As análises evidenciaram distinções entre as regiões político administrativas do Rio Grande do Sul e Santa Catarina. As variáveis produtivas (quantidade de leite, produtividade e vacas ordenhadas) e ambientais (manejo agropecuário com rotação de pastagem) foram as mais importantes na discriminação entre os clusters de regiões político administrativas. Os sistemas produtivos da Mesorregião Noroeste Rio-grandense são classificados como especializados e intensivos, e a sua produção está associada com o uso da inseminação artificial. Os valores econômicos para as características produtivas, funcionais e de fertilidade, podem ser usados na seleção para maior lucro pelos produtores de bovinos leiteiros, da Microrregião de Passo Fundo.

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[1]Tese de Doutorado em Zootecnia – Produção Animal, Faculdade de Agronomia, Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brasil.(214p.) Outubro, 2014.

INTRINSIC FACTORS PRODUCTION, THE USE OF INSEMINATION AND OBJECTIVES OF SELECTION AND OBJECTIVES OF DAIRY CATTLE SELECTION IN SOUTHERN BRAZIL[2]

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Abstract – The Brazilian dairy production is characterized by great heterogeneity of production systems and pluralities of factors that are barriers to its development. The southern region stands out for having greater productive efficiency among regions of the country. Thus, understanding the different factors that explain this production become important to further maximize this production and propose alternatives to its increase. This study aimed to discriminate milk production by productive and environmental factors, assess the impact of the use of artificial insemination, and determine economic values for productive, functional and fertility traits in dairy herds of administrative political regions in the states of Rio Grande do Sul and Santa Catarina. For this, univariate and multivariate analysis, and also bioeconomic models were used. The analyzes showed distinctions between the political-administrative regions of Rio Grande do Sul and Santa Catarina. The productive (amount of milk, productivity and milked cows) and environmental (agricultural management with pasture rotation) factors were those that best explained the differences between clusters of political-administrative regions. The productive systems of Mesoregion Northwestern Rio-grandense are classified as specialized and intensive, and its production is associated with the use of artificial insemination. Economic values for production and functional fertility traits can be used in selection for higher profits by dairy cattle producers, in the Microregion of Passo Fundo.

[2]Doctoral Thesis in Animal Science – Faculdade de Agronomia, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil. (214p.) October, 2014.

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RELAÇÃO DE ABREVIATURAS E SÍMBOLOS

%	percentual
<	menor
>	maior
♀	fêmea
♂	macho
a	número de animais
CCS	contagem de células somáticas
Cme	custo médio efetivo
COE	custo operacional efetivo
CONS	consumo alimentar
COT	custo operacional total
CT	custo total
CV	coeficiênte de variação
D	despesas
DL	duração da lactação
FSH	hormônio folículo estimulante
GnRH	hormônio liberador de gonadotrofina
GOR	gordura
IA	iInseminação artificial
IATF	inseminação artificial em tempo fixo
IDP	intervalo de partos
IFRS	Instituto Federal de Educação Ciência e Tecnologia do Rio Grande do Sul
IGF-1	fator de crescimento semelhante à insulina 1
IN	instrução normativa
IPP	idade ao primeiro parto
Kg	kilograma
L	litro
LH	hormônio luteinizante
LM	lucro médio
Lm	lucro médio antes do melhoramento genético
Lm'	lucro médio após melhoramento genético
MB	margem bruta
ML	margem líquida
MORT	mortalidade
n	idade da matriz
PIB	produto interno bruto
PIV	produção in vitro
PL	produção de leite
PRO	proteina
r	taxa de sobrevivência
R	receitas

R$	reais
RBT	receita bruta total
TE	transferência de embrião
Tr	tamanho do rebanho
Ve	valor econômico

CAPÍTULO I

INTRODUÇÃO

As projeções mundiais para a produção de alimentos, e entre eles o leite, é que até 2050 deveremos dobrar esta produção. A produção mundial em 2010 alcançou 599,6 bilhões de litros (FAO, 2010). Estes números serão insuficientes para atender o déficit mundial para as demandas futuras ocasionadas pelo aumento da população e pelo aumento do poder aquisitivo dos países emergentes. A produção de biocombustíveis, a ocupação cada vez maior de terras para o cultivo de grãos, a degradação do solo e as mudanças climáticas, pressionarão para maior competitividade da atividade leiteira.

O Brasil é o 5º colocado na produção mundial de leite com 32,1 bilhões de litros em 2011. Com rebanho leiteiro estimado em 23.227.221 cabeças de gado, que lhe confere o 2º maior rebanho mundial e com produtividade de 1382 L/leite/vaca/ano, mostram a baixa competitividade da atividade. O uso de tecnologias e gestão aumentaria a eficiência produtiva e credenciaria o país a se tornar um dos grandes provedores de leite para o mundo (Siqueira & Carneiro, 2012).

A importância social da atividade leiteira pode ser detectada quando se observa que dos 5564 municípios brasileiros existentes, somente 67 não produzem leite (IBGE, 2011). Economicamente, considerando o valor da produção, o leite ocupa o 4º lugar entre as commodities agropecuárias produzidas no Brasil, perdendo apenas para soja, cana-de-açúcar e milho (Siqueira & Carneiro, 2010).

Diversidades climáticas, econômicas, sociais, políticas e culturais contribuem para a baixa eficiência e heterogeneidade da atividade leiteira (Martins et al., 2011; Zoccal et al., 2012). A distribuição da bovinocultura de leite se dá com grande pluralidade dos processos produtivos (Hoot & Carvalho, 2007), constituindo-se em barreiras para o seu desenvolvimento.

As assimetrias de conhecimentos sobre os fatores relacionados à produtividade e à qualidade do leite (Coleman et al., 2010; Vance et al 2012), os fatores não hereditários (Kelzer, et al., 2009; Schütz et al., 2013), produtivos (Thompson, et al., 2012; Leal, et al., 2013) e ambientais (Hansen & Fuquay, 2011; Liang et al. 2013) afetam o desempenho produtivo de bovinos de leite e dificultam a eficiência produtiva. A baixa difusão do uso de tecnologias associadas à saúde (Morris et al., 2011), à genética (Miller et al 2009), à nutrição (Thatcher et al., 2011), à reprodução (Hasler, 2014) e à gestão (Khanal et al, 2010; Kamphuis et al., 2012), somam pontos importantes para o baixo desempenho das explorações leiteiras.

Especificamente, no estado do Rio Grande do Sul (RS), a metade norte se diferencia da metade sul, principalmente pelo avanço da agricultura e pela instalação da indústria que propiciaram grande desenvolvimento desta região (Coronel et al., 2007). O desempenho produtivo dos rebanhos leiteiros presentes na metade norte deste estado, o coloca em primeiro lugar no *ranking* por produtividade no Brasil (IBGE, 2011; EMBRAPA, 2012).

Dados produtivos divulgados pelos órgãos oficiais mostram a eficiência produtiva dos sistemas produtivos da Mesorregião Noroeste Rio-Grandense (NO). Pouco ou nada se sabe sobre os fatores que influenciam no desempenho produtivo destes rebanhos. Mostrar quais os fatores, compreender seus efeitos e propor novas estratégias, se torna importante para o incremento da produção e relevante para o desenvolvimento econômico e social.

Neste cenário, a proposta dessa pesquisa é diagnosticar os fatores produtivos, ambientais e socioeconômicos que discriminam a produção de bovinos de leite nos Estados do Rio Grande do Sul e Santa Catarina; determinar o impacto do uso da inseminação artificial na Mesorregião Noroeste Rio-grandense e predizer os valores econômicos para os objetivos de seleção para os sistemas produtivos da Microrregião de Passo Fundo.

REVISÃO BIBLIOGRÁFICA

Para um melhor entendimento do referencial teórico, optou-se por dividí-los nos seguintes tópicos: importância e fatores relacionados à produção leiteira; biotecnologias reprodutivas na produção leiteira e análise bioeconômica da produção leiteira.

1 Importância e fatores relacionados à produção leiteira

1.1 A produção de leite no mundo e no Brasil

Mesmo alcançando um lugar de destaque entre os principais produtores de leite do mundo, a produção brasileira possui baixa eficiência produtiva se comparado aos maiores provedores de leite (Siqueira et al., 2012). A baixa qualidade e precárias condições sanitárias (Avancini et al., 2013) e a grande heterogeneidade produtiva das explorações leiteiras (Junqueira et al., 2008) contribuem com a ineficiência produtiva.

Os reflexos da baixa competitividade resultam em baixos níveis de exportação do produto. A produção total é superior se comparada a dos países que mais exportam produtos lácteos para o Brasil, como o Uruguai, que se enquadra em 46ª maior produtor de leite, e a Argentina, na 17ª colocação. O Uruguai, com 4,5 mil produtores, vende leite para mais de 50 países. A Nova Zelândia, o maior exportador de leite no mundo, tem 13 mil produtores. Nos Estados Unidos, o país que mais produz leite, há pouco mais de 50 mil produtores. O Brasil, que possui cinco milhões de estabelecimentos rurais e um total de 1,3 milhão de produtores (IBGE, 2006), exporta somente para países da América e da África, menos de 0,5% da sua produção, ocupando a sétima posição no ranking mundial das exportações com apenas 2% (Siqueira et al., 2010).

Dados da Pesquisa Pecuária Municipal (PPM) destacam as regiões mais produtoras de leite, tendo Minas Gerais com participação de 27,3%, seguido pelo Rio Grande do Sul com 12,1%, Paraná com 11,9% e Goiás com 10,9%. Nestes estados se concentram 62,1 % de todo leite produzido no Brasil neste período (IBGE, 2011).

Siqueira & Carneiro (2012) mostram dados atualizados sobre a produtividade média nacional de leite com 1.382 litros/vaca/ano. Entre os estados, o Rio Grande do Sul aparece em 1º lugar com 2.536 litros/vaca/ano, seguido por Santa Catarina, Paraná e Minas Gerais com 2.478, 2.404 e 1.555 litros/vaca/ano, respectivamente.

A eficiência produtiva do estado do Rio Grande do Sul também pode ser observada pelos números apresentados na Tabela 1, onde a mesorregião de maior produção nacional é a Mesorregião Noroeste deste estado, com 2,3 bilhões de litros de leite. Na Tabela 2, observa-se a produtividade por microrregião, sendo a de Passo Fundo com 4.197 L/leite/vaca/ano, a de maior produtividade entre as microrregiões brasileiras, e pertencente à mesorregião NO do estado do RS.

TABELA 1- Volume de produção de leite, número de vacas ordenhadas e produtividade das principais mesorregiões produtoras de leite de vaca no Brasil em 2009.

Mesorregião	Quantidade (1 000 litros)	Vacas ordenhadas (cabeças)	Produtividade (litros/vaca/ano)
Noroeste Rio-grandense	2 219 385	847 039	2 620
Triângulo Mineiro/Alto Paranaíba	2 057 477	1 196 652	1 719
Oeste Catarinense	1 618 968	561 969	2 881
Sul Goiano	1 535 963	1 113 930	1 379
Sul/Sudoeste de Minas	1 330 926	815 836	1 631
Oeste Paranaense	235 951	182 851	1 290

Fonte: IBGE, 2009

TABELA 2 - Volume de produção de leite, número de vacas ordenhadas e produtividade das principais microrregiões produtoras de leite de vaca no Brasil em 2009.

Microrregião	Quantidade (1 000 litros)	Vacas ordenhadas (cabeças)	Produtividade (litros/vaca/ano)
Chapecó	598 977	193 428	3 097
Passo Fundo	425 088	101 277	4 197
Meia Ponte	440 732	373 040	1 181
Patos de Minas	424 674	191 990	2 212
São Miguel do Oeste	424 207	160 283	2 647
Toledo	430 154	118 777	3 622

Fonte: IBGE, 2009

1.2 A importância socioeconômica da atividade leiteira

A exploração leiteira ocupa posição de destaque no cenário econômico nacional, sendo um dos principais agronegócios do Brasil. Gera renda correspondente a 10% do valor gerado pela agropecuária brasileira e 76% do valor gerado pela pecuária (IBGE, 2010). Considerando-se o valor gerado pela produção em 2010, o leite ocupa o quarto lugar entre as *commodities* agropecuárias produzidas no Brasil, perdendo apenas para a soja, cana-de-açúcar e milho (Siqueira et al., 2010). Em 2013, o crescimento do PIB do agronegócio foi de 3,6% e a sua participação no PIB do país foi de 22,8% (CNA, 2013).

A produção nacional apresentou uma taxa média anual de crescimento de 5% entre 2000 e 2010, o que equivale a um incremento de 10,9 bilhões de litros no período. A expectativa é que esse volume continue a aumentar, pois só no primeiro trimestre de 2012 a captação foi de 4,4% maior em relação ao primeiro trimestre de 2011, segundo dados disponibilizados pelo IBGE (2012). A taxa de crescimento da atividade no Brasil tem se destacado no cenário mundial, ficando em segundo lugar no quesito crescimento da produção e em primeiro em quantidade de vacas por estabelecimento e da produção média por estabelecimento (Stock et al., 2011).

A evolução da atividade leiteira, apesar de lenta, é inegável. O volume de leite produzido aumentou nos extratos de maior produtividade e diminuiu nos extratos de menor produtividade (Stock et al., 2011). A modernização da atividade leiteira tem levado à redução do número de produtores, permanecendo aqueles que têm encarado a atividade como negócio e que investiram mais em insumos modernos (Barbosa & Souza, 2011). Mantidas as taxas de crescimento pela modernização da atividade leiteira, o Brasil estará entre os primeiros provedores de leite no mundo nas próximas décadas (Siqueira et al., 2010).

Os dados do Censo Agropecuário de 2006 indicaram que dos 5564 municípios brasileiros, apenas 67 não produziam leite. Entre os 100 municípios que mais produziam leite, 53 tinham o leite como a principal atividade econômica. A quantidade total de estabelecimentos agropecuários com atividade leiteira é de 1,3 milhões de unidades (IBGE, 2006). Cerca de 80% dos produtores de leite são pequenos (até 50L/dia) e respondem por apenas 26% do volume total produzido, enquanto 20% dos produtores são classificados como grandes e respondem por 74% da produção (Stock et al., 2011).

O RS ocupa um lugar de destaque nacional na atividade leiteira e o seu produto interno bruto (PIB) gerado mostra que, das mesorregiões com economia baseada na agropecuária, a NO é a de maior contribuição no estado com 18,69% do total produzido. A microrregião de Passo Fundo contribui com 18,23% do PIB gerado na mesorregião NO do RS, configurando-se na de maior contribuição da mesorregião NO (IBGE, 2003).

1.3 Fatores que interferem na eficiência produtiva

No País, apesar da existência de um grande número de estabelecimentos que desenvolvem a atividade leiteira, a média nacional de produtividade determina uma condição produtiva precária (Siqueira & Carneiro, 2012). O volume de produção determina que o tipo de exploração seja muito aquém do que é a expectativa de um sistema de produção eficiente e sustentável, mesmo existindo no país tecnologias desenvolvidas e adaptadas às condições climáticas, capazes de mudar a situação desse tipo de produtores.

Considerando o rebanho de vacas leiteiras, o volume de produção por animal, por propriedade e sob a ótica da intensificação, Zoccal et al. (2012) classificaram os sistemas produtivos em cinco tipos, não existindo, entretanto, uma clara definição dos limites de cada sistema.

A produção de subsistência é classificada aos estabelecimentos com rebanhos menores que 30 vacas, produção abaixo de 4 L/animal/dia, produção diária menor que 50 L/produtor e o pasto é a base da alimentação do rebanho. As pastagens, normalmente, possuem baixa capacidade de suporte e não usam a suplementação volumosa e concentrada no cocho. Apenas o sal comum é fornecido aos animais.

Os estabelecimentos com produção em base familiar contam com rebanhos entre 20 e 70 vacas, com produtividade animal de 4 a 8 L/vaca/dia e produção total variando entre 50 e 500 L/dia. O sistema de alimentação é misto, com uso de pastagens e suplementação volumosa e concentrada no inverno ou estação seca e, em muitos casos, o concentrado é fornecido durante o ano todo. O pasto possui capacidade de suporte mediana.

A produção semi-extensiva classifica produtores com rebanho entre 20 e 100 vacas e produtividade variando entre 8 e 12 L/vaca/dia, com produção total superior a 200 L/dia. A alimentação do rebanho é principalmente a pastagem, sendo usada para as vacas em lactação, suplementação volumosa na seca e concentrada durante o ano todo. O pasto possui capacidade de suporte de mediana a boa.

A produção especializada usualmente estão os rebanhos de 50 a 200 vacas, produzindo, em média, de 12 a 17 L/vaca/dia e volume total maior que 500 L/dia. A alimentação e manejo são especializados, geralmente com pastagens adubadas, com utilização de cana-de-açúcar e silagens como suplementação volumosa e concentrada que é fornecida durante o ano todo.

Produção intensiva é caracterizada por grandes estabelecimentos, com rebanho produtivo com mais de 200 cabeças e produtividade acima de 17 L/vaca/dia. O volume diário é superior a 3.000 L/unidade e a alimentação do rebanho é balanceada e fornecida integralmente no cocho durante o ano todo.

A eficiência dos sistemas produtivos se caracteriza por equalizar os fatores que interferem no desempenho produtivo da vaca leiteira de diferentes formas. Um bom desempenho produtivo é reflexo de diferentes fatores, de suas interações e do seu manejo. O entendimento dos efeitos dos diferentes fatores na produção leiteira permite elucidar os problemas da baixa eficiência produtiva. Entre os fatores determinantes da produção de leite, podem ser destacados os fatores genéticos, fisiológicos, ambientais, tecnológicos e os de gestão.

1.3.1 Genéticos

Os fatores fisiológicos hereditários são aqueles relacionados ao potencial do animal em produzir leite e que são transmitidos geneticamente de pai para filho. Raça ou grau de sangue compõem os fatores fisiológicos hereditários. Raças leiteiras europeias, normalmente, tendem a ter maior potencial de produção de leite, quando comparadas com raças zebuínas (Vance et al,. 2012; 2013).

A aptidão leiteira se constitui com algumas características que definem determinadas raças. O alto rendimento de leite com alto teor de proteína e gordura, vida produtiva longa, mínimos problemas reprodutivos, conformação que reduz a incidência de mastites e problemas de casco, resistência a doenças e conversão alimentar eficiente, são algumas características que determinam uma boa vaca leiteira (Roibas & Alvarez, 2010).

O melhor desempenho produtivo ocorre em animais selecionados para mérito genético para características quantitativas (Vance et al. 2012; Coleman et al., 2010). Estudos como o de Lagrotta et al., (2010) têm demonstrado que a ênfase da seleção para o aumento da produção de leite pode acarretar em diminuição do mérito de algumas características de tipo e influenciar a saúde da vaca, levando-as à diminuição da vida produtiva (longevidade) e ao descarte involuntário por fatores não produtivos, como os relacionados aos sistemas mamário (Roelofs et al., 2010), reprodutivo (Hudson et al., 2012), estrutural e locomotor (Morris, 2011).

1.3.2 Fisiológicos

Os fatores fisiológicos não hereditários estão diretamente correlacionados com a produção de leite do animal, mas não existe transmissão genética das características.

O ciclo lactacional de uma vaca tem início ao parto quando a produção de leite ainda não é máxima. Existe um aumento gradativo de produção até que se atinja o pico que em condições fisiológicas ocorre entre 4 e 8 semanas pós parto. Ocorrendo isso, existe uma queda gradual na produção de leite até a secagem do animal. A taxa com que a produção de leite cai após o pico determina a persistência da lactação de determinado animal. Existe grande variação entre os animais com relação ao tempo de aumento da produção do parto ao pico, taxa de subida na produção, nível máximo atingido e taxa de declínio (Stoop et al., 2009).

O período seco é importante para a reciclagem das células epiteliais mamárias, quando há uma substituição das células danificadas ou envelhecidas. Encurtar o período seco pelo fornecimento de dietas equilibradas e capazes de atender as necessidades fisiológicas e produtivas do início da lactação, é uma estratégia de gestão recomendada para a obtenção de melhores resultados (Steeneveld et al., 2013).

A formulação de dietas balanceadas, bem como o nível de intensificação de uso das dietas, associadas ao manejo alimentar, influenciam diretamente no desempenho produtivo de vacas leiteiras. O mesmo animal, quando submetido a dietas e manejos alimentares diferentes, apresenta grandes variações na produção de leite (Kelzer et al., 2009).

O escore de condição corporal das vacas ao parto influencia diretamente a produção de leite na lactação. Vacas com condição corporal excessiva ao parto têm o consumo de alimentos no pós-parto inibido e, consequentemente, aumento na mobilização de reservas e desordens metabólicas. Baixa condição corporal ao parto leva à depressão no pico de produção em vacas de alto potencial produtivo. Também a baixa condição corporal ao parto e a perda de condição corporal até 100 dias após o parto está associado à produção e ao desempenho reprodutivo (Schütz et al., 2013).

O desenvolvimento corporal do animal é fator de suma importância para a manifestação do potencial genético de produção. Garantir que as novilhas cheguem ao parto com peso em torno de 85% do peso adulto da raça é uma forma de auxiliar no bom desempenho desse animal no sistema de produção (Mohd Nor et al., 2013).

O efeito refratário ao estrogênio em multíparas diminui a intensidade do estro e indiretamente diminui a produção de leite (DeJarnette et al., 2009). No terço final da gestação, ocorre aumento da concentração plasmática de estradiol que sensibiliza a hipófise, deixando-a refratária a este hormônio no pós-parto, diminuindo assim a expressão do estro neste momento (Law et al., 2009).

Distocias, retenção de placenta, hipocalcemia, cetose, deslocamento de abomaso, entre outras, são desordens comuns no periparto e exercem grande influência na produção de leite do animal, na lactação, pelo aumento do intervalo parto-concepção (Smith & Risco, 2005; Leal et al., 2013).

A frequência de retirada do leite é diretamente proporcional à produção de leite pelas vacas durante a lactação. A maior frequência de ordenha resulta em proliferação celular e aumento da quantidade total de tecido secretor da glândula mamária (Stelwagen et al., 2013). Além da produção, o número de lactações e a época do ano do parto afetam a produção de leite por aumentarem os dias em aberto (Piccardi et al., 2013).

A somatotropina é um hormônio natural do bovino, que pode ser administrado exogenamente, visando ao aumento na produção de leite, havendo uma alteração na partição de nutrientes entre ganho corporal e glândula mamária atuando sobre o metabolismo de carboidratos, lipídios e proteínas (Neto et al., 2009). Também possui mecanismos biológicos, mediados por IGF-I, que estimulam a proliferação celular, com ação indireta sobre os tecidos mamários (Paula & Silva, 2011; Capuco & Akers, 2011).

1.3.3 Ambientais

A produção animal em determinado ambiente é consequência da interação entre os genes responsáveis pela produção em si e os fatores ambientais. A maior expressão do potencial genético é determinada por diferentes fatores ambientais que incluem: nutrição, reprodução e sanidade dos animais; o clima e as mudanças climáticas e a gestão destes fatores (Vitali et al., 2009; Staples, & Thatcher, 2011).

Lucy et al. (2011) detalham o efeito do estresse na diminuição da produção de leite, dos agentes estressores na produção do cortisol e do mecanismo de inibição sobre a fisiologia produtiva e reprodutiva. Trabalhos de Staples & Thatcher (2011) mostram também que o efeito do estresse altera não somente a produção, mas também a composição do leite. Animais geneticamente superiores para a produção leiteira são mais sensíveis aos efeitos do estresse quando comparados a raças menos especializadas ou mestiças (Liang et al., 2013).

O balanço energético negativo (Walsh et al., 2011; Cardoso et al.,2013; Schütz et al., 2013), a quantidade e qualidade da alimentação (Auldist et al., 2013) e dietas desequilibradas que levam às afecções do rúmen, como acidose ruminal e timpanismo (Wang et al., 2012; Lean et al., 2013), são importantes agentes estressores que determinam menor produção de leite.

Muitos são os trabalhos sobre as mudanças climáticas e seu impacto sobre a produção de pastagens e do leite (Lobell et al., 2008; Muller et al., 2011; Crane et al., 2011). Os baixos índices de precipitação (Stull et al., 2008), o aumento da umidade relativa do ar e da temperatura (Vitali et al., 2009), e o aumento do fotoperíodo (Vásquez et al., 2012) influenciam de forma indireta a produção leiteira pelo desencadeamento do estresse.

Da mesma forma, as afecções como laminites (Morris et al., 2011), mastites (Hudson et al., 2012) e outras doenças (Roelofs et al., 2010) são importantes agentes estressores. Determinam menor expressão do cio por parte da vaca e, consequentemente, maior dificuldade para a detecção do mesmo, resultando no aumento do intervalo entre partos e consequentemente diminuindo a produção dos animais (Dobson et al., 2008; Law et al., 2009).

1.3.4 Gestão dos processos

A gestão correta de todas as fases do processo produtivo contribui na eficiência dos sistemas produtivos. A realização de boas práticas com os animais, equipamentos e instalações, influenciam diretamente no produto final (Cabrera et al., 2010; Paranhos da Costa et al., 2012).

O manejo reprodutivo correto para a detecção do estro (Dobson et al., 2008, Law et al., 2009), momento da inseminação, local e dose inseminante (Seidel & Schenk, 2008), implicam em maiores ou menores intervalos entre partos e consequências na vida produtiva da vaca.

A prevenção de doenças como as mastites (Dobson et al., 2008) e laminites (Morris et al., 2011) para impedir o descarte involuntário e, consequentemente, evitar uma das maiores perdas da atividade leiteira, são importantes. Da mesma forma, o fornecimento de dietas desequilibradas diminui a produção de leite e aumentam o intervalo entre partos (Cardoso et al., 2013). Influenciam também no aparecimento de disfunções digestivas como acidoses ruminais (Lean et al., 2012) e timpanismos (Wang et al., 2012). O manejo de produção dos alimentos e do seu correto fornecimento evitam perdas significativas na produção.

Além disto, a gestão de outros processos que influenciam indiretamente a produção de leite deve ser considerada nos sistemas produtivos contemporâneos. A produção de biocombustíveis (Tirado et al., 2010), dos direitos e bem estar dos animais (William & Marsman, 2014), e da legislação para o uso da terra (Gerdessen & Pascucci, 2013), pressionam os sistemas produtivos por maior eficiência. Outros desafios para a gestão são a degradação do solo e da água (Ye & Ranst, 2009), a poluição e a destruição das florestas (Ruane & Sonnino, 2010), as mudanças climáticas (Vermeulen et al., 2012), as questões relacionadas à desigualdade social (Dean & Sharkey, 2011), a equidade e a bioética (Afridi et al., 2009; Martinelli et al., 2010) e o emprego e a educação (Floro & Swain, 2013). Estes fatores pressionam as entidades públicas e privadas para a busca de ações necessárias para ultrapassar estas barreiras. Políticas públicas para regulamentação e financiamento são importantes, não só para o desenvolvimento de novas tecnologias, mas também para sua aplicabilidade no campo (King et al., 2011). Ações políticas são determinantes para a elevação e para a rentabilidade da produção (Roibas & Alvarez, 2010).

1.3.5 Tecnológicos

A evolução das tecnologias contribui significativamente para o aumento da produção leiteira. Como exemplo, pode-se citar as utilizadas na alimentação animal (Cardoso et al., 2013; Auldist et al., 2013), no melhoramento genético (King et al., 2011), na prevenção de doenças (Lidder & Sonnino, 2012; Bruijnis et al., 2013) e a sua influencia na fertilidade das vacas (Walsh et al., 2011). Lucy et al. (2011) elucidaram o efeito do uso de tecnologias para minimizar o estresse animal, a diminuição da produção de corticoides e, consequentemente, a produção normal dos hormônios reprodutivos (GnRH e LH).

Neste contexto, evidenciam-se as tecnologias reprodutivas como importantes para maior eficiência produtiva e aumento de renda aos produtores

(Ruane & Sonnino, 2010; Qaim, 2010). Para alcançar estes resultados, a manipulação do ciclo estral (Suplicy et al., 2012), a sexagem de sêmen (Seidel & Shenk, 2008), a transferência de embriões (Stewart et. al., 2011), a inseminação intrafolicular (López-Gatius et al., 2011), a formação de clones e de organismos geneticamente modificados (King et al., 2011) tornam-se os meios para maior produtividade.

Não só a produção de tecnologias, mas também a sua difusão são de extrema importância (Davis et al., 2010). Da mesma forma, a compreensão e internalização deste conhecimento pelas pessoas, são determinantes para sua correta execução (Mendola, 2008; Dascalu et al., 2011).

2. As biotecnologias reprodutivas na produção leiteira

2.1 Efeito do uso da IA em bovinos de leite

O avanço genético na população bovina, particularmente no setor leiteiro, tem contado com dois processos: o uso dos principais touros com mérito genético e a criação seletiva de bezerros com alto mérito genético, como substitutos para reprodução (Miller et al., 2009). Para este fim, a IA manteve-se como principal veículo para a rápida dispersão de genes valiosos, e tem sido o método de escolha para os produtores de leite em todo o mundo para melhorar a qualidade genética do seu rebanho (Kaproth & Foote, 2011). Esse nível constante de progresso genético em bovinos de leite é, principalmente, devido aos avanços na tecnologia de sêmen e da rápida aceitação da IA para estabelecer genes favoráveis na população bovina (Arendonk, 2011).

O histórico da inseminação artificial demonstra que os países que iniciaram a utilização desta tecnologia em percentual expressivo do seu rebanho no século passado, aumentaram grandemente a sua produção (Mies Filho, 1987). Estas nações que mais investiram em tecnologia para ampliação da produtividade e em melhoria da qualidade durante todo o processo produtivo tornaram-se os mais importantes produtores de leite para o mundo (Siqueira et al., 2010).

Considerando áreas disponíveis, o rebanho existente, a sua produção mundial, a produtividade e a baixa utilização de tecnologia reprodutiva, o Brasil é uma das últimas fronteiras agrícolas capaz de aumentar consideravelmente a produção mundial de leite (ANUALPEC, 2008; USDA, 2010; EMBRAPA, 2012).

2.1.1 A IA como processo na eficiência produtiva

A eficiência da produção na modernidade, além do conhecimento de várias ciências, passa pela utilização de várias tecnologias que determinam a otimização dos resultados finais (Lidder & Sonnino, 2012; Ruane & Sonnino, 2010). Dentro deste contexto, o conhecimento sobre o sistema reprodutivo dos bovinos de leite, sua fisiologia, sua saúde e endocrinologia, e da ação dos fatores ambientais sobre o trato reprodutivo, tornam-se muito importantes (López-Gatius, 2012). As tecnologias em nutrição, sanidade, manejo, de equipamentos e materiais atenuam os efeitos de diferentes fatores que interferem no sistema reprodutivo (Cardoso et al., 2013).

A IA consolidou-se como principal dispersora de genes superiores, impactando positivamente a produção leiteira, pela agregação do mérito genético nos descendentes (Vishwanath, 2003). A estruturação da nutrição dos animais, prevenção contra doenças, a modernização de construções e equipamentos, a escrituração zootécnica e o treinamento das pessoas para a execução da técnica, aumentam indiretamente os efeitos da inseminação artificial, elevando significativamente o nível do rebanho, que passa a expressar de maneira mais adequada seu potencial genético (Mendola 2008; Shehu et al., 2010).

2.1.1.1 Fatores relacionados ao sucesso da IA

O anestro pós-parto e as falhas na detecção do estro, compõem os principais fatores de insucesso para a IA. O anestro está presente em 5 e 20% das vacas paridas em lactação e está relacionado à retomada do equilíbrio fisiológico e endocrinológico do sistema reprodutivo podendo ser aumentado ou diminuído em função dos efeitos ambientais (Crowe, 2008). As falhas na detecção do estro representam de 15 a 60% do insucesso da IA, e representam os maiores problemas (Law et al., 2009).

A detecção de estro configura-se pela expressão por parte da vaca e pela identificação por parte do produtor. As falhas na detecção do estro levam à inseminação de vacas que não estão no cio ou inseminação de vacas em momento inadequado, trazendo grandes prejuízos para a utilização da técnica em si e a produção leiteira (Dobson et al., 2008).

A genética está relacionada diretamente com a expressão do estro. *Bos taurus* apresentam maior receptividade e intensidade para aceitação da monta, e também maior duração do estro que os *Bos índicus.* Estes apresentam maior incidência de estros durante a noite (Roelofs et al., 2010)

O número de lactações e elevados níveis de produção de leite, associados com grande ingestão nutricional e correspondente atividade metabólica, afetam a eficiência reprodutiva, com repercussão negativa nas concentrações de estradiol e progesterona e na expressão do estro (Dobson et al., 2008; Thompson et al., 2012). Esta situação tem levado a maior atividade de vacas primíparas, enquanto as multíparas apresentam maior aceitação de monta. A cada lactação a atividade diminui, e, como consequência, os índices de detecção do estro e de prenhez ficam abaixo do desejável, situação esta não verificada nas novilhas e em vacas fora da lactação (Berg et al., 2010).

No pós-parto é comum o aparecimento do cio silencioso. Na primeira ovulação, ocorre devido ao efeito refratário ao estrogênio no hipotálamo, ocasionados pelo aumento da concentração plasmática de estradiol no final da gestação, diminuindo assim, a expressão do estro (Law et al,. 2009). Na segunda e terceira ovulação após o parto o cio silencioso é por aumento da produção de leite, do consumo de alimentos e como consequência aumento do metabolismo e depuração dos hormônios reprodutivos (Ranasinghe et al., 2010).

É também reconhecido que distúrbios do periparto tais como distocias, retenção placentária e transtornos metabólicos afetam a capacidade reprodutiva de bovinos leiteiros. Assim como as metrites, mastites e claudicações que vão do período pós-parto até o período de nova concepção, reduzem as chances para a expressão do estro e nova concepção (Roelofs et al., 2010). O estresse ocasionado pelas patologias ativam o eixo adrenal-hipotálamo-hipófise, com produção de corticoides que evita o aumento do estradiol no final do ciclo, ou da adenocorticotropina que suprime a pulsatilidade do LH. Estes eventos resultam em ovulação tardia, anovulação, assim como menor intensidade ou ausência dos sinais de estro (Dobson et al., 2008; Berg et al., 2010)

Duas ou três semanas após o parto, vacas leiteiras em bom estado corporal e de saúde, retomam a atividade cíclica normal. Mesmo em condições fisiológicas, os estressores ambientais podem determinar a supressão do retorno cíclico normal com baixos níveis de expressão, ausência dos sinais do estro ou ainda retorno ao estro (Emerick et al., 2009; Lucy et al., 2011).

O balanço energético negativo no periparto, além de acarretar ausência ou diminuição dos sinais do estro, pode também atrasar o início da ovulação ou a ocorrência de ciclos curtos ou longos (Dobson et al., 2008). A reduzida fertilidade das vacas de leite e o seu retorno ao cio, não é só devido a pouca viabilidade dos embriões traduzindo-se em morte embrionária (Thatcher et al., 2011; Thompson et al., 2012), mas também devido a estressores ambientais que reduzem a pulsatilidade do LH, com desequilíbrios hormonais para a manutenção da gestação (Roelofs et al., 2010). Estas perdas estão também fortemente associadas com o processo de lactação, quando se compara os índices de prenhez e de retorno aos cios obtidos de novilhas e vacas não lactantes com vacas em lactação (Berg et al., 2010). Rebanhos de alta produção devem ser melhor observados quanto à condição nutritiva, sanitária e reprodutiva, para maior expressão do estro e manutenção da gestação (Crowe, 2008; Thatcher et al., 2011).

Situações de estresse, ocasionadas por variações climáticas (Ranasinghe et al., 2010; Hansen & Fuquay, 2011) e por instalações inadequadas (Dobson et al., 2008), interferem no hipotálamo e na pituitária, com interrupção da secreção dos hormônios ovulatórios, diminuição dos sinais do estro e, consequentemente, não cumprimento do potencial genético para a produtividade e fertilidade.

Outros fatores ambientais como a presença de touros (Pfeiffer et al., 2012), o tamanho do rebanho, a interação vaca-bezerro e variação circadiana da luz (Roelofs et al., 2010; Vazquez et al., 2012), estimulam ou diminuem a secreção do LH e os sinais do estro.

Os tratamentos hormonais com base de progesterona aumentam a sensibilidade do hipotálamo ao estradiol, que estimula a hipófise através do GnRH, para a produção do FSH e LH (Escalante et al., 2013).

2.1.1.2 A detecção do estro

Das vacas que ovulam em até 90 dias após o parto, em média, 65% apresentam falhas na detecção do estro (Law et al., 2009). Deste total, um percentual de 15% é atribuído à falha na expressão do estro e 85% a falhas na identificação do estro (Ranasinghe et al., 2010). A falta de experiência por parte do produtor se constitui em principal falha na detecção do estro e consequentemente contribui para o declínio da fecundidade das vacas e para o insucesso da IA (Roelofs, 2010).

O tempo mínimo de 30 minutos em cada observação e o número mínimo de 2 observações diárias são de extrema importância para identificação dos sinais de estros em bovinos (ASBIA, 2012). Os fatores relacionados com a vaca e ambientais determinam um tempo de estro menor e menos intenso (Dobson et al., 2008). Esta dificuldade para identificação do estro pode ser atenuada com auxílio de equipamentos que medem a atividade da vaca ou pela mensuração de níveis hormonais no leite ou urina (Kamphuis et al., 2012)

O intervalo máximo de 12 em 12 horas na observação do estro, nas primeiras horas da manhã e no final da tarde, se faz importante, pois é mais frequente ao final da tarde, à noite e início da manhã (Diskin, 2011). Além da correta identificação do estro, o inseminador deve ter habilidade para passar o aplicador pela cérvix da vaca, depositar o sêmen no corpo do útero, e ter conhecimento do tempo da ovulação após o estro para a execução da IA (López-Gatius, 2012). Estes fatores refletem em maior taxa de concepção da vaca, menor taxa de retorno ao estro e maior êxito da IA.

2.1.2 O futuro da IA e as biotecnologias emergentes

A ciência da genética quantitativa e molecular progride a um ritmo surpreendente, e é mais do que provável que a combinação da IA com as novas e emergentes biotecnologias irão formar uma base sólida para várias estratégias de seleção ou melhoramento (Vishwanath, 2003). É também muito provável que, de alguma forma, todas estas biotecnologias serão utilizadas pela indústria de sêmen, na dispersão de esperma, para o estabelecimento de genes necessários.

A indústria bovina teve seu grande impulso a partir do uso das biotecnologias reprodutivas (Thibier, 2005). O uso crescente de sêmen importado vem demonstrando o interesse pela genética provada, através dos testes de progênie (ASBIA, 2012). A maior massificação da dispersão destes genes se deu a partir do entendimento sobre a foliculogênese para a manipulação e indução da ovulação (Herlihy et al., 2013; Wiltbank & Pursley, 2014). Este entendimento permite a inseminação artificial em tempo fixo (IATF), através de protocolos hormonais, com consequente eliminação do maior gargalo da IA, a detecção do estro (Gutiérrez et al., 2009; Hockey & Morton, 2010; Roelofs et al., 2010).

A partir do impulso da IA, começou a existir uma logística direcionada ao desenvolvimento de produtos e/ou processos, para a produção e conservação do sêmen, à identificação e seleção dos melhores reprodutores para um propósito específico, e a comercialização de produtos e serviços relacionados com a indústria da pecuária leiteira (Vishwanath, 2003).

As biotecnologias reprodutivas de sêmen desenvolvidas, as quais a IA está vinculada, compreendem aos programas de testes de progênie, pré-seleção do sexo do produto e marcadores genéticos. Enquanto os testes de progênie selecionam machos para aumento do mérito genético médio dos seus produtos (Miller et al., 2009), os marcadores genéticos selecionam com mais confiança e rapidez, permitindo maior precisão do mérito genético. (Gao et al., 2013). O desenvolvimento da pré-seleção do sexo do produto pelo sêmen influenciou fortemente a pecuária leiteira, e permitiu a intensificação nos programas de melhoramento genético, pela produção de embriões *in vitro* (DeJarnette, 2010; Seidel & Schenk, 2008).

Nas fêmeas, a IA está vinculada a várias biotecnologias reprodutivas de embriões. A transferência de embrião (TE), cujo impacto é o aumento em até 6 vezes do número de descendentes por vaca, contribui em programas de melhoramento genético, aumentando a intensidade de seleção de fêmeas, e diminuindo o intervalo entre gerações, quando seus filhos forem selecionados para programas de touros superiores (Hasler, 2014)

Da mesma forma que a TE, a produção embrionária *in vitro* (PIV) produz rápida multiplicação do material genético, encurtando o intervalo entre gerações e intensificando o processo de seleção (Bevacqua et al., 2012). Com a evolução da PIV, a técnica de punção folicular *in vivo* (*Ovum Pick-Up*) permite uma exploração mais eficiente do pool de gametas de fêmeas imaturas, as clinicamente inférteis, as que não respondem à superovulação, as idosas e aquelas até o quinto mês de gestação (Galli et al., 2014). Com o aprimoramento da PIV, técnicas relacionadas à micro-manipulação embrionária e engenharia genética como células totipotentes (stem cells), preservação de oócitos e embriões, transgênese e marcadores genéticos, podem ser aprimoradas e utilizadas (Kaproth & Foote, 2011; López-Gatius & Hunter, 2011; Galli et al., 2014).

3 Análise bioeconômica

O principal objetivo de qualquer atividade produtiva é a obtenção de lucro e, como tal, produtores de gado leiteiro devem gerir sua atividade de forma rentável e competitiva para permanecerem no negócio (Afridi et al., 2009; Shamsuddin et al., 2010). O caminho do êxito de uma pecuária produtiva reside na utilização racional dos recursos genéticos e ambientais, de maneira a maximizar o retorno líquido (lucro).

A seleção para características produtivas (produção de leite, gordura e proteína, assim como das percentagens destes componentes) reveste-se de grande importância para a atividade leiteira, visto ser o volume de leite e/ou componentes do leite a principal fonte de renda e objetivo maior da atividade (Hott & Carvalho, 2007; Atzori et al., 2013). Entretanto, a seleção extrema para características produtivas, pode levar à diminuição da eficiência reprodutiva, assim como maiores problemas com doenças e, consequentemente, da longevidade (Ouwelties et al., 2007; Lagrotta et al., 2010). A médio e longo prazo, diminuem a produção e, consequentemente, a rentabilidade da atividade (Morris et al., 2011; Hudson et al, 2012).

Deve-se considerar, ainda, que a melhoria do potencial produtivo dos animais deve ser acompanhada de um adequado avanço nas condições ambientais, em especial a alimentação (Vance et al. 2012; Gerdessen & Pascucci, 2013). Quando não atendida, as perdas em saúde e fertilidade poderão ser potencializadas (Walsh et al., 2011; Cardoso et al., 2013).

O intenso processo de seleção tem levado a progresso genético considerável, para características produtivas nos países e/ou regiões de pecuária leiteira desenvolvida, indicando a existência de variabilidade genética suficiente, para permitir um progresso genético continuado. Por exemplo, no Canadá, os ganhos genéticos para produção de leite nos últimos 5 anos foram de 39 kg/ano para Jersey e de 92 kg/ano para Holandês (CDN, 2013). Os ganhos para produção de gordura e proteína apresentam intensidades similares, sendo em alguns casos proporcionalmente mais intensas, enquanto que os valores genéticos para teores de gordura e proteína apresentam ganhos discretos.

Muitas vezes, torna-se difícil definir os critérios de seleção (Vercesi Filho et al., 2000; Sorensen et al., 2010; Thomasen et al., 2014), pois estes variam em razão do sistemas de produção, da região e do mercado (Gerdessen & Pascucci, 2013). Estratégias, neste sentido, precisam ser cuidadosamente estudadas, procurando-se antecipar às necessidades futuras do produtor, a fim de obter animais que possam ser mais lucrativos dentro de um cenário de mercado futuro, visto que os ganhos devido à seleção ocorrem somente em médio a longo prazo (Overton, 2005; Roibas & Alvarez, 2010; Kaproth & Footh, 2011; VanRaden et al., 2011). Estas peculiaridades exigem dos técnicos e produtores um adequado conhecimento das tendências do mercado, além de conhecimentos específicos da área.

3.1 Indicadores econômicos da produção

Existem duas metodologias muito utilizadas para realizar o custo de produção: custo total e o custo operacional de produção.

A metodologia proposta por Matsunaga et al. (1976), do custo operacional, foi desenvolvida devido às dificuldades em avaliar as parcelas dos custos fixos, como por exemplo a remuneração da terra, do capital investido e do empresário. O custo operacional se refere a todos os recursos de produção, que exigem desembolso por parte do produtor, ou seja, a todas as despesas efetivas (gastos com alimentação, mão de obra, sanidade, reprodução, impostos e despesas diversas);e outras despesas, como o custo com depreciação e mão de obra familiar.

Na metodologia de custos totais de produção, são considerados os custos fixos e variáveis. Os custos fixos, segundo Nogueira (2004), são representados pelos recursos que não são consumidos totalmente ao longo de um ciclo de produção. São aqueles recursos cujos valores não se alteram proporcionalmente ao aumento ou redução da escala de produção, dentro de certo limite. Por isso, quando se fala em redução dos custos fixos, subentende-se aumento de escala de produção, sem necessidade de novos investimentos.

Os custos variáveis são aqueles que variam em função da quantidade produzida, e cuja duração é igual ou menor ao ciclo de produção. Assim, eles são incorporados totalmente ao produto no curto prazo, não sendo aproveitados para outro ciclo produtivo (Lopes et al., 2007). Podem aumentar, reduzir ou, até mesmo, serem evitados, de acordo com a expansão, a redução ou a paralisação da atividade da empresa. São representados por todas as somas de gastos e desembolsos necessários à produção, incluindo tanto os pagamentos efetivamente realizados, quanto os pagamentos imputados (Marion, 2010).

A análise econômica é a comparação entre a receita obtida na atividade produtiva com os custos, incluindo a verificação de como os recursos empregados no processo produtivo estão sendo remunerados (Reis, 2002). Esta análise, resulta da estimativa de custos de produção e de indicadores de eficiência econômica, como margem bruta (MB), margem líquida (ML) e resultados (lucro ou prejuízo), e é forte subsídio para a tomada de decisões na empresa agrícola. De acordo com Matsunaga et al. (1976), tais indicadores são obtidos por meio dos seguintes cálculos matemáticos:

Custo operacional efetivo (COE) de produção – Obtido pelo somatório das despesas normais para a obtenção da produção no período considerado, tais como: ração, concentrados, mão-de-obra, transportes, produtos veterinários;
Custo operacional total (COT) – Somatório do COE e de outros custos operacionais, como depreciação de bens duráveis;
Custo total (CT) – Compreende o COT mais os juros ou renumeração do capital estável e a remuneração da terra;
Custo médio (CMe) – Calculado pela razão entre o CT e a quantidade (Q) obtida do produto:

CMe = CT/Q

Margem bruta (MB) = receita bruta total (RBT) – custo operacional efetivo (COE).

MB = RBT – COE

Margem líquida (ML) = receita bruta total (RBT) – custo operacional total (COT).

ML= RBT – COT

Lucro (L) = receita bruta total (RBT) – custo total (CT).

L= RBT – CT

Lucro médio (Lm) – Obtido pela razão entre L e produção (kg) final, em equivalente leite:

Lm = L/Produção (Kg)

A margem bruta é utilizada considerando que o produtor possui os recursos disponíveis (terra, trabalho e capital), e necessita tomar a decisão de como utilizar de forma eficaz esses fatores de produção; a margem líquida, é que permite concluir se a atividade é estável, com possibilidade de expansão e de se manter por longo prazo, quando essa for positiva. Diante de margem líquida igual a zero, a propriedade estará no ponto de equilíbrio e em condições de refazer, em longo prazo, o seu capital fixo. Por outro lado, se ela for negativa, significa que o produtor poderá continuar produzindo por um determinado período, embora com um problema crescente de descapitalização (Lopes et al., 2012b).

O resultado positivo significa que a atividade conseguiu quitar o custo total de produção, ou prejuízo, caso for negativo. Quando a receita se iguala aos custos totais, há uma condição de estabilidade, com tendência de manutenção dos níveis de produção em longo prazo. Essa situação sugere que a atividade esteja obtendo retornos iguais aos que poderiam ser obtidos em melhores alternativas de emprego de capital (Barbosa & Souza, 2011).

A lucratividade e a rentabilidade são indicadores econômicos utilizados com frequência. O primeiro consiste em estabelecer um índice percentual para representar o lucro obtido na atividade. A definição matemática, segundo o SEBRAE (2014), é a percentagem de receita que representa o lucro, ou seja:

Lucratividade = Lucro/RBT x 100

Rentabilidade = Lucro/Investimentos x 100

A rentabilidade mede a capacidade da atividade de gerar rendimento em relação ao capital disponível, demonstrando uma relação percentual entre o lucro e o investimento total. Matematicamente, ela é calculada da seguinte forma:

Rentabilidade do Patrimônio Líquido = L/patrimônio líquido x 100

Retorno sobre o Investimento (ROI)= L/ativos totais x 100

Este índice representa quanto de lucro a empresa obteve para cada R$ 100,00 de investimento total (Lopes et al., 2012a). Quanto maior o percentual de rentabilidade, melhor para a empresa.

3.2 Objetivos de seleção

Tendo o melhoramento genético animal o objetivo de aumentar a eficiência produtiva de um dado sistema de produção, verifica-se que essa pode ser influenciada por um grande número de características (Staples & Thatcher, 2011; Hudson et al., 2012; Leal et al., 2013). O aumento da eficiência do sistema de produção pela seleção é determinado, em parte, pela ênfase relativa das características incluídas nos objetivos de seleção (Vercesi Filho et al., 2007; Sadeghi-Sefidmazgi et al., 2012).

Portanto, objetivo de seleção ou genótipo agregado pode ser definido como a combinação de características importantes economicamente, dentro de um sistema de produção. A definição dos objetivos de seleção é um problema de natureza econômica e não genética (Ponzoni, 1992; Martins et al., 2003). A escolha das características a serem incluídas deve levar em consideração a sua influência na receita, no custo do sistema de produção (Vercesi Filho et al., 2007; Madalena, 2008) e deve descrever o que se quer melhorar.

O valor econômico de uma característica representa o retorno econômico adicional relativo ao melhoramento unitário da característica componente do objetivo de seleção. Por exemplo, é possível calcular o valor econômico para gordura do leite ou proteína do leite, por meio de derivações de equações de lucro, relacionando os custos e despesas inerentes a melhorias dessas características (Martins et al., 2003; Bittencourt et al., 2006).

Denominam-se critérios de seleção, aquelas características usadas para predizer o valor genético dos animais. Enquanto as características incluídas nos objetivos são um fim, os critérios de seleção são os meios usados para atingí-lo (Zadra, 2012). As características incluídas nos objetivos de seleção podem não ser usadas como critério de seleção, a depender da facilidade, custo ou técnica de medição. É muito raro haver coincidência entre as características nos objetivos de seleção e as usadas como critério de seleção (Ponzoni, 1992; Sadeghi-Sefidmazgi et al., 2012).

A definição do objetivo de seleção, segundo vários autores, constitui importante passo na elaboração de um programa de melhoramento (Harris, 1970; Harris et al., 1984; Ponzoni & Newman, 1989). Ponzoni (1988) propôs as seguintes etapas para estabelecer o objetivo de seleção:

1) Especificação do sistema de produção, acasalamento e comercialização;
2) Identificação de todas as fontes de receitas e despesas dentro de um rebanho. A partir daí, é construída uma função de lucro levando-se em conta todas as fontes de receitas e despesas dentro da propriedade, independentemente da dificuldade de mensurar a característica;
3) Determinação das características biológicas que influenciam a receita e a despesa;
4) Derivação dos pesos econômicos para cada característica da função lucro.

A escolha dos objetivos de seleção deve ser feita pela comparação entre os níveis de desempenho atual, com os objetivos futuros do rebanho e as necessidades do mercado. Uma vez que os objetivos de seleção estejam determinados, o próximo passo é estabelecer os critérios de seleção.

3.3 Critérios de seleção

As características componentes dos critérios de seleção não são necessariamente as mesmas características dos objetivos de seleção. Por exemplo, em programas de melhoramento genético animal, “qualidade do leite” e “resistência a doenças” são as características a serem melhoradas; enquanto “extrato seco total, extrato seco desengordurado, proteína, gordura” e “contagem de células somáticas e contagem bacteriana total”, são características mensuradas para fins de seleção (Parnell, 2000). Assim, o número de característica que compõem os objetivos de seleção não é necessariamente a mesma dos critérios de seleção. Um segundo exemplo em programa de melhoramento genético de bovinos seria o de que a precocidade deve ser melhorada, mas os critérios de seleção consistem na idade ao primeiro parto e intervalo de partos.

Para definir os objetivos de seleção, é necessário estabelecer metas de desempenho futuro para as características a serem selecionadas e conhecer os níveis atuais de produtividade média dos animais (Vercesi & Madalena, 2011). Comparando-se o desempenho atual com as metas futuras, de acordo com o mercado, é possível identificar as características a serem enfatizadas na seleção (Seno et al., 2007). O lucro não é afetado pelos critérios de seleção, e estes são utilizados para indicar o mérito genético total do animal. Estes critérios são recursos para tentar melhorar o objetivo do criador (Vercesi et al., 2007; Zadra, 2012).

Em programas de melhoramento genético de bovinos leiteiros, pode-se ter como objetivo de seleção a quantidade de leite produzido (kg/animal/dia); esta característica pode ser melhorada e apresenta valor econômico. Similarmente, pode-se utilizar a quantidade de leite produzido (kg/animal/dia) como critério de seleção, por ser, também, uma característica mensurada para fins de seleção.

As características incluídas no objetivo de seleção não são necessariamente as mesmas a serem selecionadas (critério de seleção), conforme apresentado no Quadro 1. Vários autores têm mostrado a correlação da contagem de células somáticas com a resistência à mastite (Seno et al., 2007; Sorensen et al., 2010). Obtêm-se, portanto, como objetivo de seleção, a resistência à mastite e contagem de células somáticas como critérios de seleção.

Assim, a definição dos objetivos de seleção é a base para escolher os critérios de seleção que maximizarão o ganho genético-econômico.

QUADRO 1 – Objetivos e critérios de seleção para sistemas de criação de bovinos leiteiros.

Objetivos de seleção	Critérios

Produção de leite	Quantidade, gordura e proteína do leite, peso metabólico da vaca seca, unidade formadora de colônias, contagem de células somáticas, contagem bacteriana total, taxa de descarte, fluxo lácteo, intervalo de partos, idade ao primeiro parto, número de serviços por concepção, idade aos 330 kg.
Qualidade do leite	Extrato seco total, extrato seco desengordurado, proteína e gordura, unidade formadora de colônias, contagem de células somáticas e contagem bacteriana total.
Resistência a doenças (mastite)	Unidade formadora de colônias, contagem de células somáticas, contagem bacteriana total, taxa de descarte e fluxo lácteo.
Fertilidade	Intervalo entre partos, idade ao primeiro parto, número de serviços por concepção e idade aos 330 kg.
Longevidade	Taxa de descarte enúmero de lactações.

3.4 Ponderadores econômicos de seleção

Na definição dos objetivos de seleção devem ser levadas em consideração todas as características que influenciam na receita e despesa, que devem ser combinados de acordo com seus respectivos valores econômicos relativos (Ponzoni & Newman, 1989; Krupova et al., 2009; Togashi & Lin, 2009). Espera-se que a resposta à seleção seja maior, em unidades monetárias, se os indivíduos forem ordenados de acordo com os objetivos de seleção (Wolfová et al., 2007a; Wolfová et al., 2007b). As características consideradas nos objetivos de seleção são, portanto, a base para a formulação da função lucro, a partir da qual são derivados os ponderadores econômicos (Vercesi Filho et al., 2000; Cunningham & Tauebert, 2009).

Genericamente, uma função de lucro é um procedimento ou regra que utiliza o valor genético de diversas categorias como entrada e produz lucro como saída (Chen et al., 2009). Pode incluir variáveis que são controladas por decisões de manejo (produção de leite por hectare de terra), mas esta inclusão é necessária apenas quando estas variáveis interagem com características, que afetam os lucros, que são denominadas “características de relevância econômica” (Togashi & Lin, 2009).

A escolha das características relevantes economicamente depende das condições que se tem para produzir. Uma característica pode ser relevante dentro de uma determinada circunstância, e não ser em outra (Queiroz et al., 2005). Por exemplo, a predição do valor genético para resistência a ectoparasitas, pode ser interessante quando o custo do tratamento dos animais susceptíveis for importante, mas não se justifica quando este custo for desprezível, quando comparado a outros custos.

O ponderador econômico de uma característica representa o retorno econômico adicional por unidade de melhoramento na característica (Cameron, 1997), sendo calculado derivando-se parcialmente a equação de lucro, a qual é função das receitas e dos custos do sistema de produção (Chen et al., 2009; Cunningham & Tauebert, 2009). Neste cálculo, mudanças nos fatores de produção e nos produtos provocadas por mudanças no mérito genético dos indivíduos, devem ser quantificadas. A equação de lucro deve incluir as receitas e os custos referentes a um período fixo de tempo. Valores econômicos incorretos ou a omissão de características importantes, quando da definição dos objetivos de seleção, podem levar a perda de eficiência no melhoramento da produção animal.

A principal ferramenta utilizada no cálculo dos valores econômicos das características de interesse mediante a aplicação de equações de lucro (*profit functions*) ou de modelos bioeconômicos (BEM), é a modelagem ou análise sistêmica. Esses modelos baseiam-se em análises conjuntas entre o aspecto econômico e produtivo, relacionando custos, receitas, dados biológicos e o manejo realizado na propriedade (Chen et al., 2009). Duas abordagens podem ser distinguidas da análise sistêmica: a abordagem positiva ou avaliação de dados e a abordagem normativa ou simulação de dados (Krupova et al., 2008).

Na abordagem positiva, são usados dados técnicos e econômicos observados. No caso da simulação, são usadas as equações de lucro e os modelos bioeconômicos. No Brasil, Cardoso et al. (1998) apresentaram um modelo bioeconômico, o qual simula produções de leite, gordura e proteína e peso das vacas, de acordo com a ordem de parto, níveis de produção e duração dos intervalos de partos. Já Vercesi Filho et al. (2000) e Bueno et al. (2004) apresentaram uma avaliação de dados, de dois sistemas de produção de leite, pelo uso de equações de lucro.

O objetivo em ambos os casos (modelos bioeconômicos e equações de lucro) é a obtenção da receita líquida, obtida pela diferença entre a receita obtida com o produto menos o custo estimado de produção. A modelagem de sistemas de produção animal fornece uma boa compreensão da sensibilidade dos valores econômicos, às circunstâncias de produção no nível do animal, do rebanho, da fazenda e níveis superiores.

HIPÓTESES DO TRABALHO

- Os fatores produtivos, ambientais e socioeconômicos diferenciam a produção de bovinos de leite, entre as mesorregiões e municípios nos Estados do Rio Grande do Sul e Santa Catarina;

- A utilização da inseminação artificial está associada a maior produção leiteira dos sistemas produtivos de bovinos de leite da Mesorregião Noroeste Rio-grandense;

- Os valores econômicos das características produtivas, funcionais e de fertilidade podem ser usados na seleção para maior lucro pelos produtores de bovinos de leite, da Microrregião de Passo Fundo.

OBJETIVOS GERAIS

- Identificar e discriminar entre as Mesorregiões e Municípios dos Estados do Rio Grande do Sul e Santa Catarina para produção de leite;

- Avaliar o efeito da inseminação artificial sobre a produção leiteira em propriedades da Mesorregião Noroeste Rio-grandense;

- Determinar os valores econômicos das características produtivas, funcionais e de fertilidade de rebanhos leiteiros da Microrregião de Passo Fundo.

Objetivos específicos

- Espacializar os fatores produtivos, ambientais e socioeconômicos que melhor discriminam a produção de bovinos de leite, por Mesorregião e por Municípios, nos Estados do Rio Grande do Sul e Santa Catarina;

- Determinar o impacto do uso da IA sobre o desempenho produtivo de bovinos leiteiros, na Mesorregião Noroeste Rio-grandense, pela associação com os seguintes fatores: produtivos, nutricionais, gestão, tecnologias e capital como investimento; e discriminar quais os fatores produtivos que melhor explicam esta produção;

- Predizer quais os valores econômicos das características produtivas, funcionais e de fertilidade para os objetivos econômicos de seleção, para os sistemas de produção de bovinos leiteiros da Microrregião de Passo Fundo.

METODOLOGIA GERAL

O experimento foi conduzido na região sul do Brasil entre os períodos de 2009 e 2012 para analisar a eficiência dos rebanhos leiteiros pertencentes a esta região. O estudo foi dividido em três partes: análise discriminatória da produção leiteira pelos fatores produtivos e ambientais, entre as unidades políticos administrativas dos estados do Rio Grande do Sul e Santa Catarina, a associação do uso da inseminação artificial com a produção leiteira de rebanhos leiteiros pertencentes a Mesorregião Noroeste Rio-grandense e, derivação de valores econômicos para as características relacionadas a produção de leite de vaca à serem utilizados em programas de melhoramento genético visando o lucro dos produtores, para rebanho leiteiros pertencentes a Microrregião de Passo Fundo.

No primeiro estudo, os dados foram extraídos do banco de dados censitários de 2006 do Instituto Brasileiro de Geografia e Estatística, Instituto Nacional de Meteorologia, Instituto Nacional de Pesquisas Espaciais, United States Geological Survey e do Programa das Nações Unidas para o Desenvolvimento (IBGE, 2006; INMET, 2012; INPE, 2012; USGS, 2012; PNUD,

2010) e estão descritos nos Anexos 1 e 2 do capítulo II. Para análise dos dados, utilizou-se uma base por município e por *cluster* formado, que também serviram como fontes de variação.

Para o segundo estudo, os dados foram extraídos através da aplicação de questionários a produtores de leite pertencentes à mesorregião NO e do arquivo de informações sobre cursos de extensão para a capacitação de produtores para a técnica da inseminação artificial, do Instituto Federal de Educação, Ciência e Tecnologia do Rio Grande do Sul – Campus Sertão (IFRS, 2012) e estão descritos nos Anexos 1 e 2 do capítulo III. Foram classificados de acordo com sua relação com a produção, atividades desenvolvidas, capital como investimento, tecnologias e a inseminação artificial. Os dados foram analisados utilizando-se uma base por propriedade e por *cluster* formado, que também serviram como fontes de variação.

Os dados para o terceiro estudo foram extraídos pelos técnicos do Serviço Brasileiro de Apoio às Micro e Pequenas Empresas (SEBRAE), através do acompanhamento de dados zootécnicos e econômicos mensais de 61 propriedades pertencentes a microrregião de Passo Fundo – RS entre os anos de 2009 a 2011 (Anexo 1 do capítulo IV). Os dados foram analisados a partir da formação de dois *clusters* que representaram dois sistemas produtivos da região em estudo.

As variáveis estudadas foram padronizadas por meio do procedimento STANDARD, assumindo-se média zero (0) e variância um (1). Foram realizadas análises da variância por meio do procedimento GLM para as variáveis relacionadas em estudo, com fontes de variações, os *clusters* formados. As médias foram ajustadas pelo método dos quadrados mínimos (LSMEANS). Para comparação das médias, utilizou-se teste de Tukey a 5% de probabilidade ($p<0,05$) e Duncan a 10% ($p<0,10$) de probabilidade para análises no capítulo IV.

Análises multivariadas foram realizadas para determinar os múltiplos fatores que poderiam influenciar nas fontes de variação. Foi utilizada análise canônica das variáveis para a formação de cenários com a finalidade de discriminar grupos em conjunto de dados. O procedimento FASTCLUS foi utilizado para formar grupos semelhantes a partir da frequência média de observações das variáveis utilizadas e relacionadas à produção. Para melhor entender a estrutura de correlação e tentar compreender as fontes de variação dos dados foram realizados a análise fatorial via matriz de correlação, utilizando-se o procedimento FACTOR. Nesta análise, a suposição de ortogonalidade foi testada pelo critério KMO (KAISER, 1970). A opção *smc (squared multiple correlations)* foi utilizada para melhorar a explicação de cada fator sobre a variância total. Utilizou-se o teste *scree* para estabelecer o número mínimo de variáveis a serem consideradas.

Para verificar e informar o nível discriminatório das varíaveis em diferenciar os clusters formados foi realizado o procedimento DISCRIM (LACHENBRUCH, 1997). Para determinar os subconjuntos de variáveis quantitativas utilizadas que melhor discriminam os clusters utilizou-se o procedimento STEPDISC ($p< 0,10$).

Para análise das variáveis qualitativa, as mesmas foram categorizadas e utilizadas no procedimento CORRESP para mostrar o grau de associação entre si, com o uso da inseminação artificial e com as fontes de variação.

Modelos bioeconômicos (BEM) ou equações de lucro (*profit functions*) foram utilizadas para o cálculo dos valores econômicos. Os resultados foram dados pela diferença entre o lucro médio antes (Lm) e após o melhoramento (Lm'), pela equação Ve = Lm' – Lm, em que (Ve) é o lucro médio do sistema após aumentar cada característica em 1%, mantendo a média das demais inalterada (PONZONI & NEWMAN 1989). Utilizaram-se aumento percentual (1%) com intuito de padronizar a escala de mudança da característica. Utilizou-se planilhas do Microsoft Excel® como ferramentas para cálculo dos valores econômicos.

Todas as análises foram realizadas, utilizando-se o programa computacional *Statistical Analysis System* (SAS, *Cary*, *North Carolina, v.9.3*).

CAPÍTULO II

Spatial distribution of productive, environmental and socioeconomic factors that discriminate the production of dairy cattle in RS and SC[1]

[1] Artigo elaborado conforme as Normas da Animal Science Journal (Anexo 3).

Spatial distribution of productive, environmental and socioeconomic factors to discriminate dairy cattle production in Southern Brazil

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Running title: Spatialization of Dairy Production

ABSTRACT

The southern region of Brazil differs from the others due to its higher productivity in milk production. The heterogeneity of production, climate and soil diversity, and environmental and socioeconomic reality contributes to differentiate political administrative regions. In this study we aimed to spatialize productive, environmental and socioeconomic factors that best discriminate the production of milk cows in the southern states of Brazil. Multivariate analyses were performed to discriminate both the study variables in the mesoregion and cities of these states. The Western Catarinense and Northwestern Rio-grandense mesoregion showed the highest production indices, but they were discriminated at a low level (35.76 %). The formation of clusters showed that Casca, Marau and Santo Cristo from the Northwestern Rio-grandense and Concordia, Coronel Freitas, Palmitos and São Lourenço do Oeste from the Western Catarinense mesoregion had higher production indices. The municipal clusters were discriminated at a high level by production (98.24%) and environmental (72.75%) factors. Production variables were the most important for discrimination of local clusters.

Key words: cluster, principal components, multivariate analysis, spatialization.

INTRODUCTION

The elimination of the external factors that negatively affect production is important for the improvement of the efficiency and competitiveness in dairy farming. Farmers, in general, try to reduce the negative effects of environmental factors (soil and climate, vegetation and geomorphology), socioeconomic factors (gross domestic product and population) and technological (knowledge on factors such as nutrition, management, reproduction and health) to obtain better results (Herrero *et al*. 2010).

Milk production is affected by factors such as genetics, environment such as temperature, air humidity, photoperiod, altitude, precipitation and climate change which lead to changes in technology and management use. Socio-economic factors also influence milk production, influencing the choice of production system and its productivity.

Brazil, as a country of continental size, features a wide variety of climates, as well as the economic diversity social, political and cultural contributing to a variety of dairy farming, production systems and the use of technologies in their territories.The wide distribution of milk production (Costa *et al*. 2013) leads to heterogeneity in production systems, leading to a spatial distribution of productivity (Zoccal *et al*. 2012). This heterogeneity contributes to lack of information on geographic distribution and the factors that interfere in milk production indices.

The interaction between environment and production leads to changes in production systems at different levels, and can influence farmers increasing, changing or abandoning the system. Climate change can also lead to the need for adaptations within the production system. There is a need to understand these factors, reduce their effects and use them as indicators for decision making to increase production efficiency.

Joost *et al.* (2010) and Lopes *et al*. (2012) showed the use of joining several variables in a spatial model to better understand animal production systems. The objective of the present study was to spatialize production, environmental and socioeconomic factors to better understand milk production in Rio Grande do Sul and Santa Catarina States in Brazil.

MATERIALS AND METHODS

The survey was conducted in the states of Rio Grande do Sul and Santa Catarina, where the productive, environmental and socioeconomic factors that differentiate the production of dairy cattle among 789 municipalities and 13 mesoregions composing these States were spatialized.

Data were extracted from the Agricultural Census (2006) from Brazilian Institute of Geography and Statistics, the National Institute of Meteorology, National Institute for Space Research, United States Geological Survey and the United Nations Program for Development (IBGE, 2006; UNDP, 2010; INMET, 2012; INPE, 2012; USGS, 2012). For data analysis, municipality and mesoregions were used as the basis of the study. New variables were created for production depending on the area, gross domestic product and human population of the regions.

The variables were standardized by means of the STANDARD procedure, assuming the mean zero (0) and variance one (1) in SAS (Statistical Analysis System, Cary, NC, USA). Clusters of mesoregions and municipalities were formed according to production levels (PROC CLUSTER, TREE).

Canonical variable analysis (CANCORR, CANDISC) was used to discriminate groups of clusters, mesoregions and municipalities in the dataset. A factor analysis of the correlation matrix (PROC FACTOR) was used to better understand the structure of the data. The orthogonality criterion KMO (KAISER, 1970) was used to test the model. *SMC (squared multiple correlations)* was used to improve the explanation of each factor on the total variance. We used the scree test to establish the minimum number of variables to be considered.

Discriminate analysis (PROC DISCRIM, STEPDISC) was used to verify the use of variables in differentiating among mesoregions (Lachenbruch, 1997).

RESULTS AND DISCUSSION

Geographical distribution and production

The Western mesoregion (Table 1) has the largest number of cows milked and the higher production. However productivity and milked cows for effective herd are not higher in middle Northwestern Rio-grandense mesoregion. The number of cows milked per effective herd size determine greatest number of dairy cows by total herd and explain greater effectiveness of production systems. These factors indicate that these two mesoregions are the most efficient and specialized in dairy farming in the states of SC and RS, as also seen for productivity indices (Table 2).

All mesoregions show distinct production levels (Tables 1 and 2). These are related to environmental and socioeconomic peculiarities in each region. The Northwest Rio-grandense mesoregion has highest milk production, followed by the Western Catarinense. These differences are attributed not only to the specialization of production systems and environmental effects, but also to the use of biotechnology, with technical guidance, the level of information of producers, and the demand for this product. Several authors (Fuhrer *et al*. 2014; Liang *et al.* 2013) showed that environmental factors affect the level of production and productivity. The adoption of technologies such as management practices and techniques for animal breeding, contributed to the intensification of production systems (Ferraz & Eller, 2010).

The differences among the average estimates of cows milked, production and productivity among mesoregions also arise from distinctions among different types of herds (Table 1). When specialized herds don't use improved technologies results tend to be less satisfactory (Hansen & Fuquay, 2011; Staples & Thatcher, 2011).

The highest number of milked cows, levels of production and productivity, as well as their relations by area and gross domestic product per capita (Table 2) are located in the Western of Catarinense and Northwestern of Rio-grandense mesoregions. These results reflect the productive efficiency of dairy herds in these two mesoregions, showing greater specialization of livestock, intensification of processes and the economic and social importance in these regions (Siqueira & Carneiro, 2012).

Although the Northeastern Rio grandense mesoregion had significantly lower milk production (Table 1), it had higher productive efficiency. The production factors by area, gross domestic product and per capita are statistically equal between Western Catarinense and Northwestern Rio-grandense. These relationships are important in economic terms, because regions with higher gross domestic product and a larger number of people demand more animal products (Gerbens-Leenes *et al.* 2010).

The Southeast and Southwest Rio-grandense mesoregions showed no differences with the most productive mesoregions (Western Catarinense and Northwestern Rio-grandense), compared to average estimates of milked cows and their relationships by area, gross domestic product and per capita. However the production and productivity were lower ($p < 0.05$). These results indicated that these two mesoregions are less specialized for milk production, characterized by subsistence or small-scale production (Zoccal *et al.* 2012). These mesoregions are more specialized in meat production, having 50 % of the total number of cattle in Rio Grande do Sul State and only 3% of cows milked in the effective herd (IBGE, 2011). The Southeast Rio-grandense does not differ from Western Catarinense and Northwestern Rio-grandense (in terms of quantity of milk per gross domestic product and population. These two mesoregions are characterized by the presence of large farms with lower rates of economic growth. The economy is not diversified, being based on the primary sector, having been colonized by immigrants and therefore with a cultural differences compared to the northern half of Rio Grande do Sul state (Fee, 2012).

The East Central and West Central Rio-grandense mesoregions, despite having smaller dairy herd, production and productivity does not differ from other more productive mesoregions in terms of production by gross domestic product and population. These results show a direct relationship to the number of inhabitants and gross domestic product, these regions have smaller dairy herd, milk production and productivity, lower gross domestic product and number of inhabitants (Fee, 2012).

The Metropolitan Porto Alegre region has a smaller herd and milk production among all mesoregions, but not differs from the middle region of Greater Florianopolis Catarinense. This mesoregion concentrates large cities, industrial parks and shopping malls. The herd in this region shows little specialization (Zoccal *et al*. 2012).

Characteristics of production

The value of Kaiser-Meyer- Olkin (KMO), which represents a measure of adequacy of the sample was 0.63. A minimum of two factors was necessary to explain an average percentage of 63 % of the variance.

There was a positive relationship between production variables (Figure 1) and their relationship by area, population and gross domestic product (Autovector 1). However, there is a subgroup of mesoregions (Autovector 2) where there is a high number of milked cows per effective herd size (MCEH) and their relationships (MCEH_area; MCEH_GDP; MCEH_pop) and low number of milked cows (MC) and amount of milk (AM). These mesoregions are less productive and less competitive. The production growth can be explained by the greater professional and are influenced by environmental

(Staples & Thatcher, 2011), socioeconomic (Mapiye *et al*. 2011) and technological factors (Main *et al*. 2012).

Clustering by municipalities

The grouping of municipalities by productivity (Figure 2) showed that the high cluster (low production) consists of 439 municipalities belonging to all mesoregions. Cluster 2 (average to high production) consists of 11 municipalities in the Northwest Rio-grandense, 16 in Western Catarinense, 02 in Eastern center Rio-grandense, 01 in Northeast Rio-grandense, 02 in Southeast Rio-grandense, 01 in Southwest Rio-grandense e 01 in South Catarinense. High production (cluster 3) is formed by municipalities belonging to the Noroeste Rio-grandense (03) and Oeste Catarinense (04). The fourth (average) and fifth (average to low) clusters are formed by 77 and 229 municipalities, respectively, in all 10 mesoregions.

The most productive group of municipalities include Casca, Marau and Santo Cristo, in the Northweste Rio-grandense and Concórdia, Coronel Freitas, Palmito and São Lourenço do Oeste belonging to the Western Catarinense mesoregion with an average yield of 3492.14 liter/cow/year and 11.44 liter/cow/day. Less productive municipalities are present in the North Catarinense, South Catarinense and Vale do Itajaí Catarinense regions with productivity of 1713.66 liter/cow/year and 5.61 liter/cow day (Table 3). Production systems in these regions are characterized by their family farming, with dairy production and handmade cheeses for comsuption.

Productive factors on discrimination of milk production per cluster

Greater than 97% of municipalities were correctly allocated in their clusters due to production levels. Unlike the poor discrimination among mesoregions (35.67%), grouping by municipality due to the similarity in production enables high differentiation among the groups formed. Therefore, political units within the administrative mesoregions have different production and may be influenced by several factors.

In cluster 3, composed of the more productive municipalities, there was no confounding with other clusters. Clusters 2, 4, 5 and 1, the second, third, fourth and fifth most productive show high levels of discrimination, 97.6%, 98.7%, 97.82% and 97.1% respectively.

These results contrasted with those obtained in the discriminate analysis for mesoregion, showing that this was due to the diversified productions in the municipalities, resulting in similar production levels. The production in the municipalities is the result of the genetic makeup of the herds (Vance *et al.* 2013) and also the interaction with soil and climatic variables (Fuhrer *et al.* 2014), socioeconomic (Mapiye *et al.* 2011), and technological (Costa *et al.* 2013) variables. These factors help to increase the understanding of the spatial distribution of milk production (Lopes *et al.* 2012).

The quantity of milk produced, productivity and number of cows milked explain 93.01%, 12.11% and 20.72% of the variation among clusters (Table 4). The quantitative variables (AM and MC) better explain the difference between clusters compared to productivity variables (Produc). These variables are important to determine the productive and economic efficiency of dairy farming (Roibas & Alvarez, 2010).

Environment factors on discrimination of milk production per cluster

Environmental and socioeconomic factors were used to discriminate the groups of municipalities formed. The discriminatory power of these factors ranged from 59.46% to 85.71% with an average 72.75%. Environmental and socioeconomic variables explained most of the differences between the clusters formed. Agricultural management with rotational grazing is the main management variable explaining the variation among clusters (42.88%). Clusters that showed the highest number of properties that perform the management of rotational grazing had significantly higher production. Nutrition is a key factor for animal production. Strategies to improve that (Auldist *et al.* 2013), as well as nutritional imbalances and excesses (Lean *et al.* 2013) have been widely studied to circumvent the negative effects on animal production.

Farmers with off-farm jobs and other agricultural activities significantly explain the variation among clusters (Table 5). Producers with non-agricultural activity or farming and non farming did not help to explain this variation. Farm owners with off-farm jobs and those who have farming with other agricultural activities influence in higher productivity significantly. The practice of off-farm or other activity affects specialization as well as production and productive efficiency (Khanal *et al.* 2010).

Farms with water sources (springs, rivers, streams and ponds and / or reservoirs), protected forests or not explained the difference among the clusters. Water availability has direct effects on forage and animal production (Crane *et al.* 2011). For Nardone *et al.* (2010), improving information on biophysical vulnerability contributes to optimize production and address the effects of climate change. This understanding by the producer about risks with drought and by the government for investment in irrigation ensures understanding and application of better practices for increasing productivity (Milgroom & Giller, 2013).

The climatic factors explained the majority of differences between groups were temperature and altitude which correlates with the temperature, because they alter the comfort zone of the animals thus altering their physiology, metabolism and endocrinology. The effects of an increase in these factors affect the animal organism in various ways, determining in general decreased production, which may affect the quantity and quality of milk (Staples & Thatcher, 2011), reproductive physiology (Hansen & Fuquay, 2011), mortality rates (Vitali *et al*. 2009) and the breeds (Liang *et al.* 2013).

In terms of management factors, men between 5 and 10 years responsible for the farm and technical guidance received by the government, farmer and cooperatives explained most variations between clusters. The clusters that were less technical guidance were significantly less productive. There is, at present, a restructuring of activities and job responsibilities (Hovorka, 2012), but cultural and historical issues still determine that the man should be the farm manager and the woman a collaborator. Mapiye *et al*. (2011) also noted that cattle management was performed mostly by men.

The human development index was the socioeconomic variable that best explained variation among clusters. The higher human development index, the greater consumption and demand for product quality as well as a higher degree of understanding and application of methods in production processes. When technical guidelines are well understood and applied to the property, these can result not only in higher production (Main *et al.* 2012), but in improved animal welfare (Paranhos da Costa *et al*. 2012). The process of learning about new technologies (Scherzer *et al.* 2010), the understanding of productivity and extension services (Volanis *et al.* 2007) contribute in the management and development of more productive systems. Policies for the development of human capital (Davis *et al.* 2010) are important actions for economic and social development and consequently production (Mendola, 2008).

The results generally showed the importance of knowing the effects of the environment on the animals as a mean to understand the different production levels (Andreu-Vázquez *et al.* 2012). Consequently, technologies in animal breeding (Ferraz &

Eller, 2010), management (Khanal *et al.* 2010) and reproductive (Hansen & Fuquay, 2011) processes become important tools to reduce the negative effects of the environment on the production levels.

Conclusion

Physical, climatic and socioeconomic variables are important components that should be considered to meet the challenges to greater productive efficiency and thus allow early recognition of local, natural and social conditions between regions determining the use of different technologies according to their purposes.

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Figure Legends

Figure 1 Graphical representation of the key production factors between the mesoregions of RS and SC states.

Abbreviations see table 3.

Figure 2 Clusters of municipalities formed due to milk production and productivity.

Table 1 Least squared means per municipality within the mesoregion for milked cows, amount of milk, productivity and % of milked cows in herd

Mesoregion	Milked Cows (head)	Milk (1 000 liters)	Produtivity (L/cow/year)	Milked Cows/ Effective Herd (%)
W_SC	4762.4[a]	13720[a]	2859.0[a]	26.19[a]
SE_RS	3991.9[ab]	6043[bcd]	1512.1[bcde]	21.24[a]
NW_RS	3921.5[ab]	10275[ab]	2604.8[a]	23.65[a]
SW_RS	3807.5[ab]	7000[bc]	1726.9[bcd]	31.79[a]
NE_RS	2953.2[abc]	6925[bc]	2791.1[a]	21.52[a]
ME_RS	2502.0[bcd]	5511[bcd]	1993.4[b]	21.70[a]
MW_RS	2382.3[bcd]	2943[cd]	1173.5[e]	24.57[a]
Highlands_SC	2375.4[bcd]	3348[cd]	1295.0[de]	22.10[a]
S_SC	2269.4[bcd]	4069[cd]	1637.7[bcde]	21.27[a]
Itajaí Valley_SC	2254.7[bcd]	3807[cd]	1727.1[bcd]	24.02[a]
Greater Flor_SC	1851.7[cd]	2486[cd]	1390.9[cde]	24.52[a]
N_SC	1535.3[cd]	3138[cd]	1801.5[bc]	26.58[a]
POA Met_RS	755.1[d]	1453[d]	1736.8[bcd]	23.89[a]
CV (%)	84.42	94.45	31.34	76.84
Mean	3033.45	7154.81	2173.35	23.89

[abcde] different superscripts in column indicate statistically significant difference ($p < 0.05$) between the mesoregions using Tukey test. CV: coefficient of variation

Abbreviations: W_SC: Western Catarinense mesoregion; SE_RS: Southeast Rio-grandense mesoregion; NW_RS: Northwestern Rio-grandense mesoregion; SW_RS: Southwest Rio-grandense mesoregion; NE_RS: Northeast Rio-grandense mesoregion; ME_RS: Mideast Rio-grandense mesoregion; MW_RS: Midwest Rio-grandense mesoregion; Highlands_SC: Highlands Catarinense mesoregion; S_SC: Southern Catarinense mesoregion; Itajaí Valley_SC: Itajaí Valley Catarinense mesoregion; Greater Flor_SC: Greater Florianópolis Catarinense mesoregion; N_SC: North Catarinense mesoregion; POA Met_RS: Porto Alegre Metropolitan Rio-grandense mesoregion

Table 2 Least square means per municipality within the mesoregion for cows milked, amount of milk, productivity and % of milked cows in herd per area, gross domestic product and per capita

Mesoregion	MC_area (head/ km²)	MC_GDP (head/R$ 1000)	MC_Pop (head/hab)	AM_area (1.000l/ km²)	AM_GDP (1 000 l/R$ 1 000)	AM_pop (1 000l/inhabitants)	Produc_area (L/cow/ km²)	Produc_GDP ((L/cow/R$ 1 000)	Produc_pop (L/cow/inhabitants)	MCEH_area (%/km²)	MCEH_gdp (%/R$ 1 000)	MCEH_pop (%/inhabitants)
MW_RS	9.40^{bcd}	0.0278^{bcde}	0.4223^{abcde}	10.75^{d}	0.0288^{cde}	0.4475^{cd}	5.168^{cd}	0.0141^{cd}	0.2111^{cd}	0.1359^{ab}	0.000349^{ab}	0.00525^{abc}
ME_RS	11.76^{bcd}	0.0346^{abcde}	0.5122^{abcde}	28.93^{bcd}	0.0831^{abcde}	1.2970^{abc}	10.854^{bcd}	0.0308^{abc}	0.4724^{abc}	0.1032^{ab}	0.000316^{ab}	0.00499^{abc}
Greater Flor_SC	5.08^{cd}	0.0252^{bcde}	0.2823^{cde}	7.05^{d}	0.0308^{cde}	0.3487^{cd}	5.402^{cd}	0.0164^{cd}	0.1816^{d}	0.0833^{ab}	0.000324^{ab}	0.00373^{abc}
POA Met_RS	3.76^{cd}	0.0105^{de}	0.1501^{e}	7.20^{d}	0.0203^{de}	0.2895^{cd}	10.533^{bcd}	0.0260^{bcd}	0.3671^{bcd}	0.1470^{ab}	0.000391^{ab}	0.00523^{abc}
NE_RS	19.31^{ab}	0.0462^{abcd}	0.6395^{abcd}	53.05^{abc}	0.1147^{abc}	1.6499^{ab}	19.808^{a}	0.0484^{a}	0.6793^{a}	0.1566^{ab}	0.000376^{ab}	0.00512^{abc}
NW_RS	21.74^{ab}	0.0570^{abc}	0.7896^{ab}	56.23^{ab}	0.1476^{ab}	2.0519^{ab}	15.033^{ab}	0.0394^{ab}	0.5642^{ab}	0.1344^{ab}	0.000385^{ab}	0.00544^{abc}
N_SC	2.48^{d}	0.0053^{e}	0.0735^{e}	4.74^{d}	0.0097^{e}	0.1357^{d}	3.845^{cd}	0.0081^{d}	0.1102^{d}	0.0612^{ab}	0.000122^{b}	0.00161^{c}
W_SC	26.56^{a}	0.0584^{ab}	0.8525^{ab}	76.19^{a}	0.1624^{a}	2.4176^{a}	20.291^{a}	0.0486^{a}	0.6966^{a}	0.1821^{a}	0.000471^{a}	0.00649^{ab}
SE_RS	21.89^{ab}	0.0711^{a}	0.8705^{a}	34.26^{bcd}	0.1077^{abcd}	1.3172^{abc}	6.655^{cd}	0.0216^{bcd}	0.2801^{bcd}	0.0882^{ab}	0.000289^{ab}	0.00366^{abc}
Highlands_SC	3.60^{cd}	0.0331^{bcde}	0.4022^{bcde}	4.72^{d}	0.0417^{cde}	0.5064^{cd}	2.933^{d}	0.0236^{bcd}	0.2841^{bcd}	0.0412^{b}	0.000359^{ab}	0.00437^{abc}
SW_RS	16.72^{abc}	0.0402^{abcde}	0.7396^{abc}	25.17^{bcd}	0.0644^{bcde}	1.1461^{bcd}	7.658^{bcd}	0.0201^{bcd}	0.3265^{bcd}	0.1734^{a}	0.000427^{ab}	0.00684^{a}
S_SC	10.30^{bcd}	0.0178^{de}	0.2265^{de}	18.35^{cd}	0.0327^{cde}	0.4386^{cd}	9.713^{bcd}	0.0156^{cd}	0.2138^{cd}	0.1318^{ab}	0.000174^{ab}	0.00226^{bc}
Itajaí Valley_SC	10.43^{bcd}	0.0201^{cde}	0.2983^{cde}	18.06^{cd}	0.0343^{cde}	0.5073^{cd}	11.395^{bc}	0.0167^{cd}	0.2210^{cd}	0.1523^{ab}	0.00023^{ab}	0.003187^{abc}

^{abcde}different superscripts in column indicate statistically significant difference ($p < 0.05$) between the mesoregions using Tukey test. Abbreviations for mesoregions see table 1. MC_area: Milked cows per area (head/km²); MC_GDP: Milked cows per gross domestic product (head/RS1000); MC_Pop: Milked cows per population (head/hab); AM_area: Amount of milk per area (1.000l/ km²); AM_GDP: Amount of milk per gross domestic product (1000l/R$1000); AM_Pop: Amount of milk per population (1000l/inhabitants); Produc_area: Productivity per area (L/cow/km²); Produc_GDP: Productivity per gross domestic product (L/cow/R$1000); Produc_pop: Productivity per population (L/cow/inhabitants); MCEH_area: Milked cows per effective herd per area (%/Km²); MCEH_gdp: Milked cows per effective herd per gross domestic product (%/RS1000); MCEH_pop: Milked cows per effective herd per population (%.inhabitants).

Table 3 Mean production levels per cluster for milk production

Variables	Cluster				
	1	2	3	4	5
MC	1326.33[e]	10283.76[b]	15424.57[a]	6321.68[c]	3760.11[d]
AM	2155.61[e]	30348.56[b]	50198.14[a]	17292.68[c]	8613.95[d]
Produc	1713.66[c]	3201.21[ab]	3492.14[a]	3050.18[ab]	2570.86[b]
MCEH	24.20[a]	25.24[a]	23.86[a]	20.28[a]	24.33[a]
MC_area	0.11[d]	0.36[b]	0.47[a]	0.31[bc]	0.25[c]
AM_area	0.20[d]	1.17[b]	1.59[a]	0.92[b]	0.63[c]
Produc_area	0.25[a]	0.13[a]	0.11[a]	0.18[a]	0.21[a]
MCEH_area	0.003[a]	0.001[a]	0.001[a]	0.001[a]	0.002[a]
MC_GDP	0.02[b]	0.09[a]	0.08[a]	0.07[a]	0.06[a]
AM_GDP	0.03[d]	0.23[b]	0.35[a]	0.22[bc]	0.14[c]
Produc_GDP	0.03[a]	0.02[a]	0.03[a]	0.04[a]	0.04[a]
MCEH_GDP	0.0004[a]	0.0002[a]	0.0002[a]	0.0002[a]	0.0004[a]
MC_pop	0.25[b]	1.29[a]	1.12[a]	1.07[a]	0.86[a]
AM_pop	0.43[d]	3.60[ab]	4.49[a]	3.20[b]	2.02[c]
Produc_pop	0.35[a]	0.38[a]	0.36[a]	0.61[a]	0.62[a]
MCEH_pop	0.005[a]	0.003[a]	0.002[a]	0.004[a]	0.01[a]
Number of observations	441	34	7	78	229

Abbreviations: MC: Milked cows; AM: amount of milk; Produc: productivity; MCEH: Milked cows per effective herd; MC_area: Milked cows per area; MC_GDP: Milked cows per gross domestic product; MC_pop: Milked cows per population; AM_area: amount of milk per area; AM_GDP: amount of milk per gross domestic product; AM_pop: amount of milk per population; Produc_area: productivity per area; Produc_GDP: productivity per gross domestic product; Produc_pop: productivity per population; MCEH_area: Milked cows per effective herd per area; MCEH_GDP: Milked cows per effective herd per gross domestic product; MCEH_pop: Milked cows herd per effective population.

Table 4 Productive variables that explain the differences between the clusters formed

Variable	Partial R-Square	F Value	Pr> F
AM	0.9301	2591.71	<.0001
Produc	0.1211	26.8	<.0001
MC	0.2072	50.77	<.0001
AM_pop	0.0634	13.13	<.0001
Produc_pop	0.0452	9.16	<.0001
MC_area	0.0492	9.99	<.0001
Produc_area	0.0607	12.48	<.0001
MC_pop	0.0277	5.5	0.0002
AM_GDP	0.0175	3.43	0.0086
MC_GDP	0.0378	7.56	<.0001

Abbreviations see table 3.

Table 5 Environmental and socioeconomic variables that explain the differences between the cluster formed

Variable	Partial R-Square	F Value	Pr > F
Farmers with off-farm jobs	0.0147	2.36	0.0518
Farmers with other agricultural activities	0.0284	4.61	0.0011
Forests planted with forest trees per area	0.0118	1.89	0.111
Water resources in establishments with springs protection of forests	0.0251	4.07	0.0029
Water resources in establishments with springs without protection of forests	0.0162	2.61	0.0347
Water resources in establishments with rivers or streams protected forest	0.0196	3.15	0.0139
Water resources in establishments with rivers or streams without protection of forests	0.0338	5.53	0.0002
Water resources in establishments with natural lakes and / or ponds protected forests	0.0196	3.15	0.0139
Water resources in establishments with natural lakes and / or ponds without protection of forests	0.0488	8.11	<.0001
Technical guidance received by the government (federal, state or municipal)	0.0121	1.94	0.1021
Technical guidance received from the producer himself or itself	0.0242	3.92	0.0038
Technical guidance received by private planning	0.0319	5.2	0.0004
Men between 5 and 10 years as responsible for the farm	0.0254	4.12	0.0027
Management with agricultural pasture rotation	0.4288	118.6	<.0001
Municipal human development index	0.0238	3.86	0.0042
Altitude (meters above sea level)	0.0405	6.67	<.0001
Mean temperature	0.0497	8.26	<.0001
Solar radiation	0.0111	1.78	0.1321

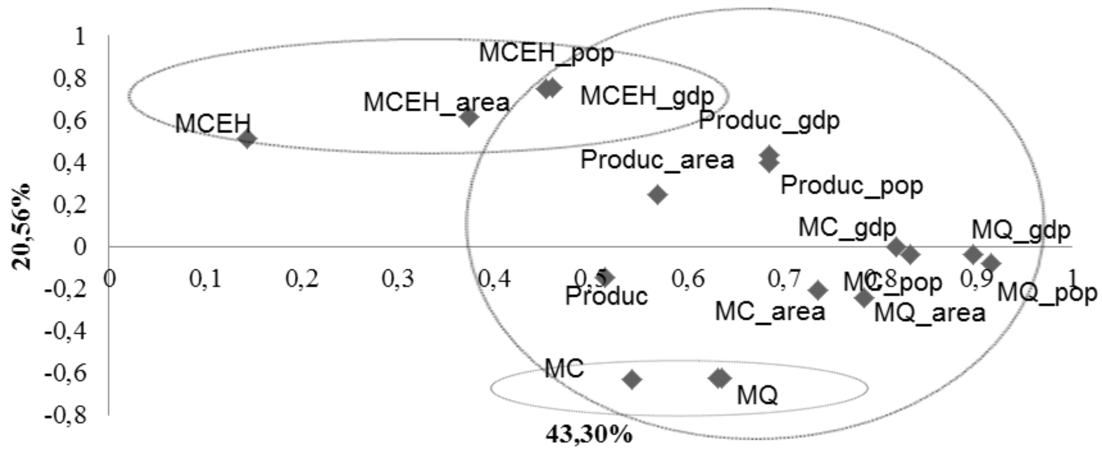

FIGURE 1 - Graphical representation of the key production factors between the mesoregion of RS and SC states.
Abbreviations: MC: cow milked; MQ: quantity of milk; Produc: productivity; MCEH: cows milked effective herd; MC_area: cows milked per area; MC_gdp: cows milked by gross domestic product; MC_pop: cows milked per population; MQ_area: quantity milk per area; MQ_gdp: quantity of milk per gross domestic product; MQ_pop: quantity of milk per population; Produc_area: yield per area; Produc_gdp: productivity by gross domestic product; Produc_pop: productivity per population; MCEH_area: cows milked effective herd per area; MCEH_gdp: cows milked effective herd by gross domestic product; MCEH_pop: cows milked herd by effective population.

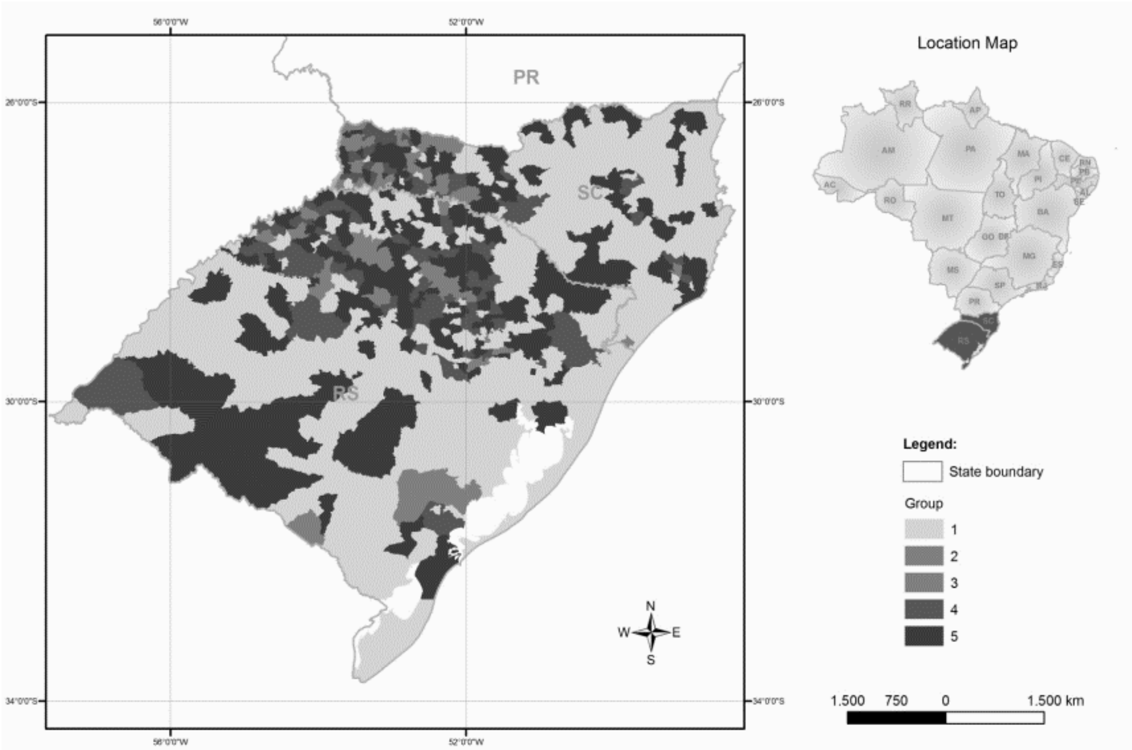

FIGURE 2 – Clusters of municipalities formed due to milk production and productivity

CAPÍTULO III

The use of artificial insemination in dairy herds in the Northwestern Rio-grandense mesoregion[1]

[1] Artigo elaborado conforme as Normas da Revista Brasileira de Medicina Veterinária e Zootecnia (Anexo 9).

The use of artificial insemination in dairy herds in the Northwestern Rio-grandense mesoregion

[O uso da inseminação artificial em rebanhos leiteiros na mesoregião Noroeste Rio-Grandense]

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ABSTRACT

The use of artificial insemination (AI) in dairy cattle impacts directly on production levels through genetic improvement and indirectly through the use of other technologies that allow better expression of genetic potential. The Northwestern Rio-grandense Mesoregion produces 2.6 billion liters of milk/year with an average yield of 2.620 liters/cow/year (8.59 liters/cow/day), the largest production Brazil, and 89.69% of producers using AI in their herds. This study was conducted on 195 properties to observe the impact of the use of AI in dairy cattle production through the application of questionnaires to milk producers. Multivariate analysis were performed to observe the degree of association of artificial insemination with production. Clusters by size of holdings and milk yields of herds were formed and showed high discrimination (89.55%). The use of AI is associated with to the production and the use of nutrition, management, genetics and technology investments. The study concludes that the use of AI enhances production by increasing productivity and enables greater gains per liter of milk marketed.

Keywords: cluster, management, multivariate analysis, production

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RESUMO

O uso da inseminação artificial (IA) em bovinos leiteiros impacta a sua produção de forma direta com agregação de mérito genético nos descendentes e, de forma indireta, pela ação em conjunto de outras tecnologias que permitem a melhor expressão do potencial genético. A mesorregião Noroeste Rio-grandense com 2,6 bilhões de litros de leite/ano, produtividade média de 2.620 litros de leite/vaca/ano (8.59 litros de leite/vaca/dia) e com 89,69% dos produtores utilizando a IA em seus rebanhos, é a de maior produção no Brasil. O presente trabalho foi realizado em 195 propriedades pertencentes a esta mesorregião e teve como objetivo principal observar o impacto do uso da inseminação artificial na produção dos rebanhos leiteiros pela aplicação de questionários aos produtores. Análises multivariadas foram realizadas para observar o grau de associação da inseminação artificial com a produção. Foram formados clusters por tamanho das propriedades e por produção de leite dos rebanhos, os quais foram discriminados em alto nível (89,55%). Os fatores qualitativos, relacionados à nutrição, melhoramento genético, capital como investimento, inseminação artificial e outras biotecnologias reprodutivas foram categorizados e observada a sua ligação com a produção leiteira. O uso da IA está associado com a produção e com o uso de tecnologias de nutrição, manejo, genética e investimentos. O estudo permite concluir que o uso da IA intensifica a produção pelo aumento da produtividade e permite maiores ganhos por litro de leite comercializado.

Palavras-chave: análise multivariada, cluster, manejo, produção

INTRODUCTION

Artificial insemination (AI) is the most successful technology in cattle breeding to improve quality, productivity and reproductive health of dairy cows (Kaproth and Foote, 2011). The two main factors responsible for that are improved reproductive health, particularly through the control of venereal diseases, and genetic improvement in productivity and reduction in the proportion of lethal genes (Foote and Parks, 2011). To use this technology the farmer needs adequate structure in terms of nutrition, animal health organization and record keeping, in addition to properly trained and educate employees (Mendola, 2008; Shehu et al., 2010), impacting indirectly the production level of the herd, which more adequately express their genetic potential.

The evolution of the use of AI in developed countries led to increased productivity and improved milk quality, making these nations of important milk suppliers to the world (Siqueira et al., 2010). The increased use of technologies enhanced global production of cow's milk, in 2010, to 599 billion liters (FAO, 2010).

Brazil, with an estimated 23 million heads of dairy cows, is the 5th largest producer of milk with 31 billion liters in 2010 (EMBRAPA, 2012). There are estimates that only 10% of Brazil's total herd of females in reproductive age, are inseminated (ASBIA, 2012). In dairy herds, using 1.8 doses of semen per conception, only 13.7% of females would be inseminated (ANUALPEC, 2008). This is relatively low when compared to Japan, for example, that in the last century inseminated 95.7% of its herd, Czech Republic 87%, Austria 73.9%, Denmark 68.4%, Italy 66.2% and Germany 65.9% (Barbosa and Machado, 2008). While in the U.S.A there was an average yield of 9593 liters/cow milked/year (31.45 liters/cow/day) over and 65% of dairy cattle inseminated, in Brazil production is 1381 liters/cow milked/year (4.52 liters/cow/day) (USDA, 2010; EMBRAPA, 2012).

The State of Rio Grande do Sul (RS) has the highest productivity in Brazil at 2536 liters/cow/year (8.31 liters/cow/day) and the second largest producer with about 3.9 billion liters of milk/year, second only to the State of Minas Gerais with 8.8 billion liters. Within states, the Mesoregion Northwestern Rio-grandense (NO) had the highest milk production in Brazil in 2011, with 2.6 billion liters, followed by Triangulo Mineiro and the Oeste Catarinense Mesoregions with 2.2 billion and 1.9 billion liters, respectively (EMBRAPA, 2012).

Milk production has high socioeconomic importance in the NO. There are several studies that show the benefits of using AI to production (Lima et al., 2010, 2012; Pfeiffer et al., 2012; Galvão et al., 2013). Little or nothing is known about the relationship of AI use to production. The objectives of this study was to determine the association of the use of AI on the productive performance of dairy cows in Mesoregion Northwestern and which combination with other factors is related to milk production.

MATERIALS AND METHODS

This study was approved by the ethics committee of Rio Grande do Sul Federal University. Data were obtained through random questionnaires with milk producers belonging to the Mesoregion Northwestern and the storage of information on about the number of people trained by municipalities to the technique of artificial insemination (npttotal) through courses, by the Federal Institute of Education, Science and Technology of Rio Grande do Sul (IFRS, 2012). The farmers (195) belonging to 216 municipalities that make up this mesoregion were randomly drawn for analysis and classified according to production activities, capital investment, technology and use of artificial insemination (AI). Clusters were formed based on production levels and size of area for production of pastures.

All analyzes were performed using the computer program Statistical Analysis System (SAS, Cary, North Carolina, v.9.3). The variables were standardized through the STANDARD procedure, assuming mean zero (0) and variance one (1). Analysis of variance (GLM) was used to evaluate herd size milk production and the size of the property. The variables used in the analysis were dairy cows (LC), dry cows (DC), calves up to 1 year (C1), males (M), bulls (B), working animals (WA), total number of animals (total), amount of milk produced by lactating cow (Produc), monthly milk production (TMPM), price received per liter of milk (PLM) and area for pasture production (ha). Means were adjusted by least squares (LSMEANS) method.

Multivariate analyzes were performed to determine the factors that could influence the sources of variation. Canonical variable analysis (CANCORR, CANDISC) was used for testing scenarios to discriminate groups in the dataset. The FASTCLUS procedure was used to form similar clusters from production and size of area for production of pastures. A factor analysis was performed to better understand the correlation structure and understand the sources of variation. In this analysis, the assumption was tested by the KMO orthogonality criterion (Kaiser, 1970). The SMC (squared multiple correlations) option was used to improve the explanation of each factor on the total variance. A screen test was used to establish the minimum number of variables to consider. Discriminated analysis (DISCRIM, STEPDISC) was used to see which variables separated the clusters (Lachenbruch, 1997).

For analysis of qualitative variables, results were categorized and used in the CORRESP procedure to show the degree of association with the use of artificial insemination and the sources of variation. The size of the property was set to 1 (up to

40ha), 2 (between 40 and 100 ha) or 3 (over 100ha) and the time in the dairy business as 1 (under 5 years), 2 (between 5 and 10 years) or 3 (over 10 years).

RESULTS AND DISCUSSION

Formation of clusters by size owned and productive factors

The cluster of small size and low production (Tab.1) called for the given productivity (5477.61 l / cow / year) as specialized, is formed of 139 properties. Cluster 2, with low average to average production and small to medium size, called less intensive (6177.19 L / cow / year), consists of 36 properties. The average production of high and medium to large size, cluster 3, consists of 11 properties has been termed intensive (7757.79 L / cow / year). The cluster 4, called the more intensive (9794.79 l / cow / year) is formed by 9 properties and has a high output and large in area.

The difference in properties of high production and large size for the low production and small size is that they have on average 11 times more total animals (total) and lactating cows per year (LC). They also produce 20 times more milk (TMPM) and have assigned area for food production for the dairy herd 44 times higher.

Table 1. Clusters formed due to production traits and farm size

Cluster	Production and farm size	Frequency	Mean vc_lac	Mean total	Mean lt_mes	Mean ha
1	Low and small	139	11.35	23.85	5176.35	10.28
2	Low to average and small to medium	36	25.92	48.00	13337.58	18.33
3	Average and medium to large	11	46.64	80.82	30145.45	66.36
4	High and large	9	125.56	270.56	102477.78	450.56

Abbreviations: LC: lactating cows; total: total number of animals; TMPM: total amount of milk produced per month; ha: area used for producing food for the cows (ha).

Descriptors of clusters formed

Two factors explained 69.76% of the variance between the clusters. Therefore, the value of Kaiser-Meyer-Olkin (KMO), which is a measure of the adequacy of the sample, was 0.6976 (Fig. 1). There is a positive relationship between production variables and size of properties that explain 54.76% of the variation among the clusters formed (Autovector 1). Within this general group there are also properties there are properties where the higher productivity (Produc) is associated with the greatest number of people trained for artificial insemination (npttotal) and the higher price received per liter of milk (PLM). These properties are more efficient and profitable.

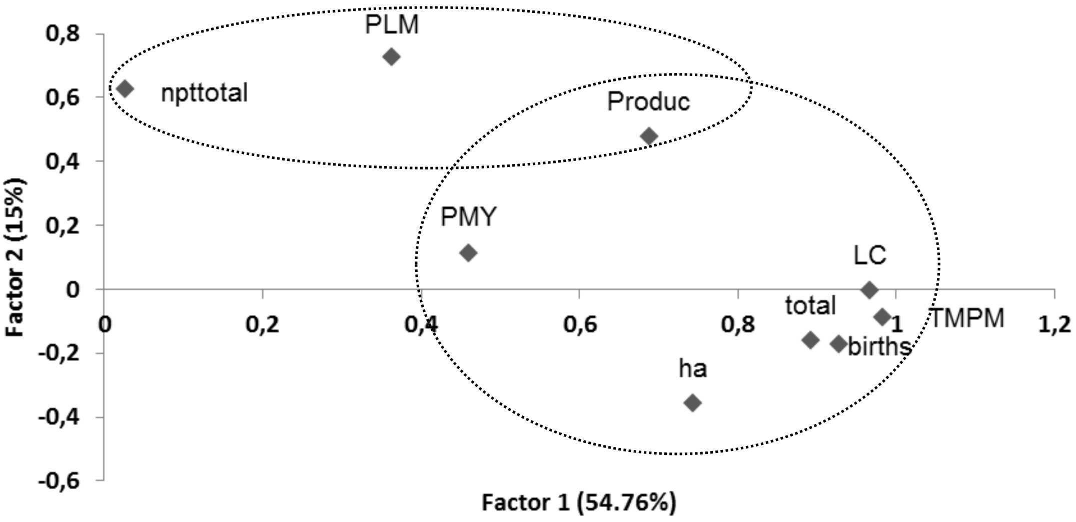

Figure 1. The two main factors that explain the variance between the clusters formed.

Abbreviations: LC: lactating cows; total: total number of animals; TMPM: total amount of milk produced per month; ha: area used for producing food for the cows (ha); Produc: milk quantity produced per year per lactating cow; PLM: price of a liter of milk received; PMY: monthly gross income of the property with the sale of milk; births: births during the year; npttotal: total number of people trained in the technique of artificial insemination between 1998 and 2012 by IFRS.

The efficiency of the properties is related to the intensification of production processes (Cabrera et al., 2010). Producers who invest more in technology tend to have large-scale production, receive more per volume produced and achieve higher quality (Hott and Carvalho, 2007). Properties that invest more in training and knowledge are more likely to use technology thereby achieving higher production and economic returns (Mendola, 2008; Davis, 2010). Not only producers access to new technologies, but also the extension services performed by institutions (Russi et al., 2009; Shehu et al, 2010) are crucial for productive (Arendonk, 2011; Dascalu et al., 2011) and economic (Roibas and Alvarez, 2010) efficiency.

The similarity in production variables and size allowed for high differentiation between the clusters formed. On average, the properties were correctly allocated in their clusters at an average of 89.55%. These results determine the existence of properties and productions with different sizes that can be influenced by factors related to the use of technology and process management.

Clusters 3, 2 and 1, the second, third and fourth most productive, are discriminated at higher levels (100%, 94.44% and 97.12%) respectively. The variables that best explained the variation between clusters formed were LC, TMPM, ha, and total explaining 86.74%, 7.66%, 6.68% and 5.34% of this variation, respectively. The variable related to production (LC) best explains the difference among the clusters formed. The number of dairy cows has been shown to be a determining factor in the classification of production systems (Zoccal et al., 2012) and use of technologies (Khanal et al., 2010). The results, although discriminate well among clusters for production and size, show that there could be other factors in the differentiation of clusters. In the previous chapter (spatial discrimination of production), we found that environmental (Fuhrer et al., 2014; Liang et al., 2013), and socioeconomic (Siegmund-Schultze et al., 2010; Mapiye et al., 2011) factors also influence the production of dairy herds.

Cluster 4, the most productive properties, shows confounding with cluster 3. There are other factors that could distinguish them, that are not only associated with the production or size of property. Technologies that minimize the effect of heat stress (Lucy et al., 2011.), disease-preventing (Main et al., 2012; Bruijnis et al., 2013), that provide greater efficiency in the utilization of food (Thatcher et al., 2011; Auldist et al., 2013), and other related management factors (Paranhos et al., 2012) and process management (Cabrera et al., 2010; Costa et al, 2013) are associated positively with milk production.

Also, reproductive technologies linked to semen (DeJarnette et al., 2010; Hansen and Fuquay, 2011), and embryo (Stewart et al., 2011; Hasler, 2014) use influence production. Where AI is used more intensely (Foote and Parks 2011; Kaproth and Foote, 2011) there tends to be higher technology use causing productive (Arendok, 2011; Dascalu et al., 2011) and economic (Afridi et al., 2009; Roibas and Alvares, 2010) impacts on the properties that use it.

The impact of the use of artificial insemination in dairy herds

The percentage of farms using AI in their dairy herds in Mesoregion Northwestern are 89.69% with 48.97% using exclusively the IA and 40.72% using AI and natural breeding of cows returning to estrus. This average is higher than the national of 13.7% of the dairy herd. It is assumed from this that the use of IA has an effect on milk productivity of Mesoregion Northwestern (IBGE, 2011; EMBRAPA, 2012).

Correspondence analyzes show that more AI use is associated with higher milk production and factors related to production in mesoregion NO (Figures 2-6). Use of AI is linked to higher productivity (Produc), the size of the property (PZ), the time on the dairy business (TDB) and the higher price received per liter of milk sold (PMY) (Fig. 1 and 2).

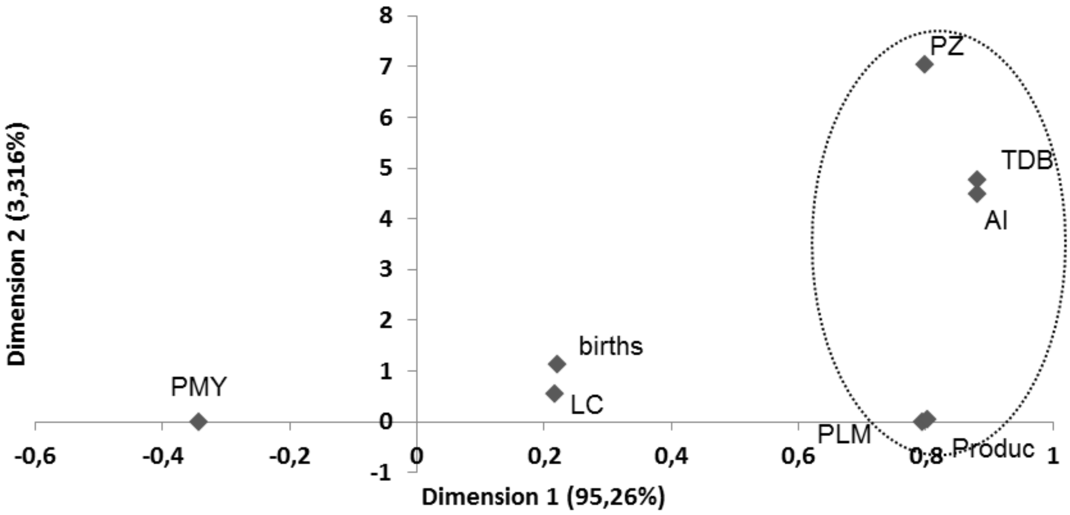

Figure 2. Association of use of AI with productive factors and sizes of dairy properties of Mesoregion Northwestern.
Abbreviations: use artificial insemination (AI); Property size (own + land lease) (PZ); time in the dairy business (TDB); deliveries in the year (births); existence of lactating cows (LC); price received per liter of milk (PLM); monthly gross income received from the sale of milk (PMY); milk produced by lactating cow per year (Produc).

The effect of AI is related to genetic merit of proven parents and passed on to offspring (Roibas and Alvarez, 2010). Genetics to increase productivity (Shamsuddin et al., 2010), fertility (Cummins et al., 2012), resistance against diseases that promote involuntary culling (Ouwelties et al., 2007), or selection to increase the solids milk and milk quality (Miller et al., 2009; Coleman et al., 2010) increase the production efficiency and profitability of dairy farms (Afridi et al., 2009; Lima et al., 2010).

More time spent in the dairy business (TDB) leads to the improvement of the practices related to animal production and management (Bezerra et al., 2011; Bruijnis et al., 2013; Costa et al., 2013), constituting a significant factor for productive efficiency.

As an example, knowledge about the transmission of diseases and accidents caused by the bull, acquired over the years, determine better results to the activity (Foote and Parks, 2011; Kaproth and Foote, 2011). Experience with the AI process brings improvements in handling equipment and materials, identification of estrus, choice of the ideal moment for insemination, greater ability to perform the technique and better choice of location for semen deposition. Experience can therefore lead to pregnancy levels close to those obtained with natural mating (Russi et al., 2009; Diskin, 2011; López-Gatius, 2012).

Fig. 3 shows a negative association among the use of AI and grazing native pasture (GNP); the common salt (CS) and crop residues (RC), and positive association with the use of conserved forage (hay and Silag), concentrates (conc) and mineral salt (MS) for feeding livestock. However, the use of crop residues associated with the use of hay (hay) and concentrates (conc) can increase the use of AI and consequently of the production. The importance of nutrition for the growth, maintenance, health, reproduction and gene expression is reflected in productive efficiency (Dascalu et al., 2011; Cardoso et al., 2013; Mohd Nor et al., 2013; Schütz et al., 2013). Stored forage (hay and silage), concentrates and minerals have greater nutritional potential for being manipulated and balanced to better meet the food needs of animals (Ferreira et al., 2013; Thomas et al., 2013).

There are several studies that show a lower rate of return to estrus (Law et al., 2009; Cardoso et al., 2013), increased fertility (Walsh et al., 2011; Leal et al., 2013), decreased embryonic mortality (Thatcher et al., 2011) and its association with better nutrition so the animals can increase the reproductive and productive efficiency.

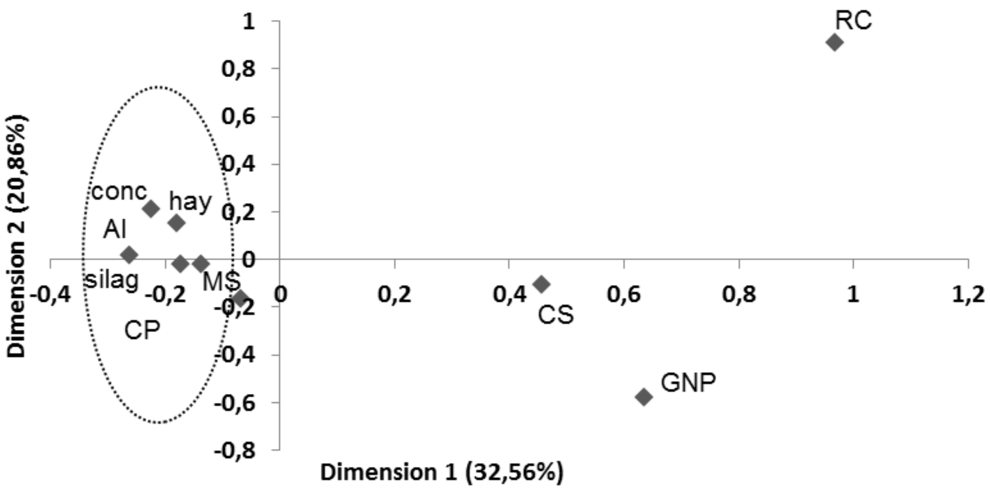

Figure 3 - Association of IA with nutrition of dairy cattle in the Mesoregion Northwestern Abbreviations: using artificial insemination (AI); grazing native pasture (GNP); cultivated pasture (CP); residue crops (RC); Hay (hay); silage (silag); common salt (CS); mineral salt (MS); concentrate (conc).

Fig. 4 shows outsourcing rearing of replacement animals (OR) is associated with the selection of animals for higher production (SPI), and a second time to the use of artificial insemination. Decision making for services and processes are key to productive and economic success. Increased production efficiency in dairy farming requires investment in technological innovations that allow the intensification of activity (Kym, 2010; Qaim, 2010; Sonnino and Ruane, 2010; Suplicy et al., 2012). Hiring expert services or service integration practices are often used for farming activities.

Outsourcing calf rearing to puberty is a common practice in some dairy farms. The decision to use outsourcing is related to management processes that enhance this activity (Khanal et al., 2010). These services reduce the age of first calving through intensive animal nutrition, and improve herd genetics through AI with semen from superior sires (Lagrotta et al., 2010; Cummins et al., 2012). Use of this outsourced service decreases the use of AI in the property at first, by subtracting these animals from the total herd

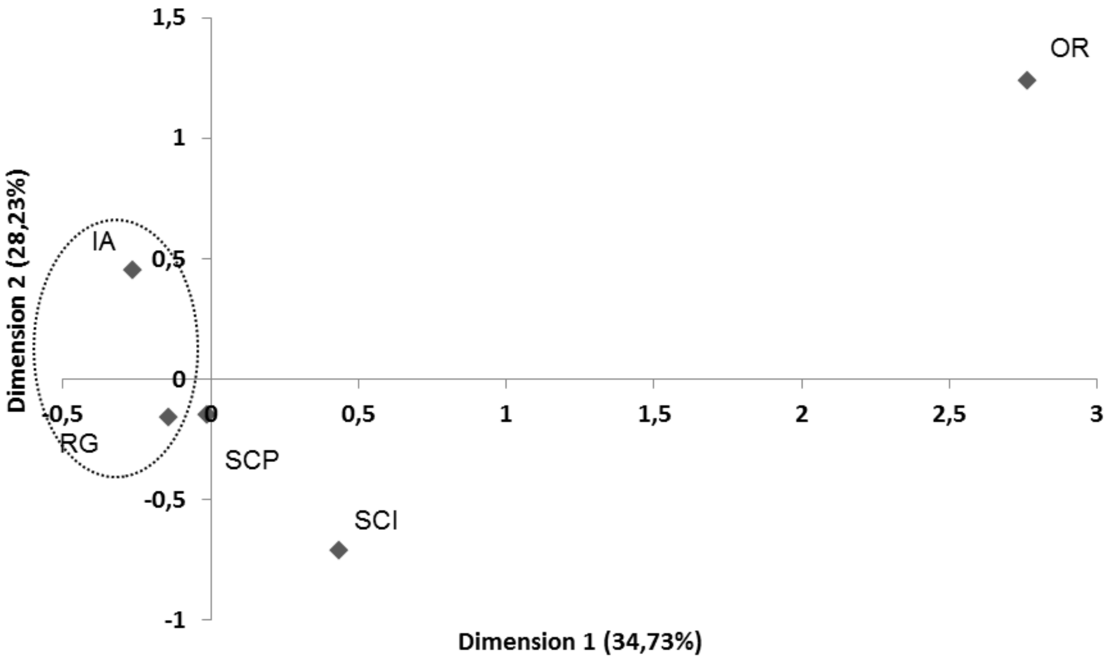

Figure 4. Association of use of AI with the management of animals and pastures in dairy farms of Mesoregion Northwestern.
Abbreviations: outsources replacements (OR); rotational grazing (RG); selection against cows with problems (SCP); selection for production indices (SCI); artificial insemination (AI).

Figure 5 shows in general the importance of training producers for the of AI technology. The properties belonging to the municipalities that received the highest number of people trained to the technology of AI (npttotal) is associated with increased production (LC and births), the largest investment in natural capital (PZ and LV), physical (TBP and TEU) institutional (ST and PE) and human (F1, F2, E1, E2 and E3). Secondly, larger properties (PZ), with better facilities (TBP), greater number of devices (TEU), but with lower production (LC, births) are associated with the greatest number of people trained in AI technology (npttotal). This result shows that both properties those with high production, as those with low production seek AI as an alternative to production efficiency.

In this sense, IFRS has a important role in training people for the technique of artificial insemination, being the only institution in RS approved by for ASBIA this training (ASBIA 2012; IFRS, 2012). Figure 1 shows that properties belonging to municipalities with the highest number of people trained to perform artificial insemination (npttotal) and the greatest use of AI (Fig.2) earn more for a liter of milk and have higher productivity.

Greater use of AI is also associated with farmer participation in events (PE). The dissemination of technologies and their consequences for production can be seen through participation in fairs, field days, seminars, refresher courses and others and are important to determine the extent that new technologies can be used to obtain best results (Russi et al., 2009; Paranhos et al., 2012). The involvement of farmers in the use of instruments that enable them to become efficient ensures greater profitability (Davis et al., 2010) and quality of life (Dascalu et al., 2011).

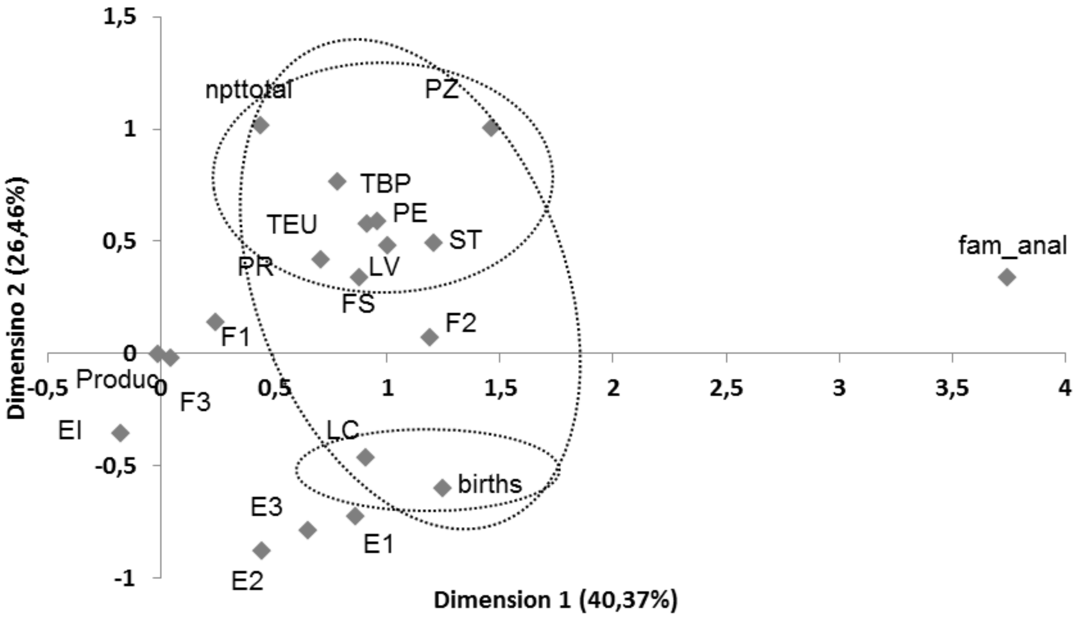

Figure 5. Association of production factors and capital as investment in dairy farms of Rio Grande Mesoregion Northwestern.

Abbreviations:deliveries in the year (births); existence of lactating cows (LC); milk produced by lactating cow per year (Produc); Property size (PZ); either rent or own (PR) property; land value (LV); employees illiterate (EI); employees with 2nd degree (E2); employees with 1st degree (E1); employees with 3rd degree (E3); illiterate family members (FI); family members with 1st degree (F1); family members with 2nd degree (F2); family members with 3rd degree (F3); participation in events (part_ev); support training (ap_cap); financial support (FS); type of equipment used on the farm (TEU); type of buildings on the property (TBP); participates in events (PE); support training (ST) number of people trained in the technique of artificial insemination by Federal Institute of Rio Grande do Sul - Campus Sertão (IFRS) during the years 1998-2012 (npttotal).

The use of AI in dairy herds determines increased production (Lima et al., 2010; Kaproth& Foote, 2011) and higher income (Afridi et al., 2009; Arendok, 2011) served as the basis for the development of other biotechnologies (Thibier, 2005). The association of use of AI with other reproductive biotechnologies (TE, IATF, DP and SS), as shown in Fig. 6, is positive, and new biotechnologies may eventually lead to a decrease in its use of AI.

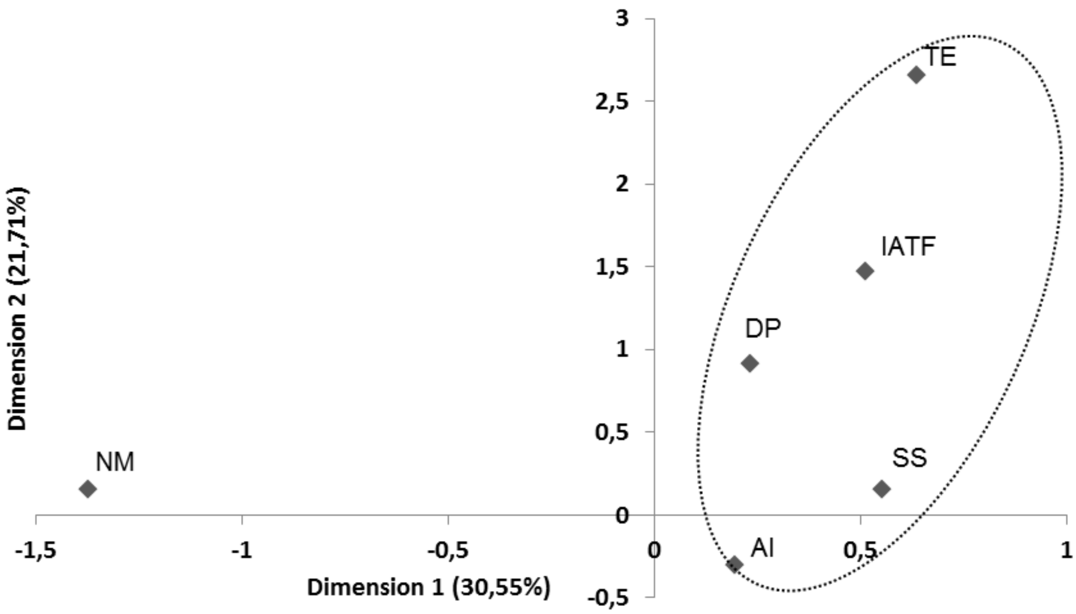

Figure 6. Association of use of AI with other reproductive technologies in dairy herds of Mesoregion Northwestern.

Abbreviations: uses artificial insemination (AI); uses embryo transfer (TE); uses estrous synchronization for artificial insemination (IATF); Pregnancy diagnosis (DP); using sexed semen (SS); uses natural mating (NM).

Synchronization of artificial insemination (IATF) has as main objective the reduction in calving interval and consequently increased production (Suplicy et al., 2012; Giordano et al., 2012; Lima et al., 2012; Wiltbank and Pursley, 2014). The problems related to the silent heat, deficiencies in the detection of estrus and anestrous, which decrease production, are or minimized with the use of this technology (Walsh et al., 2011; Thompson et al., 2012; Piccardi et al., 2013).

Male calves do not have economic value in dairy herds and the genetic potential of the mother is reduced. The use of AI with sexed semen (SS) allows greater gene expression by decreasing the time between generations (Seidel Jr. et al., 2008; Dejarnette et al., 2008; 2010), as well as increasing production and profitability of dairy farming (Colazo et al., 2009; Gutiérrez et al., 2009). The use of early diagnosis of pregnancy (DP) brings the advantage of quick perception by the producer about problems that increase the calving interval, such as embryonic mortality, improper time of AI, improper insemination technique as well as metritis and endometritis, endocrine changes and anatomical defects (Ranasinghe et al., 2010; Roelofs et al., 2010; López - Gatius 2012) allowing farmers to make decisions as soon as possible.

Environmental and productive stresses are also causes of embryonic mortality (Berg et al., 2010; Walsh et al., 2011). The use of embryo transfer (TE), while optimizing the use of the female also becomes solution for embryonic losses that lead to increased calving interval and decreasing production (Vieira, 2011; Thompson et al., 2012.).

In general, the use of AI in the Northwestern Rio-grandense Mesoregion is associated not only with increased productivity, but also with the use of other technologies necessary to meet the needs of global production systems and specialized milk technified.

CONCLUSIONS

The analyzes showed that the use of artificial insemination is determinant factor for increased production and quality of milk and, for greater profitability of production systems belonging to Northwestern Rio-grandense Mesoregion.

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CAPÍTULO IV

Economic values for production, functional and fertility traits milk production systems in Southern Brazil[1]

[1] Artigo elaborado conforme as Normas da Agricultural Systems (Anexo 14).

Economic values for production, functional and fertility traits in milk production systems in Southern Brazil

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ABSTRACT

This study presents economic values of production, functional and fertility characteristics to be included in economic breeding objectives when selecting for milk production based on farming systems in Southern Brazil. Two clusters were

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formed according to their production and characteristics considered were: milk production (MP), lactation persistency (LP), milk fat (FAT), milk protein (PROT), somatic cell count (SCC), age at first calving (AFC), calving interval (CI), Feed intake (Intake), mortality (MORT) and cow weight. Revenue was based on the sale of milk, surplus heifers and cull cows and the actual operating costs were used to calculate profit and gross margin. The profit function used to calculate the economic values was based on a 100 cows farm. The average economic values of the characteristics that affect the profit of the producer are in order: FAT: U$ 3,776.07; SCC: U$ -3,146.87; PROT: U$ 1,888.03; AFC: U$ -2,724.29; MP U$ 1,258.69, LP: U$ 1,258.69; CI: U$ -1,023.62; INTAKE: U$ -614.01, Weight: U$ 124.03 and MORT: U$ -14.30.

Keywords: Economic goal, Economic value, Selection, Profit function.

1. Introduction

Dairy farming is one of the main agribusinesses in Brazil, generating 10% of the income generated by Brazilian agriculture, and 76% of income from livestock (IBGE, 2010). In 2013, the growth of agribusiness GDP was 3.6%, and its share in the Brazilian GDP was 22.8% (CNA, 2013).

The most widely used method for obtaining improved animals is through artificial insemination; 89.69% of dairy herds in southern Brazil use this resource, higher than the national average of 13.7% (ANUALPEC, 2008). In most cases, selection criteria are for the increase in production volume, without perception of other correlated traits, such as functional and fertility traits that can indirectly influence the productivity of the animals.

Selection aiming only at improving the animals, often does not lead to profit for the farmer. Therefore, one must consider, not only animal breeding, but also the environmental interference and production level. Bioeconomic models were developed to identify the selection objective traits, to maximize the economic genetic gain (Hazel, 1943).

Despite the importance of this issue, only recently has the determination of economic selection objectives in Brazil received attention, both in their determination and practical assessment. There is little knowledge of these evaluations for the selection of cattle in tropical countries such as Brazil, where the traits of interest may have different importance compared with developed temperate countries (Vercesi Filho et al., 2000).

Assessments of economic selection objectives for dairy cattle were presented by some autors (Martins et al., 2003, Cardoso et al., 2004 and Bueno et al., 2004) for the southeast region. In southern Brazil, there are no studies that determine the objectives of selection in dairy cattle, even though this region has the second largest dairy herd and highest productivity (Siqueira and Carneiro, 2012). More studies are necessary in this area, to make this activity more profitable and competitive.

The objective of this study was to predict the economic values for production, functional and fertility traits, as well as to rank them in order of economic importance for milk production systems in southern Brazil.

2. Materials and methods

2.1 Data collection and analysis

On farm data were collected by technicians of the Brazilian Service of Support for Micro and Small Enterprises (Sebrae), through monthly monitoring of husbandry and economic data on 61 properties belonging to the microregion of Passo Fundo – Rio Grande do Sul State, Brazil, between 2009 and 2011. The properties were randomly chosen and the owners agreed to monthly collections of production and economic data.

Cluster analysis was performed to form two groups, based on number of dairy cows and total number of animals, through FASTCLUS procedure of SAS ® (Statistical Analysis System Inc, Cary, NC, USA). The herd size was standardized to 100 cows. The FACTOR procedure was used in a factor analysis, to understand the correlation structure and the sources of data variation.

Analyzes of variance were performed using the GLM procedure for economic and related milk production variables to differentiate between the clusters formed. The variables were normalized, standardized by the STANDARD procedure, assuming mean zero (0) and variance one (1), and adjusted means by the least squares method (LSMEANS). To compare means, we used Duncan's test at 5% probability ($p < 0.05$).

Clusters 1 and 2 were designated high and medium-high output respectively, which served for calculation of economic values (Fig. 1). Production systems were considered specialized in dairy production (Zoccal et al., 2012). Sales included milk, cull females with an average weight of 550 Kg and heifers and/or pregnant heifers weighing 330 Kg. Males were culled at birth because they lacked commercial value.

Herd structure (Fig. 1) was based on 100 cows for each production systems, and equation 1 was used to determine the number of cows in each age group as well as those available for culling and replacement needs.

Equation 1. $$HS = \frac{a\left(1-r^{n}\right)}{1-r}$$

Where, HS is the herd size; r is the survival rate; a is the number of animals; and n is the dam age.

Cluster	**(1) High production**								**(2) Medium-high production**							
Pregnancy rate	85								82							
Offspring	85								82							
Mortality rate	0								8							
Survival	85								76							
Cow age	2	3	4	5	6	7	8	9	2	3	4	5	6	7	8	9
Nº Animals= 100	15	14	13	13	12	12	11	10	17	16	15	14	13	12	11	10

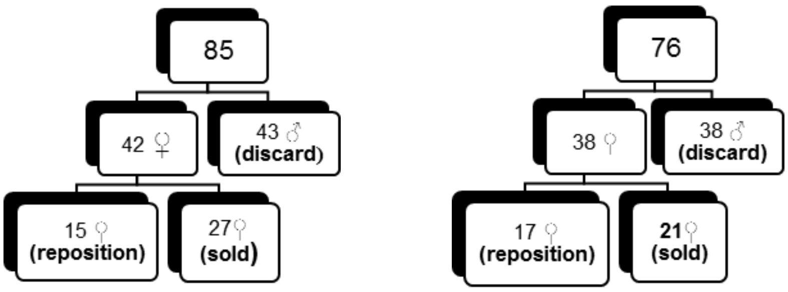

Fig. 1 Herd structure with 100 cows based on true indexes of the high and medium-high production herds.

2.2 Economic analysis

The costs were calculated based on the actual operating cost structure (OCS) conceptualized by Matsunaga et al. (1976), where the profit identifies the return on sales income, calculated by dividing operating income (OI) by total gross income (TGR). Profitability is the percentage of return or gain obtained by the farm through sales.

Income (I) and expenses (E) were combined in different ways to estimate the economic value of their respective characteristics that affect the profit of the dairy activity (Table 1).

Table 1

Average production, economic (U$) and annual performance indexes for high and medium productivity clusters, standardized to a 100 cow herd.

Traits	Ab	Cluster		Indexes	Ab	Cluster	
		High (9)	Medium (52)			High	Medium
Property area (ha)	PA	37.16^{a}	22.26^{b}	Cows in production (head)	PC	100	100
Area used for dairy farming (ha)	ADF	23.15^{a}	8.40^{b}	Number of lactating cows (head)	LC	85.03	82.26
Number of cows in milk (head)	LC	32.22^{a}	12.28^{b}	Number of dry cows (head)	DC	14.96	17.73
Number of dry cows (head)	DC	5.66^{a}	2.46^{b}	Percentage lactating cows (%)	LC%	85.03	82.26
Total number of animals (head)	TA	67.22^{a}	25.38^{b}	Percentage cows in the total herd (%)	CTH%	47.93	47.87
Value of a liter of milk (U$)	VLM	0.34^{a}	0.33^{a}	Calving rate (%)	CR	85.03	82.26
Income from the sale of milk (U$)	ISM	43502^{a}	17291^{b}	Calving interval (months)	CI	14	14
Total income of dairy farming (U$)	TIDF	46683^{a}	18666^{b}	Age at first calving (months)	AFC	26	26
Total operating expenses (U$)	TOE	33032^{a}	12117^{b}	Lactation persistency (days)	LP	365	365
Expenses with concentrate (U$)	EC	19917^{a}	7380^{b}	Productivity per lactating cow (L in 365 days)	PLC	4601.94	3998.86
Investment in purchase of animals (U$)	IPA	380.4^{a}	73.6^{a}	Productivity per total cow (L in 365 days)	PTC	3916.61	3306.19
Total investment (U$)	TI	2124^{a}	1341^{a}	Production per cow milked / day (L in 365 days)	PCM	12.6	10.95
Annual income (U$)	AIN	46683^{a}	18666^{b}	Production per total cow/day (L in 365 days)	PTC/day	10.73	9.06
Annual expenses (U$)	AE	33032^{a}	12117^{b}	Annual Milk production (L/year/herd)	AMP	337877.46	336543.50
Gross margin (U$)	GM	13650^{a}	6549^{b}	Total mortality of animals (%)	TMA	0	7.91
Annual investments (U$)	AINV	2124^{a}	1341^{a}	Number of animals sold (discard and young) (head)	NAS	37	31
Annual balance (U$)	AB	11525^{a}	5207^{b}	Young female replacements (head)	YFR	15	17

(P<0.10); Ab: Abbreviation

2.3 Economic value

Economic values were calculated from SEBRAE data per cluster, where revenue was due to the sale of milk, cull cows and young heifers (Fig.2). Variable costs included those related to feeding (concentrate, mineral, silage, hay and pasture), and management (labor, medicines, energy and fuel, taxes, semen, cleaning materials, milk transportation, outsourced services, powdered milk and milk replacers to feed the calves).

	Source of income and expenses	**Characteristics**
Income	Milk:	Quantity of milk, Fat and protein in milk, persistency of lactation, somatic cell count, total bacterial count, weight, calving interval, age at first calving, mortality and food consumption.
	Rearing and reproduction in females:	Mortality, age at first calving, weight and feed intake.
	Pregnant females:	Mortality, weight and feed intake.
Expenses	Nutrition:	Amount of milk, persistency of lactation, calving interval, age at first calving, mortality, feed intake and weight.
	Housing:	Amount of milk, persistency of lactation, calving interval, age at first calving, mortality, feed intake and weight.
	Labor:	Amount of milk, persistency of lactation, calving interval, age at first calving, mortality, food consumption and weight.
	Health:	Forming colonies unit, somatic cell count, total bacterial count and weight.
	Marketing	Amount of milk, persistency of lactation, milk fat, milk protein, somatic cell count, total bacterial count, weight, calving interval, age at first calving, mortality and feed intake.

Fig. 2 Component characteristics of income and expense that affect the profit of dairy cattle breeding systems.

Three scenarios were considered to calculate the economic values of traits related to milk quality (fat, protein and somatic cell count): scenario I, where the dairy industry does not give bonus and/or penalize the quality of milk, and therefore has an economic value of zero. Scenario II and III, the economic values were calculated by the minimum and maximum bonus and/or penalty, respectively, performed by a dairy industry in the region, according to the White Paper 62 - Brazil, 2011 (http://www.agricultura.gov.br/legislacao). Economic values were also determined for traits related to milk production (milk volume and duration of lactation), fertility (calving interval and age at first calving), weight, food consumption and mortality.

Bioeconomic models (BEM) or profit equations (profit functions) were used for the economic value calculation. The results were given by the difference between the average profits before (Pa) and after the improvement (Pa'), by the equation Sp = Pa' - Pa, where (Sp) is the average profit of the system, after each characteristic increased 1%, while maintaining the other mean traits unchanged (Ponzoni and Newman, 1989). We used one percent increase (1%) to standardize the scale of each trait. The values were dollarized by the average of the years 2009 to 2011, resulting in U$ 1.00 for each R $ 1.81.

2.1. Sensivity analysis

Sensitivity analyzes were performed to assess the impact of possible changes in the variations of dietary components in ± 25 and ± 50% on the profit, when there is an increase of 1% in expression of the traits examined.

3. Results

The high production system (*cluster 1*) has higher production ($P<0.10$) than the medium-high production system (*cluster 2*) as expected. Economically, it also has higher income from the sale of milk (ISM) and the total income of dairy activity (TIDF), which resulted in higher gross margin (GM) for the high production system (Table 1).

Table 2 shows the annual economic indices for clusters 1 and 2, equalized to 100 cows.

Table 2

Annual economic indices (U$) for high and medium production clusters standardized to a 100 cow herd.

Economic indexes	Clusters		
	High (H)	Medium (M)	(H/M)*100
Income milk sold	138487.86	113250.71	122.28
Income animals sold	13236.25	11195.86	118.22
Total income	151724.12	124446.57	121.91
AOP	87180.24	79429.33	109.75
GM	64543.86	45017.24	143.37
Profitability (%)	42.27	36.76	114.98

Abbreviations: AOP: actual operating costs; GM: gross margin.

High cluster had 21.91% higher annual income (sale of milk and animals) than the medium cluster. At the same time, the operating cost for production increased in smaller proportions (9.75%) determining higher gross margin (MB) (43.37%) and increased profitability (14.98%) compared to the medium cluster.

Table 3 shows a similar distribution of actual operating costs (AOC), between the two production systems, and the higher cost is due to the animal feed (concentrate and roughage), with 73.55 and 73.88% of operating cost, for high and medium clusters, respectively.

Table 3

Distribution of annual expenses for milk production between the clusters formed and standardized to 100 cows (SEBRAE, 2011).

Expenses	Cluster				
	High (U$)	%	Medium (U$)	%	(H/M)*100
Concentrate	52569.69	60.30	48150.06	60.62	109.18
Roughage	11551.38	13.25	10532.04	13.26	109.68
Labor	10592.39	12.15	9610.95	12.10	110.21
Medicine	3740.03	4.29	3359.86	4.23	111.32
Energy and fuel	2353.86	2.70	2104.87	2.65	111.83
Taxes and fees	1691.29	1.94	1517.09	1.91	111.48
Semen/inseminator	1438.47	1.65	1294.69	1.63	111.10
Cleaning supplies	1081.03	1.24	961.09	1.21	112.48
Milk transportation	958.98	1.10	834.00	1.05	114.98
Out sourced services	636.41	0.73	563.95	0.71	112.85
Powdered milk	575.39	0.66	508.34	0.64	113.19
Total	87180.24	100	79429.33	100	109.76

The second largest cost is due to the payment of labor, with an average of 12.1% of the operating cost. Cow and heifer weight were less expressive, because the focus of this activity is on income coming from milk production. Likewise, mortality had a low economic value, being within acceptable parameters and does not significantly influence the producer profit.

The economic values calculated for the traits studied and the scenarios I, II and III are shown in Table 4. Scenario I shows payment by the companies that do not consider milk quality (set out in White Paper 62 - Brazil, 2011), which represents the vast majority in this region. In scenario II, payment was considered taking into consideration bonus/penalty for milk quality using the lower (scenario II) and higher (scenario III) ranges used by a manufacturing company in the region. Considering scenario III, where all traits can contribute to the maximum producer profit, the higher economic values, for 100 cows, were found for fat (U$ 4,154.63 and U$ 3,397.51), SCC (U$ -3,462.19 and U$ -2,831.26), PROT (U$ 2,077.32 and U$ 1,662.03), AFC (U$ -2,997.40 and U$ -2,451.18), MP (U$ 1,384.87 and U$ 1,132.50), CI (U$ -1,187.03 and U$ -860.22), feed intake (U$ -641.20 and U$ -586.82), cow weight (U$ 125.26 and U$ 122.81) and mortality (U$ 0.00 and U$ -28.61), for high and medium clusters, respectively.

The decrease in the diet costs caused an increase in the profit percentage (Table 5) (up to 40.64% for FAT^{II} in the medium cluster with 50% decrease in diet costs). On the other hand, the increase (+25 and +50%) in the diet costs, would cause a decrease in farm profits (up to 25.33% in AFC with 50% increase in diet costs).

Table 4

Economic value (U$) for production, fertility, quality, consumption, weight and mortality traits, with the company scenarios that do not bonus/penalize (I), which bonus/penalizes the lower range (II) and the higher range (III), standardized to a 100 cow herd.

Scenario	Cluster	Traits									
		AFC	MP	LP	CI	INTAKE	Weight	MORT	FAT	PROT	SCC
I	High	-2997.40	1384.87	1384.87	-1187.03	-641.20	125.26	0.00	0.00	0.00	0.00
	Medium	-2451.18	1132.50	1132.50	-860.22	-586.82	122.81	-28.61	0.00	0.00	0.00
		AFC	MP	LP	CI	FAT	SCC	INTAKE	PROT	Weight	MORT
II	High	-2997.40	1384.87	1384.87	-1187.03	830.92	-692.44	-641.20	415.46	125.26	0.00
	Medium	-2451.18	1132.50	1132.50	-860.22	679.50	-566.25	-586.82	339.75	122.81	-28.61
		FAT	SCC	AFC	PROT	MP	LP	CI	INTAKE	Weight	MORT
III	High	4154.63	-3462.19	-2997.40	2077.32	2506.63	2506.63	-1187.03	-641.20	125.26	0.00
	Medium	3397.51	-2831.26	-2451.18	1698.76	2049.84	2049.84	-860.22	-586.82	122.81	-28.61

Abbreviations: MP: total milk production; LP: lactation persistency; CI: calving interval; AFC: age at first calving; MORT: mortality; FAT: milk fat; PROT: milk protein and SCC: somatic cell count.

Table 5

Sensitivity analysis for percentage change in profit for production, functional and fertility traits depending on cost of diet components.

Diet variation costs (%)	Cluster	Traits												
		MP	LP	CI	AFC	Weight	Intake	MORT	FAT[I]	PROT[I]	SCC[I]	FAT[II]	PROT[II]	SCC[II]
-50	High	21.46	21.46	20.84	20.40	21.16	21.07	21.13	21.33	21.23	20.96	22.10	21.62	20.28
	Medium	23.94	23.94	23.26	22.77	23.62	23.55	23.56	40.13	40.07	39.89	40.64	40.52	39.45
-25	High	10.99	10.99	10.20	9.62	10.60	10.37	10.57	10.82	10.69	10.35	11.82	11.20	9.47
	Medium	12.26	12.26	11.38	10.74	11.84	11.54	11.77	28.41	28.31	28.28	28.16	28.69	27.39
0	High	0.52	0.52	-0.46	-1.16	0.05	-0.42	0.00	0.31	0.16	-0.26	1.53	0.78	-1.34
	Medium	0.58	0.58	-0.54	-1.28	0.06	-0.47	-0.01	0.35	0.17	-0.29	1.70	0.86	-1.49
25	High	-9.95	-9.95	-11.10	-11.94	-10.51	-10.85	-10.57	-10.19	-10.38	-10.88	-8.75	-9.65	-12.15
	Medium	-11.11	-11.11	-12.38	-13.11	-11.71	-12.15	-11.81	4.96	4.80	4.37	6.21	5.43	3.26
50	High	-18.64	-18.64	-19.94	-20.89	-19.28	-19.46	-19.34	-20.70	-20.92	-21.49	-19.04	-20.07	-22.97
	Medium	-22.79	-22.79	-24.26	-25.33	-23.49	-23.64	-23.60	-6.77	-6.96	7.48	-5.26	-6.20	-8.80

Abbreviations: MP: total milk production; LP: duration of lactation; CI: calving interval; AFC: age at first calving; MORT: mortality; FAT: milk fat; PROT: milk protein and SCC: somatic cell count; I: company which grants and / or penalizes the lower range; II: company which grants and / or penalizes the higher range.

4. Discussion

The micro-region of Passo Fundo has the highest percentage of herds in agriculture and production within the northwestern mesoregion of Rio Grande do Sul State. It is the second in milk production and first in milk productivity in Brazil (IBGE, 2009).

Observing the performance indexes the high and medium-high production clusters, were considered specialized in milk production due to their production levels and feed management (Zoccal et al., 2012). Thus, if environmental effects in this microregion are the same (IBGE, 2006), most production differences are based on process management (Cabrera et al., 2010) and the use of genetic (Vance et al., 2012), nutritional (Auldist et al., 2013) and herd health (Roelofs et al., 2010) technologies.

The objectives of selection were based on the above mentioned indices, and are the basis for choosing the selection criteria that will maximize economic gain. Zadra (2012a) defined this as the most important decision to be taken by the farmer, as this is when he decides which traits should be improved.

The economic selection objective may show low impact due to the traits measured on the animals, or the economically relevant traits can have many indicator traits. The calculations of the economic values of the selection criteria traits may or not affect the average profit, which may or may not be counted, economically, for weighting coefficients of selection indices (Cameron, 1997).

Economic values were calculated from an economic analysis of production systems. More intensive systems may be seen to be more economically profitable (Simões et al., 2009), since they tend to have more efficient process management

(Cabrera et al., 2010 and Inchaisria et al., 2010). The management of animal welfare (Frase, 2008), factors that increase days open (Piccardi et al., 2013 and Leal et al., 2013), nutrition (Walsh et al., 2009), genetics (Ouwelties et al., 2007 and Lean et al, 2013) and environmental effects on animal stress (Hansen and Fuquay, 2011) are crucial to the intensification of the processes and increase production and economic efficiency of production systems. Likewise, the economic genetic selection of animals is important for the competitiveness of production systems.

In this study, the higher operating cost was due to the animal feed (concentrate and roughage), and the second due to the payment of labor. Similar results for operating costs in goat dairy farming in Brazil were found by Lopes et al. (2012a). This cost distribution shows that the most productive and economic efficiency of the high cluster is related to better management of production processes.

The economic values for the traits of economic selection objectives for the two clusters of milk producers, were similar. However, the magnitude of the economic values in the high cluster were higher due to higher gross margin and profitability.

The selection of traits to meet the economic objectives also depend on the form of payment received. Thus, the economic values in accordance with the milk payment by companies, and in order of economic importance, were considered. The economic values for milk production were positive, indicating that selection for this trait would imply in economic gain for the producer. These values are consistent with those reported in other studies (Cardoso et al., 2004, Vercesi

Filho et al., 2000, Martin et al., 2003 and Komlósi et al., 2010), even though, at the time when these studies were developed, the economic scenarios were different. As in the literature, the results of this study were expected, since there is still greater emphasis on payment by volume of milk produced and not quality.

Lactation persistency also has positive economic values and, similar to milk production, its selection would result in greater profit to the producer (Togashi et al., 2009). According to Zadra (2012b), under the economic point of view, lactation persistency is the most important characteristic of the lactation curve. In cows with less steep production declines, their energy needs are more constant and balanced throughout the lactation, allowing better utilization of food and thereby reducing production costs (Dorneles et al., 2009).

The economic values for age at first calving (AFC) was negative for the two clusters studied, showing that for the producer to increase his profit, selection should be for the early calving animals (Wolfová et al., 2007a and Brumatti et al., 2011). As it is of greater economic magnitude than milk production traits, inclusion of AFC as a criterion for selection of economic objectives in genetic improvement programs for dairy herds is important. With smaller magnitude, calving interval (CI) should also be included in the economic selection objectives. This is justified because animals with lower calving interval and age at first calving are more fertile and therefore more productive (Vercesi Filho et al., 2007 and Chen, 2009).

At the same time, the negative correlation between these characteristics and milk production should be noted (Pantelić et al., 2008 and Seno et al., 2010). There are several studies showing that higher productivity determines lower female fertility, increased metabolic clearance of reproductive hormones (Berg et al., 2010), due to the productive stress (Piccardi et al., 2013) or negative energy balance (Law et al., 2009). Lower fertility increases the calving interval, and consequently decreases production. Thus, appropriate management for the reduction of environmental effects that contribute to decreased fertility (Hansen and Fuquay, 2011, López-Gatius, 2012 and Leal et al., 2013) and the use of technologies for the manipulation of fertility (Gutiérrez et al., 2009, Herlihy et al., 2013 and Hasler, 2014), become essential for the inclusion of these traits in the economic selection objectives.

In scenario II and III, when there was a bonus/penalty for milk quality by the companies, fat was the trait with higher economic value and protein with the lower. The economic values for these traits, in scenario II and III, were positive, the increase of their production through selection result in an increase in profit (Madalena, 2008 and Wolvová et al., 2010b), and for the companies, higher yield of dairy products (Seno et al., 2007 and Prata et al., 2012). This value indicates that the remuneration applied by companies for these components in milk justify and compensate their inclusion in the economic selection objectives.

Similarly, increased somatic cell count has a negative economic value, and fat and protein have an intermediate economic value. These values reflect the need to include these traits in a breeding program when the company practices the rules outlined in White paper 62. However, the interpretation is different, because the increase in SCC gives a negative economic value, which leads the companies to penalize farmers that supply milk with high SCC. Their increase in milk reflected in lower yield in manufactured dairy products and lower shelf life of these products (Barbano et al., 2006 and Gargouri et al., 2008). Another relevant aspect regarding SCC is related to public health issues, because, according to Fonseca et al. (2009) and Ribeiro and Wuerges (2013), as SCC increases the likelihood of antibiotic residues in milk being found also increases.

According to Prata et al. (2009) and Miller et al. (2009), the SCC increase also causes decrease in milk production and its components, which could contribute to the reduction of the annual profit of the herd. Clinical and subclinical mastitis are related to increased production of SCC in milk (Lopes et al., 2012b) and are also causes of involuntary culling of dairy cows (Roelofs et al., 2010 and Lagrotta et al., 2010). The study of the inclusion of SCC as a selection criterion to reduce mastitis would be interesting, because as this trait is an indicator of health of the mammary gland (Urioste et al., 2012 and Koeck et al., 2012), the producer would have the herd monitored for this problem.

For producers who sell milk to companies that practice payment with bonus/penalty for milk quality, greater attention should be paid to the correct definition of the criteria in the selection objectives in genetic improvement programs, as the construction of an index of selection, these criteria would give higher profits to the producer.

For the feed intake, the economic value was significant because of the high cost to feed the animals, which are responsible for an average of 73.7% of effective operating cost. Selecting animals with better feed efficiency and the proper nutrition management, to reduce costs of diet components and their waste, causes reduction of costs, and consequently, increased income to the producer (Capper et al., 2009).

The largest economic impact was seen in milk quality traits and disease resistance, followed by precocity and CI, MP, LP and INTAKE. Therefore, the criteria to be considered in the selection objectives result in animals producing milk of better quality, more disease resistant, more fertile and therefore more productive.

To better understand the economic impact of genetic breeding, changes of ± 25 and ± 50% in the price of the diet ingredients, and the consequent changes in the profitability of the systems were studied (Cunningham et al., 2009). The results show that profit and consequently the economic values, are sensitive to price changes of the diet and, thus, other production costs. They also show that producers must not only to focus on breeding animals for greater profit, but also with environmental factors (Lobell et al., 2008, Crane et al., 2011 and Fuhrer et al, 2013), management (Giordano et al., 2012, Gerdessen and Pascucci, 2013 and Atzori et al., 2013) and technologies (Edgerton, 2009, Qaim, 2010 and Thatcher et al., 2011), which can interfere with production costs and profit.

The economic values should be calculated based on future prices, since breeding is oriented with a view to the future. The consequences of the decisions taken in the present will be observed only when the offspring express their productive potential. One of the advantages of using bioeconomic models is the ability to easily assess the impact of the scenario changes in the trait´s economic values, and recalculate these values. The bioeconomic models can also be used to compare pathogens and mastitis (Sorensen et al., 2010), semen of bulls (Sadeghi-Sefidmazgi et al., 2012 and Thomasen et al., 2014) and other traits under different feeding conditions and management (Rennó et al., 2008), and thus guide the direction for future genetic progress.

Other production traits in dairy farming related to conformation, longevity, calving ease and growth, among others, could also be included as criteria for selection objectives in breeding programs in this region. Lack of information/sufficient data to judge the impacts of different alternatives for selection in animal breeding and its effect on the profitability of production systems cause them to be ignored or forgotten during the selection process.

5. Conclusion

The economic values calculated for the volume of milk (milk production and lactation persistency), fertility (age at first calving and calving interval), milk quality (milk fat, milk protein and somatic cell count), disease resistance (somatic cell count) and feed intake, indicate that selection for these traits as selection objectives in breeding programs result in increased profitability for the farmer.

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CAPÍTULO V

CONSIDERAÇÕES FINAIS

Dentro da perspectiva mundial para a produção de alimentos, pode-se dizer que a pecuária leiteira do Sul do Brasil é produtivamente eficiente e economicamente rentável. A difusão deste modelo produtivo a outras regiões, tornaria esta atividade relevante e colocaria o Brasil entre os dois maiores provedores mundiais de leite, com produção entre 60 e 100 bilhões de litros anuais.

O conhecimento dos diferentes fatores que explicam a produção de leite de vacas em diferentes regiões torna-se importante para sua maximização. Frente a isso, várias ações podem ser tomadas no sentido de incrementar a produção. A profissionalização das atividades com gestão dos processos e uso de tecnologias, para otimização da produção, são determinantes para a competitividade das explorações leiteiras.

A inseminação artificial continua sendo o método mais simples, barato e de fácil difusão a produtores de leite, para a dispersão de genes melhoradores. A sua implementação nas explorações leiteiras, além de determinar maior produção, é base para implementação de outras biotecnologias necessária para a diminuição dos efeitos negativos do estresse produtivo e ambiental, como a inseminação artificial em tempo fixo e transferência de embriões.

Os objetivos econômicos de seleção é a forma racional de fazer o melhoramento genético de rebanhos leiteiros. Esta ação, além da genética animal, leva em consideração o ambiente onde estão inseridos os animais e o seu sistema produtivo. Os valores econômicos determinam as características economicamente mais importantes para o produtor, em determinada região. Os valores econômicos das características dos objetivos de seleção resultam da interação entre genética, ambiente e manejo, os quais determinam o principal objetivo da atividade, o lucro.

As análises mostraram diferentes fatores intrínsecos à produção leiteira e que a pesquisa deve entender, elucidar e propor alternativas para o aumento da eficiência produtiva. Portanto, pode-se dizer que o papel da ciência e tecnologia é de alicerçar e mediar este processo, na transformação da produção e, assim, atender as necessidades mundiais de alimentos.

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ANEXOS

Capítulo II

Annex 1–Data productive with their acronyms, source extraction and measurement units.

Variables	**Abbreviation**	**Data Source**	**Units**
Cows milked	MC	IBGE	heads
Quantity of milk	MQ	IBGE	1 000
Productivity	Produc	IBGE	L/cow
Cows milked effective herd	MCEH	IBGE	%
Cows milked per area	MC_area	IBGE	heads/km^2
Quantity of milk per area	MQ_area	IBGE	1 000l/km^2
Productivity per area	Produc_area	IBGE	L/cow/km^2
Cows milked herd by effective area	MCEH_area	IBGE	%/km^2
Cows milked by gross domestic product	MC_gdp	IBGE	heads /R$ 1 000
Quantity of milk per gross domestic product	MQ_gdp	IBGE	1 000l/R$ 1 000
Productivity by gross domestic product	Produc_gdp	IBGE	L/cow/R$ 1 000
Cows milked effective herd by gross domestic product	MCEH_gdp	IBGE	%/R$ 1 000
Cows milked per population	MC_pop	IBGE	heads /inhabitants
Quantity of milk per population	MQ_pop	IBGE	1 000l/inhabitants
Productivity per population	Produc_pop	IBGE	L/cow/inhabitants
Cows milked effective herd by inhabitants	MCEH_pop	IBGE	%/inhabitants

Annex 2–**Data on socioeconomic and environmental respective acronyms, source extraction and measures.**

Variables	Abbreviation	Data Source	Units
Producer with activity outside the establishment	pae	IBGE	nº
Producer with activity outside agriculture in	paa	IBGE	nº
Producer with outside activity in non agricultural	paan	IBGE	nº
Producer with outside activity in agricultural and non-agricultural	paana	IBGE	nº
Water resources in establishments with springs protected forest	wrf	IBGE	nº
Water resources in establishments with springs without protection forests	wrfw	IBGE	nº
Water resources in establishments with rivers or streams protected forest	wrs	IBGE	nº
Water resources in establishments with rivers or streams without protection of forests	wrsw	IBGE	nº
Water resources in establishments with natural lakes and / or ponds protected forests	wrl	IBGE	nº
Water resources in establishments with natural lakes and / or ponds without protection forests	wrlw	IBGE	nº
Existing water wells in establishments with common	wc	IBGE	nº
Existing water resources on properties with wells, artesian or semi-tubular	wa	IBGE	nº
Water resources in establishments with cistern	wci	IBGE	nº
Technical guidance received by the government (federal, state or municipal)	tgg	IBGE	nº
Technical guidance received from the producer himself or itself	tgp	IBGE	nº
Technical guidance received by cooperatives	tgc	IBGE	nº
Technical guidance received by integrators	tge	IBGE	nº
Technical guidance received by private planning	tgpr	IBGE	nº

“continuação” Data on socioeconomic and environmental respective acronyms, source extraction and measures.

Establishments with economic activity with breeding and keeping other animals per area (ha)	epa	IBGE	nº
Establishments with economic activity with production forest - forests planted area (ha)	epf	IBGE	nº
Establishments with economic activity with production forest - native forests by area (ha)	epfn	IBGE	nº
Producer men younger than 1 year of work toward the establishment	m1	IBGE	nº
Producer men between 1 and 5 years in the direction of the work in establishments	m15	IBGE	nº
Producer men between 5 and 10 years at the helm of jobs in establishments	m510	IBGE	nº
Producer men above 10 years at the helm of jobs in establishments	m10	IBGE	nº
Producer woman with less than one year in the direction of the work in establishments	w1	IBGE	nº
Producer women between 1 and 5 years in the direction of the work in establishments	w15	IBGE	nº
Producer women between 5 and 10 years at the helm of jobs in establishments	w510	IBGE	nº
Producer women above 10 years at the helm of jobs in establishments	w10	IBGE	nº
Establishments with family farming	efar	IBGE	nº
Establishments with agricultural unfamiliar	eunfar	IBGE	nº
Total establishments with agricultural management	mae	IBGE	nº
Management control of agricultural diseases and / or parasites in animals	mad	IBGE	nº
Agricultural management with rotational grazing	mrg	IBGE	nº
Land unusable for agriculture or livestock per area	la	IBGE	ha
Establishments by area	ea	IBGE	ha
Permanent crops by area	pca	IBGE	ha
Seasonal crop by area	sca	IBGE	ha
Crop acreage with forage cutting area	cafc	IBGE	ha
Rangelands by area	pra	IBGE	ha

Pls degraded by area	ppd	IBGE	ha

“continuação” Data on socioeconomic and environmental respective acronyms, source extraction and measures.

Planted pastures in good condition by area	ppg	IBGE	ha
Matas and / or natural forests for permanent preservation and legal reserve by area	nfpp	IBGE	ha
Matas and / or natural forests (exclusive area of preservation and agroforestry systems) per area	nfep	IBGE	ha
Forests planted with forest trees per area	fp	IBGE	ha
Forestry systems agros - acreage with forest species also used for crops and grazing animals per area	fsa	IBGE	ha
Area occupied by tanks, lakes, reservoirs and / or area of public waters for exploration area for aquaculture	ta	IBGE	ha
Area with buildings, improvements or paths by area	ab	IBGE	ha
Land unusable for agriculture or livestock by Area	ala	IBGE	ha
Establishments with temporary crops by area	etc	IBGE	ha
Family farming area	aff	IBGE	ha
Agriculture unfamiliar area by	aunfam	IBGE	ha
Number of cattle	nc	IBGE	heads
Relative humidity	UR	INMET	%
Temperature	Temp	INMET	ºC
Solar radiation	Srl	INMET	W/m^2
Index of temperature and humidity	THI	INMET	ºC e %
Maximum temperature	max	INMET	ºC
Minimum temperature	min	INMET	ºC
Temperature range	Tr	INMET	ºC
Precipitation	Precip	INMET	mm/h
Area	Area	USGS	km^2
Normalized difference vegetative index	NDVI	Landsat/INPE	NDVI
Altimetry	Alt	USGS	M
Municipal Human Development Index-2000	idhm_00	PNUD	R$/percapita
Internal produc b rute	gdp	IBGE	R$ 1 000
Population	Pop	IBGE	inhabitants

Anexo 3 – **Normas para preparação de trabalhos científicos para publicação na Animal Science Journal**

Animal Science Journal

Author Guidelines

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Animal Science Journal(a continuation of Animal Science and Technology) is the official journal of the Japanese Society of Animal Science (JSAS) and publishes Original Research Articles (full papers and rapid communications) in English in all fields of animal and poultry science: genetics and breeding, genetic engineering, reproduction, embryo manipulation, nutrition, feeds and feeding, physiology, anatomy, environment and behavior, animal products (milk, meat, eggs and their by-products) and their processing, and livestock economics. *Animal Science Journal* will invite Review Articles in consultations with Editors. Submission to the Journal is open to those who are interested in animal science.

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• Do not use Enter at the end of lines within a paragraph.
• Turn the hyphenation option off; include only those hyphens that are essential to the meaning.
• Specify any special characters used to represent non-keyboard characters.
• Take care not to use l (ell) for 1 (one), O (capital o) for 0 (zero) or ß (German esszett) for β (Greek beta).
• Use a tab, not spaces, to separate data points in tables. If you use a table editor function, ensure that each data point is contained within a unique cell (i.e. do not use carriage returns within cells).
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Journals

Drori D, Loosli JK. 1959. Influence of fistulation on the digestibility of feeds by steers. *Journal of Animal Science* **18**, 206–210.

Online article not yet published in an issue

An online article that has not yet been published in an issue (therefore has no volume, issue or page numbers) can be cited by its Digital Object Identifier (DOI). The DOI will remain valid and allow an article to be tracked even after its allocation to an issue.

Abe H, Takeuchi H. 2012. Characterization of the intronic VNTR polymorphisms found in a paralog of chicken serotonin transporter gene.*Animal Science Journal*. 2012, doi: 10.1111/asj.12011

Books

Nalbandov AV. 1963. *Advances in Neuroendocrinology* 2nd edn. University of Illinois Press, Urbana, IL.

Chapter in a book

Folley SJ, Malpress FH. 1948. Hormonal control on mammary growth. In: Pincuss G, Thimamm KV (eds), *The Hormones* Vol. 1, pp. 695–743. Academic Press, New York.

Electronic material

National Center for Biotechnology Information (NCBI). 1999. Nucleotide–nucleotide BLAST (blastn) [homepage on the Internet]. National Center for Biotechnology Information, Bethesda, MD; [cited 13 December 2002]. Available from URL:http://www.ncbi.nlm.nih.gov/blast/

Patent

Tomogane H. 2002. Improved method for meat quality. Japanese Patent No.3433212, granted 19 January 2002.

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```
data um;
input  estado $ micro $ meso $ munici $ pro_est pro_agr pro_nagr pro_aena ter_area
lav_pare lav_tare
lav_apa pas_nar pas_par pas_ppa mat_are mat_area flo_area sis_acatan_area
cons_are
ter2area reh_npm reh_nspm reh_rpm reh_rspm reh_lpm reh_lspm reh_pcom reh_pasa
reh_pcis ort_gov ort_prop ort_coop ort_eint ort_epri eae_area eae_ltar eae_lpar
eae_hfar eae_pcar eae_fpar eae_fnar hom_me1 hom_1a5 hom_5a10 hom_10am
mul_me1 mul_1a5
mul_5a10 mul_10am eaf_afes eaf_afar eaf_nfes eaf_nfar mag_est mag_cdp
mag_ropa
pec_bonc codigo  idhm_00  Vacaord quantlei valorlei produt voporef Longitude
Latitude
Alt Area Precip NDVI PIB Pop Prod_ovinos Solos $ UR Temp Radsol THI max min
ampl ;
if max = 0 then max = .;
if min = 0 then min = .;
if ampl = 0 then ampl = .;
if thi lt 55 then delete;

Vaca_area = Vacaord/ter_area;
quant_area = quantlei/ter_area;
prod_area = produt/ter_area;
vopo_area = voporef/ter_area;

Vaca_pib = Vacaord/pib;
quant_pib = quantlei/pib;
prod_pib = produt/pib;
vopo_pib = voporef/pib;

Vaca_pop = Vacaord/pop;
quant_pop = quantlei/pop;
prod_pop = produt/pop;
vopo_pop = voporef/pop;
prodade = quantlei/vacaord;

DADOS

/* proc glm;
class estado meso;
model Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop
prodade =  estado meso(estado) /ss3;
means estado meso(estado)/tukey lines alpha=0.1;
lsmeans estado meso(estado)/pdiff adjust=tukey alpha=0.1;
proc reg ; by regiao;
model Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop =
```

```
pro_est pro_agr pro_nagr pro_aena ter_area lav_pare lav_tare
lav_apa pas_nar pas_par pas_ppa mat_are mat_area flo_area sis_aca tan_area
cons_are
ter2area reh_npm reh_nspm reh_rpm reh_rspm reh_lpm reh_lspm reh_pcom reh_pasa
reh_pcis ort_gov ort_prop ort_coop ort_eint ort_epri eae_area eae_ltar eae_lpar
eae_hfar eae_pcar eae_fpar eae_fnar hom_me1 hom_1a5 hom_5a10 hom_10am
mul_me1 mul_1a5
mul_5a10 mul_10am eaf_afes eaf_afar eaf_nfes eaf_nfar mag_est mag_cdp
mag_ropa
pec_bonc codigo  idhm_00   Alt Area Precip NDVI PIB Pop Prod_ovinos  UR Temp
Radsol THI max min ampl/ selection = stepwise vif slstay=0.1 ;
/*
proc discrim;
class regiao;
var  Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop ;

proc discrim;
class regiao;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;

proc stepdisc;
class regiao;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;

proc discrim; by regiao;
class munici;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;

proc stepdisc; by regiao;
class munici;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;

proc factor;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;
*/
procfastclus data=um maxclus = 5 maxiter=5 out=clus;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;
run;
proccandisc anova out=can;
```

```
    class cluster;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;
    title2 'Canonical Discriminant Analysis of Clusters';
run;
  legend1 frame cframe=ligr label=none cborder=black
        position=center value=(justify=center);
  axis1 label=(angle=90 rotate=0) minor=none;
  axis2 minor=none;

procgplot data=Can;
    plot Can2*Can1=Cluster/frame cframe=ligr
               legend=legend1 vaxis=axis1 haxis=axis2;
    title2 'Plot of Canonical Variables Identified by Cluster';
run;

PROCSTEPDISC;
CLASS CLUSTER;
VAR  pro_est pro_agr pro_nagr pro_aena ter_area lav_pare lav_tare
lav_apa pas_nar pas_par pas_ppa mat_are mat_area flo_area sis_aca tan_area
cons_are
ter2area reh_npm reh_nspm reh_rpm reh_rspm reh_lpm reh_lspm reh_pcom reh_pasa
reh_pcis ort_gov ort_prop ort_coop ort_eint ort_epri eae_area eae_ltar eae_lpar
eae_hfar eae_pcar eae_fpar eae_fnar hom_me1 hom_1a5 hom_5a10 hom_10am
mul_me1 mul_1a5
mul_5a10 mul_10am eaf_afes eaf_afar eaf_nfes eaf_nfar mag_est mag_cdp
mag_ropa
pec_bonc codigo  idhm_00  Vacaord quantlei valorlei produt voporef Longitude
Latitude
Alt Area Precip NDVI PIB Pop Prod_ovinos  UR Temp Radsol THI max min ampl;

PROCSTEPDISC;
CLASS CLUSTER;
VAR Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;

PROCDISCRIM;
CLASS CLUSTER;
VAR  pro_est pro_agr pro_nagr pro_aena ter_area lav_pare lav_tare
lav_apa pas_nar pas_par pas_ppa mat_are mat_area flo_area sis_aca tan_area
cons_are
ter2area reh_npm reh_nspm reh_rpm reh_rspm reh_lpm reh_lspm reh_pcom reh_pasa
reh_pcis ort_gov ort_prop ort_coop ort_eint ort_epri eae_area eae_ltar eae_lpar
eae_hfar eae_pcar eae_fpar eae_fnar hom_me1 hom_1a5 hom_5a10 hom_10am
mul_me1 mul_1a5
mul_5a10 mul_10am eaf_afes eaf_afar eaf_nfes eaf_nfar mag_est mag_cdp
mag_ropa
pec_bonc codigo  idhm_00  Vacaord quantlei valorlei produt voporef Longitude
Latitude
Alt Area Precip NDVI PIB Pop Prod_ovinos  UR Temp Radsol THI max min ampl;
```

```
PROCDISCRIM;
CLASS CLUSTER;
VAR Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;

RUN;
procsort; by cluster ;
procmeans ;
class cluster;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;
 output out = outmun mean = Vacaord quantlei valorlei produt voporef Vaca_area
quant_area prod_area vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;

PROCCLUSTER DATA=outmun METHOD=ward STD  PSEUDO RSQUARE k = 8
OUTTREE=treedat2;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;
 copy CLUSTER;
  ID CLUSTER;
*- the TREE procedure produces a dendrogram;
PROCTREE DATA=treedat2 HORIZONTAL;
  ID cluster ;
  title " ";

RUN;

/*
proc factor; by regiao;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop
pro_est pro_agr pro_nagr pro_aena ter_area lav_pare lav_tare
lav_apa pas_nar pas_par pas_ppa mat_are mat_area flo_area sis_aca tan_area
cons_are
ter2area reh_npm reh_nspm reh_rpm reh_rspm reh_lpm reh_lspm reh_pcom reh_pasa
reh_pcis ort_gov ort_prop ort_coop ort_eint ort_epri eae_area eae_ltar eae_lpar
eae_hfar eae_pcar eae_fpar eae_fnar hom_me1 hom_1a5 hom_5a10 hom_10am
mul_me1 mul_1a5
mul_5a10 mul_10am eaf_afes eaf_afar eaf_nfes eaf_nfar mag_est mag_cdp
mag_ropa
pec_bonc codigo  idhm_00  Vacaord quantlei valorlei produt voporef Longitude
Latitude
Alt Area Precip NDVI PIB Pop Prod_ovinos  UR Temp Radsol THI max min ampl;

proc fastclus data=um maxclus = 5 maxiter=5 out=clus; by regiao;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;
```

```
   run;
proc candisc anova out=can; by regiao;
      class cluster;
var pro_est pro_agr pro_nagr pro_aena ter_area lav_pare lav_tare
lav_apa pas_nar pas_par pas_ppa mat_are mat_area flo_area sis_aca tan_area
cons_are
ter2area reh_npm reh_nspm reh_rpm reh_rspm reh_lpm reh_lspm reh_pcom reh_pasa
reh_pcis ort_gov ort_prop ort_coop ort_eint ort_epri eae_area eae_ltar eae_lpar
eae_hfar eae_pcar eae_fpar eae_fnar hom_me1 hom_1a5 hom_5a10 hom_10am
mul_me1 mul_1a5
mul_5a10 mul_10am eaf_afes eaf_afar eaf_nfes eaf_nfar mag_est mag_cdp
mag_ropa
pec_bonc codigo  idhm_00  Vacaord quantlei valorlei produt voporef Longitude
Latitude
Alt Area Precip NDVI PIB Pop Prod_ovinos  UR Temp Radsol THI max min ampl;
      title2 'Canonical Discriminant Analysis of Clusters';
   run;
   legend1 frame cframe=ligr label=none cborder=black
         position=center value=(justify=center);
   axis1 label=(angle=90 rotate=0) minor=none;
   axis2 minor=none;

   proc gplot data=Can; by regiao;
      plot Can2*Can1=Cluster/frame cframe=ligr
                  legend=legend1 vaxis=axis1 haxis=axis2;
      title2 'Plot of Canonical Variables Identified by Cluster';
   run;

RUN;
proc sort; by regiao ;
proc means data = clus noprint; by regiao;
class cluster;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop
pro_est pro_agr pro_nagr pro_aena ter_area lav_pare lav_tare
lav_apa pas_nar pas_par pas_ppa mat_are mat_area flo_area sis_aca tan_area
cons_are
ter2area reh_npm reh_nspm reh_rpm reh_rspm reh_lpm reh_lspm reh_pcom reh_pasa
reh_pcis ort_gov ort_prop ort_coop ort_eint ort_epri eae_area eae_ltar eae_lpar
eae_hfar eae_pcar eae_fpar eae_fnar hom_me1 hom_1a5 hom_5a10 hom_10am
mul_me1 mul_1a5
mul_5a10 mul_10am eaf_afes eaf_afar eaf_nfes eaf_nfar mag_est mag_cdp
mag_ropa
pec_bonc codigo  idhm_00  Vacaord quantlei valorlei produt voporef Longitude
Latitude
Alt Area Precip NDVI PIB Pop Prod_ovinos  UR Temp Radsol THI max min ampl;
 output out = outmun mean = Vacaord quantlei valorlei produt voporef Vaca_area
quant_area prod_area vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop
pro_est pro_agr pro_nagr pro_aena ter_area lav_pare lav_tare
lav_apa pas_nar pas_par pas_ppa mat_are mat_area flo_area sis_aca tan_area
cons_are
```

```
ter2area reh_npm reh_nspm reh_rpm reh_rspm reh_lpm reh_lspm reh_pcom reh_pasa
reh_pcis ort_gov ort_prop ort_coop ort_eint ort_epri eae_area eae_ltar eae_lpar
eae_hfar eae_pcar eae_fpar eae_fnar hom_me1 hom_1a5 hom_5a10 hom_10am
mul_me1 mul_1a5
mul_5a10 mul_10am eaf_afes eaf_afar eaf_nfes eaf_nfar mag_est mag_cdp
mag_ropa
pec_bonc codigo  idhm_00  Vacaord quantlei valorlei produt voporef Longitude
Latitude
Alt Area Precip NDVI PIB Pop Prod_ovinos  UR Temp Radsol THI max min ampl;

  PROC CLUSTER DATA=outmun METHOD=ward STD  PSEUDO RSQUARE k = 8
OUTTREE=treedat2;by regiao;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;
 copy cluster;
  ID cluster;
*- the TREE procedure produces a dendrogram;
PROC TREE DATA=treedat2 HORIZONTAL;by regiao;
  ID cluster;
  title " ";
*/
run;
quit;
data mapa;
input UF $ Vacaord Number quantlei  valorlei produt prodade quant_area  prod_area
vopo_area quant_pib prod_pib Vaca_pop quant_pop prod_pop vopo_pib  vopo_pop;
IF UF='AC' THEN ID=1;  IF UF='AL' THEN ID=2;  IF UF='AP' THEN ID=3;
IF UF='AM' THEN ID=4;  IF UF='BA' THEN ID=5;  IF UF='DF' THEN ID=6;
IF UF='CE' THEN ID=7;  IF UF='ES' THEN ID=8;  IF UF='GO' THEN ID=9;
IF UF='MA' THEN ID=10; IF UF='MT' THEN ID=11; IF UF='MS' THEN ID=12;
IF UF='MG' THEN ID=13; IF UF='PA' THEN ID=14; IF UF='PB' THEN ID=15;
IF UF='PR' THEN ID=16; IF UF='PE' THEN ID=17; IF UF='PI' THEN ID=18;
IF UF='RJ' THEN ID=19; IF UF='RN' THEN ID=20; IF UF='RS' THEN ID=21;
IF UF='RO' THEN ID=22; IF UF='RR' THEN ID=23; IF UF='SC' THEN ID=24;
IF UF='SP' THEN ID=25; IF UF='SE' THEN ID=26; IF UF='TO' THEN ID=27;
cards;

AC 3061.381 1 1906.3333 1478.8571 563 0.56297045 0.01530937 0.00867791
0.00014934 0.01239715 0.0055594 0.18393132 0.11424653 0.04384411 0.00007163
0.00049007
AL 1587.1584 2 2358.7228 1433.4158 1413.43564 1.41343712 0.13614061
0.15982657 0.00127364 0.04948948 0.03266468 0.11384238 0.17322393 0.11857178
0.0002824 0.00099255
AM 1710.1636 3 759.0909 831.1091 464.47273 0.46439327 0.01053965 0.03143774
0.00051484 0.00523068 0.00565639 0.04817568 0.02212909 0.02166417 0.00009368
0.00034639
AP 496.9375 4 419 511.25 787.125 0.78707844 0.01464616 0.06750012 0.00063842
0.00437905 0.00989478 0.04555098 0.03874848 0.08748906 0.00007586 0.00073056
BA 5121.9591 5 2841.4159 2267.774 550.30529 0.55031477 0.07248886 0.10301752
0.00217309 0.03978295 0.00977627 0.29984084 0.16020499 0.0362393 0.00043613
0.00159345
```

CE 2849.5326 6 2350.7826 1836.6739 794.05978 0.7940888 0.06429489 0.05249016 0.00128328 0.024315 0.01181411 0.11536062 0.09141829 0.04265696 0.00030603 0.00108555
DF 20900 7 36000 23400 1722 1.72248804 0.14324367 0.00685182 . 0.0003062 0.00001465 0.00813179 0.01400691 0.00067 . .
ES 4979.2179 8 5404.5897 3748.2821 1115.30769 1.1153002 0.15974513 0.12859946 0.00471411 0.03002083 0.00829535 0.2497149 0.27745117 0.07245956 0.00015221 0.00137586
GO 9923.435 9 12208.0854 7191.935 1161.96341 1.16194906 0.18664944 0.03918849 0.00039754 0.14133852 0.02427799 1.1786777 1.38946627 0.2168788 0.00031392 0.00270276
MA 2510.9259 10 1643.5 1182.2407 487.29167 0.48729874 0.02961834 0.02780752 0.00040036 0.01869516 0.00888479 0.13118602 0.08113562 0.03257004 0.00015391 0.00055983
MG 6224.9634 11 9352.7512 6274.4186 1412.34788 1.41234926 0.34008351 0.12106674 0.00257537 0.10809706 0.02994706 0.61874894 0.92491934 0.22072447 0.00062112 0.00418499
MS 6745.9359 12 6442.0769 3413.0385 971.57692 0.97157915 0.03283493 0.00800884 0.00002502 0.04078913 0.00806611 0.51369887 0.49225122 0.08961204 0.00002395 0.0002602
MT 4222.6525 13 4826.9149 2966.0355 1094.86525 1.09486064 0.02739976 0.00678029 0.00004969 0.05005163 0.01358804 0.46280839 0.52884678 0.15963751 0.00010798 0.00126757
PA 6500.8227 14 4228.5887 3062.8794 614.14184 0.61413822 0.02900884 0.02319325 0.00030139 0.03232839 0.00759103 0.26921764 0.17509537 0.02799693 0.00009443 0.0003331
PB 1047.9731 15 959.0045 694.3274 900.33184 0.9003163 0.06826246 0.12353269 0.00229329 0.0296128 0.03793598 0.13174998 0.12024895 0.15488294 0.0008061 0.00327218
PE 3112.9835 16 4331.0604 3058.2088 1101 1.1010098 0.21425204 0.20776961 0.00608513 0.04438788 0.015014 0.13717047 0.17588574 0.05663491 0.00031797 0.00122077
PI 718.0314 17 389.6816 474.852 524.78475 0.52479104 0.01525058 0.0378243 0.00073917 0.01368749 0.02554367 0.09799888 0.04534497 0.08475368 0.00056519 0.00183827
PR 3732.4336 18 8369.213 5021.7569 1843.68672 1.84367585 0.25836211 0.09004397 0.00109234 0.0727814 0.02329187 0.39317093 0.81296973 0.25002227 0.00027059 0.00277288
RJ 4796.4432 19 5490.1477 3240.25 1252.40909 1.25241061 0.24065692 0.29460413 0.00520102 0.02185856 0.00471037 0.20093113 0.2230032 0.04969123 0.00006547 0.00068436
RN 1603.3234 20 1413.1317 1223.976 790.0479 0.7900511 0.73421196 0.3757271 0.01092473 0.03019063 0.02642354 0.16974201 0.13787001 0.1203639 0.00078277 0.0035592
RO 20104.3846 21 14363.0192 6461.7115 631.71154 0.63172213 0.1153064 0.00543472 0.0000974 0.09205784 0.00492997 1.38083379 0.97073729 0.05774298 0.00008198 0.0008799
RR 1098.6667 22 341.2 307.0667 308.33333 0.30832741 0.00464207 0.00648711 0.00008223 0.00320355 0.00367114 0.07940118 0.02439796 0.02772041 0.00003693 0.00027449
RS 2942.8707 23 6869.0687 3967.1232 2212.15556 2.21215759 0.40712893 0.21693964 0.00219059 0.09960797 0.03358735 0.59763779 1.41095715 0.48289772 0.0003723 0.00526932

```
SC 3186.4949 24 7637.5563 4288.2082 2107.80546 2.10780256 0.5200158
0.24099822 0.00276194 0.08399135 0.02931953 0.50025255 1.22187794 0.40527938
0.00032865 0.0043997
SE 2894.5467 25 3820.8933 2494.32 973.86667 0.97384497 0.18159281 0.18419959
0.00379815 0.04854295 0.01886864 0.20441511 0.27090315 0.10634188 0.00037054
0.00209223
SP 2366.0266 26 2631.1096 1792.0249 1227.88704 1.22789015 0.12735493
0.18674476 0.0182836 0.02606867 0.01439295 0.27703838 0.29326605 0.16656537
0.00019736 0.0022013
TO 3681.1655 27 1676.4604 1287.446 442.11511 0.44212775 0.03475714
0.01382388 0.00032057 0.03646594 0.01422108 0.62365336 0.27548129 0.10447398
0.00028297 0.0018978

goptions reset=global transparency colors=(GRAY99 GRAY80 GRAY60 GRAY40
GRAY20 GRAY00);
legend across=1 POSITION=LEFT;
procgmap  map=maps.Brazil all;
id ID;
choro Vacaord Number quantlei  valorlei produt prodade quant_area  prod_area
vopo_area quant_pib
prod_pib Vaca_pop quant_pop prod_pop vopo_pib  vopo_pop/ coutline=white
legend=legend;

run;
quit;

/*  proc glm;
class estado meso;
model Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop
prodade =  estado meso(estado) /ss3;
means estado meso(estado)/tukey lines alpha=0.1;
lsmeans estado meso(estado)/pdiff adjust=tukey alpha=0.1;
/*
proc reg ; by regiao;
model Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop =
pro_est pro_agr pro_nagr pro_aena ter_area lav_pare lav_tare
lav_apa pas_nar pas_par pas_ppa mat_are mat_area flo_area sis_aca tan_area
cons_are
ter2area reh_npm reh_nspm reh_rpm reh_rspm reh_lpm reh_lspm reh_pcom reh_pasa
reh_pcis ort_gov ort_prop ort_coop ort_eint ort_epri eae_area eae_ltar eae_lpar
eae_hfar eae_pcar eae_fpar eae_fnar hom_me1 hom_1a5 hom_5a10 hom_10am
mul_me1 mul_1a5
mul_5a10 mul_10am eaf_afes eaf_afar eaf_nfes eaf_nfar mag_est mag_cdp
mag_ropa
pec_bonc codigo  idhm_00   Alt Area Precip NDVI PIB Pop Prod_ovinos  UR Temp
Radsol THI max min ampl/ selection = stepwise vif slstay=0.1 ;
/*
proc discrim;
class regiao;
```

```
var  Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop ;

proc discrim;
class regiao;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;

proc stepdisc;
class regiao;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;

proc discrim; by regiao;
class munici;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;

proc stepdisc; by regiao;
class munici;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;

proc factor;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;
*/
procfastclus data=um maxclus = 5 maxiter=5 out=clus;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;
run;

procglm;
class cluster;
model pro_est pro_agr pro_nagr pro_aena ter_area lav_pare lav_tare
lav_apa pas_nar pas_par pas_ppa mat_are mat_area flo_area sis_aca tan_area
cons_are
ter2area reh_npm reh_nspm reh_rpm reh_rspm reh_lpm reh_lspm reh_pcom reh_pasa
reh_pcis ort_gov ort_prop ort_coop ort_eint ort_epri eae_area eae_ltar eae_lpar
eae_hfar eae_pcar eae_fpar eae_fnar hom_me1 hom_1a5 hom_5a10 hom_10am
mul_me1 mul_1a5
mul_5a10 mul_10am eaf_afes eaf_afar eaf_nfes eaf_nfar mag_est mag_cdp
mag_ropa
pec_bonc codigo  idhm_00  Vacaord quantlei valorlei produt voporef Longitude
Latitude
```

```
Alt Area Precip NDVI PIB Pop Prod_ovinos UR Temp Radsol THI max min ampl =
cluster;
means cluster/tukey lines;
  /*
proc candisc anova out=can;
    class cluster;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;
    title2 'Canonical Discriminant Analysis of Clusters';
  run;
  legend1 frame cframe=ligr label=none cborder=black
        position=center value=(justify=center);
  axis1 label=(angle=90 rotate=0) minor=none;
  axis2 minor=none;

  proc gplot data=Can;
    plot Can2*Can1=Cluster/frame cframe=ligr
               legend=legend1 vaxis=axis1 haxis=axis2;
    title2 'Plot of Canonical Variables Identified by Cluster';
  run;

RUN;
proc sort; by regiao ;
proc means data = um ;
class regiao;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;
 output out = outmun mean = Vacaord quantlei valorlei produt voporef Vaca_area
quant_area prod_area vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;

  PROC CLUSTER DATA=outmun METHOD=ward STD  PSEUDO RSQUARE k = 8
OUTTREE=treedat2;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;
 copy regiao;
  ID regiao;
*- the TREE procedure produces a dendrogram;
PROC TREE DATA=treedat2 HORIZONTAL;
  ID regiao ;
  title " ";

RUN;
pro_est pro_agr pro_nagr pro_aena ter_area lav_pare lav_tare
lav_apa pas_nar pas_par pas_ppa mat_are mat_area flo_area sis_aca tan_area
cons_are
ter_area reh_npm reh_nspm reh_rpm reh_rspm reh_lpm reh_lspm reh_pcom reh_pasa
reh_pcis ort_gov ort_prop ort_coop ort_eint ort_epri eae_area eae_ltar eae_lpar
eae_hfar eae_pcar eae_fpar eae_fnar hom_me1 hom_1a5 hom_5a10 hom_10am
mul_me1 mul_1a5
```

```
mul_5a10 mul_10am eaf_afes eaf_afar eaf_nfes eaf_nfar mag_est mag_cdp
mag_ropa
pec_bonc codigo  idhm_00  Vacaord quantlei valorlei produt voporef Longitude
Latitude
Alt Area Precip NDVI PIB Pop Prod_ovinos Solos $ UR Temp Radsol THI max min
ampl

proc factor; by regiao;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop
pro_est pro_agr pro_nagr pro_aena ter_area lav_pare lav_tare
lav_apa pas_nar pas_par pas_ppa mat_are mat_area flo_area sis_aca tan_area
cons_are
ter2area reh_npm reh_nspm reh_rpm reh_rspm reh_lpm reh_lspm reh_pcom reh_pasa
reh_pcis ort_gov ort_prop ort_coop ort_eint ort_epri eae_area eae_ltar eae_lpar
eae_hfar eae_pcar eae_fpar eae_fnar hom_me1 hom_1a5 hom_5a10 hom_10am
mul_me1 mul_1a5
mul_5a10 mul_10am eaf_afes eaf_afar eaf_nfes eaf_nfar mag_est mag_cdp
mag_ropa
pec_bonc codigo  idhm_00  Vacaord quantlei valorlei produt voporef Longitude
Latitude
Alt Area Precip NDVI PIB Pop Prod_ovinos  UR Temp Radsol THI max min ampl;

proc fastclus data=um maxclus = 5 maxiter=5 out=clus; by regiao;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;
  run;
proc candisc anova out=can; by regiao;
    class cluster;
var pro_est pro_agr pro_nagr pro_aena ter_area lav_pare lav_tare
lav_apa pas_nar pas_par pas_ppa mat_are mat_area flo_area sis_aca tan_area
cons_are
ter2area reh_npm reh_nspm reh_rpm reh_rspm reh_lpm reh_lspm reh_pcom reh_pasa
reh_pcis ort_gov ort_prop ort_coop ort_eint ort_epri eae_area eae_ltar eae_lpar
eae_hfar eae_pcar eae_fpar eae_fnar hom_me1 hom_1a5 hom_5a10 hom_10am
mul_me1 mul_1a5
mul_5a10 mul_10am eaf_afes eaf_afar eaf_nfes eaf_nfar mag_est mag_cdp
mag_ropa
pec_bonc codigo  idhm_00  Vacaord quantlei valorlei produt voporef Longitude
Latitude
Alt Area Precip NDVI PIB Pop Prod_ovinos  UR Temp Radsol THI max min ampl;
    title2 'Canonical Discriminant Analysis of Clusters';
  run;
  legend1 frame cframe=ligr label=none cborder=black
       position=center value=(justify=center);
  axis1 label=(angle=90 rotate=0) minor=none;
  axis2 minor=none;

  proc gplot data=Can; by regiao;
    plot Can2*Can1=Cluster/frame cframe=ligr
              legend=legend1 vaxis=axis1 haxis=axis2;
```

```
    title2 'Plot of Canonical Variables Identified by Cluster';
  run;

RUN;
proc sort; by regiao ;
proc means data = clus noprint; by regiao;
class cluster;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop
pro_est pro_agr pro_nagr pro_aena ter_area lav_pare lav_tare
lav_apa pas_nar pas_par pas_ppa mat_are mat_area flo_area sis_aca tan_area
cons_are
ter2area reh_npm reh_nspm reh_rpm reh_rspm reh_lpm reh_lspm reh_pcom reh_pasa
reh_pcis ort_gov ort_prop ort_coop ort_eint ort_epri eae_area eae_ltar eae_lpar
eae_hfar eae_pcar eae_fpar eae_fnar hom_me1 hom_1a5 hom_5a10 hom_10am
mul_me1 mul_1a5
mul_5a10 mul_10am eaf_afes eaf_afar eaf_nfes eaf_nfar mag_est mag_cdp
mag_ropa
pec_bonc codigo  idhm_00  Vacaord quantlei valorlei produt voporef Longitude
Latitude
Alt Area Precip NDVI PIB Pop Prod_ovinos  UR Temp Radsol THI max min ampl;
 output out = outmun mean = Vacaord quantlei valorlei produt voporef Vaca_area
quant_area prod_area vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop
pro_est pro_agr pro_nagr pro_aena ter_area lav_pare lav_tare
lav_apa pas_nar pas_par pas_ppa mat_are mat_area flo_area sis_aca tan_area
cons_are
ter2area reh_npm reh_nspm reh_rpm reh_rspm reh_lpm reh_lspm reh_pcom reh_pasa
reh_pcis ort_gov ort_prop ort_coop ort_eint ort_epri eae_area eae_ltar eae_lpar
eae_hfar eae_pcar eae_fpar eae_fnar hom_me1 hom_1a5 hom_5a10 hom_10am
mul_me1 mul_1a5
mul_5a10 mul_10am eaf_afes eaf_afar eaf_nfes eaf_nfar mag_est mag_cdp
mag_ropa
pec_bonc codigo  idhm_00  Vacaord quantlei valorlei produt voporef Longitude
Latitude
Alt Area Precip NDVI PIB Pop Prod_ovinos  UR Temp Radsol THI max min ampl;

  PROC CLUSTER DATA=outmun METHOD=ward STD  PSEUDO RSQUARE k = 8
OUTTREE=treedat2;by regiao;
var Vacaord quantlei valorlei produt voporef Vaca_area quant_area prod_area
vopo_area
Vaca_pib quant_pib prod_pib vopo_pib Vaca_pop quant_pop prod_pop vopo_pop;
 copy cluster;
  ID cluster;
*- the TREE procedure produces a dendrogram;
PROC TREE DATA=treedat2 HORIZONTAL;by regiao;
ID cluster;
  title " ";
*/
run;

quit;
```

CAPÍTULO III

Annex 5 – Points asked in questionnaire to farmers.

Variable			Abreviation	Unit
Production		Lactating cows	LC	head
		Dry cows	DC	head
		Calves up to 1 yr	C1yr	head
		Heifers above 1 yr	H1yr	head
		Males	M	head
		Bulls	B	head
		Work animlas	WA	head
		Total	total	head
		Milk per ano per cow	Produc	litros
		Monthly milk production	TMPM	litros
		Price per liter	PLM	R$
		Gross monthly receipt from milk	PMY	R$
		Number of calvings per yr	births	nº
		Pasture area for cows (ha)	ha	há
		Breeds	Br	%
		Seasonality of milk production (Y/N)	SMP	%
		Which season?	S	%
		Main receipt of property	MRP	%
		Receipts from outside farming	ROF	%
		Time in dairying	TDB	%
		Where sell milk	SM	%
		Type of contract	TC	%
		Distance to processing plant	DPP	% and km
		Take part is expositions, fairs etc	TEF	%
Ativities		Livestock	L	%
		Grain	G	%
		Job outside farm	JF	%
		Which area	WE	%
Capital	Natural	Size of property (own+ rented)	PZ	% e há
		Who owns the land belongs (producer, etc.)	PR	%
		Value of land (per ha)	LV	% e R$
	Physical	Constructions	TBP	%
		Equipments	TEU	%
	Human	Family - Analphabet	FI	%
		Family - Primary	F1	%
		Family - Secondary	F2	%
		Family - Degree	F3	%
		Employees - analphabeto	EI	%
		Employees - Primary	E1	%
		Employees - Secondary	E2	%
		Employees - Degree	E3	%
		Participate events	PE	%
	Institutional	Capacitation support	ST	%
		Financial support	FS	%

"continuação" Points asked in questionnaire to farmers.

Tecnology	Reprodution	Artifical Insemination	AI	%
		Synchronization of heat	IATF	%
		Embryo transfer	TE	%
		SêmeSexed semen	SS	%
		Natural mating	NM	%
		Pregnancy diagnosis	DP	%
	Nutritional	Natural pasture	GNP	%
		oats, azevém, milheto, . etc	CP	%
		Crop leftovers	RC	%
		Hay	hay	%
		Silage	silag	%
		Mineral salt	CS	%
		Common salt	MS	%
		Concentrate	conc	%
	Sanitary	Rabies	Ra	%
		Carbúnculo hemático	HC	%
		Carbúnculo sintomático	SC	%
		Gangrena gasosa	GG	%
		BVD	BVD	%
		IBR	IBR	%
		Others	Others	%
		Don´t vaccinate	DV	%
	Managem ent	Repalcements outsourced	OR	%
		Pasture rotation	RG	%
		Culling problem cows	SCP	%
		Selection through production	SPI	%
	Other	Fertilizers	Fer	%
		Corrective soil measures	Cor	%
		Herbicides	Her	%
		Pesticides	Pes	%
		Uso de unidades armazenadoras	UUA	%
	Artificail Insemination	Use AI	AI	%
		On all animals	AIA	%
		AI main method of mating	MMM	%
		Doses per cow	DPC	%
		Why use AI	WAI	%
		Why not use AI	WNAI	%
		How long use AI	LAI	%
		Who carried out AI	WCAI	%
		If Farmer, where di course	FWCAI	%
		If don´t use any more	DUAI	%
		How long ago	HDUAI	%
		Why	WDUAI	%

Annex 6–Total number of people trained in the technique of artificial insemination (nptIA) by Mesoregions by IFRS from 1998 to 2012.

IFRS	Nº nptIA	%
Mesoregion Noroeste Rio-grandense	1200	72,97
Other Mesoregions RS	439	26,78
Other states	4	0,24
Total between 1998-2012	1643	100

Annex 7–**Number of people trained in the technique of artificial insemination (nptIA) per year in Meso NO Rio Grande and other Mesoregions by IFRS from 1998 to 2012.**

Year	Mesoregion NO	Others Mesoregions	Total
nptIA_98	136	10	146
nptIA_99	79	11	90
nptIA_00	66	27	93
nptIA_01	101	18	119
nptIA_02	42	52	94
nptIA_03	41	41	82
nptIA_04	35	39	74
nptIA_05	37	74	111
nptIA_06	98	30	128
nptIA_07	114	29	143
nptIA_08	107	24	131
nptIA_09	87	11	98
nptIA_10	84	27	111
nptIA_11	88	41	129
nptIA_12	85	9	94
npttotal	1200	443	1643

Annex 8–Average number of people trained for the technique of artificial insemination (nptIA) by Municipality belonging to Mesoregion NO Rio Grande by IFRS from 1998 to 2012.

Microregions	Nº Municipalities /Micro	nptIA by Microregion	Média nptIA by Municipalities (Microregion)
Carazinho	18	42	2,33
Cerro Largo	11	4	0,36
Cruz Alta	14	50	3,57
Erechim	30	277	9,23
FredericoWestphalen	27	51	1,89
Ijuí	15	2	0,13
Não-Me-Toque	7	87	12,43
Passo Fundo	26	525	20,15
Sananduva	11	126	11,45
Santa Rosa	13	3	0,23
Santo Angelo	16	0	0
Soledade	8	29	3,63
Três Passos	20	4	0,2
Meso NO	216	1200	5,55

Anexo 9 – **Normas para preparação de trabalhos científicos para publicação no Arquivo Brasileiro de Medicina Veterinária e Zootecnia**

Arquivo Brasileiro de Medicina Veterinária e Zootecnia

- O texto **não** deve conter subitens em qualquer das seções do artigo e deve ser
- apresentado em Microsoft Word, em formato A4, com margem 3cm (superior,
  inferior, direita e esquerda), em fonte Times New Roman tamanho 12 e em espaçamento entrelinhas 1,5, em todas as páginas e seções do artigo (do título às referências), com linhas numeradas.
- Não usar rodapé. Referências a empresas e produtos, por exemplo, devem vir, obrigatoriamente, entre parêntesis no corpo do texto na seguinte ordem: nome do produto, substância, empresa e país.

Título: Em português e em inglês. Deve contemplar a essência do artigo e não ultrapassar 150 dígitos.

Autores e Filiação: Os nomes dos autores são colocados abaixo do título, com identificação da instituição a que pertencem. O autor para correspondência e seu e-mail devem ser indicados com asterisco.

Nota:

1. o texto do artigo em Word deve conter o nome dos autores e filiação;
2. o texto do artigo em pdf **não** deve conter o nome dos autores e filiação.

Resumo e Abstract: Deve ser o mesmo apresentado no cadastro contendo até 2000 dígitos incluindo os espaços, em um só parágrafo. Não repetir o título e não acrescentar revisão de literatura. Incluir os principais resultados numéricos, citando-os sem explicá-los, quando for o caso. Cada frase deve conter uma informação. Atenção especial às conclusões.

Palavras-chave e Keywords: No máximo cinco.

Introdução: Explanação concisa, na qual são estabelecidos brevemente o problema, sua pertinência e relevância e os objetivos do trabalho. Deve conter poucas referências, suficientes para balizá-la.

Material e Métodos: Citar o desenho experimental, o material envolvido, a descrição dos métodos usados ou referenciar corretamente os métodos já publicados. Nos trabalhos que envolvam animais e/ou organismos geneticamente modificados deverá constar, obrigatoriamente, o número do protocolo de aprovação do Comitê de Bioética e/ou de Biossegurança, quando for o caso.

Resultados: Apresentar clara e objetivamente os resultados encontrados.

*Tabela:*Conjunto de dados alfanuméricos ordenados em linhas e colunas. Usar linhas horizontais na separação dos cabeçalhos e no final da tabela. O título da tabela recebe inicialmente a palavra Tabela, seguida pelo número de ordem em algarismo arábico e ponto (ex.: Tabela 1.). No texto a tabela deve ser referida como Tab seguida de ponto e do número de ordem (ex.: Tab. 1), mesmo quando se referir a várias tabelas (ex.: Tab. 1, 2 e 3). Pode ser apresentada em espaçamento simples e fonte de tamanho menor que 12 (o menor tamanho aceito é 8). A legenda da Tabela deve conter apenas o indispensável para o seu entendimento. As tabelas devem ser, obrigatoriamente, inseridas no corpo do texto preferencialmente após a sua primeira citação.

Figura: Compreende qualquer ilustração que apresente linhas e pontos: desenho, fotografia, gráfico, fluxograma, esquema, etc. A legenda recebe inicialmente a palavra Figura, seguida do número de ordem em algarismo arábico e ponto (ex.: Figura 1.) e é referida no texto como Fig seguida de ponto e do número de ordem (ex.: Fig.1), mesmo se referir a mais de uma figura (ex.: Fig. 1, 2 e 3). Além de inseridas no corpo do texto, fotografias e desenhos devem também ser enviadas no formato jpg com alta qualidade, em um arquivo zipado, anexado no campo próprio de submissão na tela de registro do artigo. As figuras devem ser, obrigatoriamente, inseridas no corpo do texto preferencialmente após a sua primeira citação.

Nota:

Toda tabela e/ou figura que já tenha sido publicada deve conter, abaixo da legenda, informação sobre a fonte (autor, autorização de uso, data) e a correspondente referência deve figurar nas Referências.

Discussão: Discutir somente os resultados obtidos no trabalho. (Obs.: As seções Resultados e Discussão poderão ser apresentadas em conjunto a juízo do autor, sem prejudicar qualquer das partes e sem subitens).

Conclusões: As conclusões devem apoiar-se nos resultados da pesquisa executada e serem apresentadas de forma objetiva, **sem** revisão de literatura, discussão, repetição de resultados e especulações.

Agradecimentos: Não obrigatório. Devem ser concisamente expressados.

Referências: As referências devem ser relacionadas em ordem alfabética, dando-se preferência a artigos publicados em revistas nacionais e internacionais, indexadas. Livros e teses devem ser referenciados o mínimo possível, portanto, somente quando indispensáveis. São adotadas as normas gerais ABNT, adaptadas para o ABMVZ conforme exemplos:

Como referenciar:

1. Citações no texto

A indicação da fonte entre parênteses sucede à citação para evitar interrupção na sequência do texto, conforme exemplos:

- autoria única: (Silva, 1971) ou Silva (1971); (Anuário..., 1987/88) ou Anuário... (1987/88)
- ü dois autores: (Lopes e Moreno, 1974) ou Lopes e Moreno (1974)
- mais de dois autores: (Ferguson et al., 1979) ou Ferguson et al. (1979)
- mais de um artigo citado: Dunne (1967); Silva (1971); Ferguson et al. (1979) ou (Dunne, 1967; Silva, 1971; Ferguson et al., 1979), sempre em ordem cronológica ascendente e alfabética de autores para artigos do mesmo ano.

Citação de citação: Todo esforço deve ser empreendido para se consultar o documento original. Em situações excepcionais pode-se reproduzir a informação já **citada por** outros autores. No texto, citar o sobrenome do autor do documento não consultado com o ano de publicação, seguido da expressão citado por e o sobrenome do autor e ano do documento consultado. Nas Referências, deve-se incluir apenas a fonte consultada.

Comunicação pessoal: Não fazem parte das Referências. Na citação coloca- se o sobrenome do autor, a data da comunicação, nome da Instituição à qual o autor é vinculado.

2. Periódicos (até 4 autores, citar todos. Acima de 4 autores citar 3 autores *et al*.):

ANUÁRIO ESTATÍSTICO DO BRASIL. v.48, p.351, 1987-88.

FERGUSON, J.A.; REEVES, W.C.; HARDY, J.L. Studies on immunity to alphaviruses in foals. *Am. J. Vet. Res.*, v.40, p.5-10, 1979.

HOLENWEGER, J.A.; TAGLE, R.; WASERMAN, A. et al. Anestesia general del canino. *Not. Med. Vet.*, n.1, p.13-20, 1984.

3. Publicação avulsa (até 4 autores, citar todos. Acima de 4 autores citar 3 autores *et al*.):

DUNNE, H.W. (Ed). Enfermedades del cerdo. México: UTEHA, 1967. 981p.

LOPES, C.A.M.; MORENO, G. Aspectos bacteriológicos de ostras, mariscos e mexilhões. In: CONGRESSO BRASILEIRO DE MEDICINA VETERINÁRIA, 14., 1974, São Paulo. *Anais*... São Paulo: [s.n.] 1974. p.97. (Resumo).

MORRIL, C.C. Infecciones por clostridios. In: DUNNE, H.W. (Ed). Enfermedades del cerdo. México: UTEHA, 1967. p.400-415.

NUTRIENT requirements of swine. 6.ed. Washington: National Academy of Sciences, 1968. 69p.

SOUZA, C.F.A. *Produtividade, qualidade e rendimentos de carcaça e de carne em bovinos de corte.*1999. 44f. Dissertação (Mestrado em Medicina Veterinária) – Escola de Veterinária, Universidade Federal de Minas Gerais, Belo Horizonte.

4. Documentos eletrônicos (até 4 autores, citar todos. Acima de 4 autores citar 3 autores *et al*.):

QUALITY food from animals for a global market. Washington: Association of American Veterinary Medical College, 1995. Disponível em: <http://www.org/critca16.htm>. Acessado em: 27 abr. 2000.

JONHNSON, T. Indigenous people are now more cambative, organized. Miami Herald, 1994. Disponível em: <http://www.summit.fiu.edu/MiamiHerld-Summit-RelatedArticles/>. Acessado em: 5 dez. 1994.

Nota:

- Artigos que não estejam rigorosamente dentro das normas acima não serão aceitos para avaliação.
- O Sistema reconhece, automaticamente, como "Desistência do Autor" artigos em diligência e/ou "Aguardando liberação do autor", que não tenha sido respondido no prazo dado pelo Sistema.

Anexo 10 – **Comando do SAS e dados apresentados no Capítulo III**

```
data um;
input envel $ folha $ munic $ vc_lac vc_sec tern novil macho touro ani_trab total lt_dia lt_ano
lt_mes prec_lt prec_t
partos ha raca $ ex_epoc $ epoca $ mai_rem $ out_rec $ tpo_lei $ lt_vend $ cont_lt $ dist_lt $
par_exp $ ati_pec $ emp_fora $
emp_area $ tam_pro1 $ tam_pro2  $ val_ter $ fam_anal $ fam_1gr $ fam_2gr  $ fam_3gr $
emp_anal $ emp_1gr $ emp_2gr $
emp_3gr $ part_ev $ ap_cap $ ap_fin $ ia $ sinc_ia $ tra_emb $ sem_sex $  mon_nat $ dia_pre
$ pas_cn $ pas_cul  $
res_lav $ feno $ silag $ sal_com $ sal_min $ conc $ raiva $ car_hem $ car_sin $ gang $ bvd $
ibr $ outras $ n_vac $ rec_3a $ rot_pas $ sel_pro $
sel_ipr $ fertil $ corret $ def_agr $ cont_pr $ uni_arm $ usa_ia $ td_ins $ pri_met $ qt_dos1
qt_dos2  pq_usa $ pq_nusa $ temp_us
qm_ins $ ond_cur $ dei_usa $ qt_temp  pq_dei $;
if vc_lac = 0 then vc_lac = .;
if vc_sec  = 0 then vc_sec = .;
if tern = 0 then tern = .;
if novil = 0 then novil = .;
if macho = 0 then macho = .;
if touro = 0 then touro = .;
if ani_trab = 0 then ani_trab = .;
if total = 0 then total = .;
if lt_dia = 0 then lt_dia = .;
if lt_ano = 0 then lt_ano = .;
if lt_mes = 0 then lt_mes = .;
if prec_lt = 0 then prec_lt = .;
if prec_t= 0 then prec_t = .;
if partos = 0 then partos = .;
if ha= 0 then ha = .;
if qt_dos1 = 0 then qt_dos1 = .;

cards;
A 1 GetúlioVargas 48 8 17 21 3 0 0 97 0 6405 28500 0.86 24510 44 38 H N 0 A ANS 3 L NC 2
N N N F 5 0 2 0 2 1 2 0 2 0 0 TODAS SUIP B,C X 0 0 X 0 X X X X X X X X X X X X X X X X X
X X X X X X X X S S 0 1 0 123457 0 3 1 1 N 0 0
A 2 SantoEspeditodoSul 14 2 8 2 0 1 0 27 0 6000 8400 0.77 6500 14 13 H,C S I L 1,2 2 1 3 3 S
N N 0 1 0 1 0 2 2 0 0 0 0 0 2,3,5 1,2,5,6,12 B X 0 0 X X 0 X X 0 X X X X X 0 X X X X X X 0 0 X
X X X X X X X S N 0 1 0 1,2,3,4,5,6,7 0 1 6 1 N 0 0
A 3 Sananduva 22 0 7 4 3 0 0 36 0 7600 13500 0.8 10800 26 10 H,J,C N 0 L 1 3 1 1 3 0 N N 0
2 0 2 0 3 2 0 0 0 0 0 1,2,3 1,2,6 B X 0 0 X 0 X 0 X 0 X X 0 X X 0 X X 0 X X X 0 0 X X X X X X X
0 S S 0 1 0 1,2,3,4,5,6,7 2 0 5 1 N 0 0
A 4 SantaCecíliadoSul 25 6 11 22 2 0 0 66 0 5200 14500 0.8 11600 19 6 H N 0 A 1 1 1 3 2 N N
N 0 4 0 3 0 3 1 0 0 0 0 0 2,5 2,6,10 B,C X 0 0 0 X 0 0 X 0 X X X X X 0 X X X X X X 0 0 X X X X
X X X X S N 0 1 0 1,2 3 1 6 0 N 0 0
A 5 Sertão 47 11 4 6 2 1 0 71 0 6000 25500 0.78 0 50 40 H S I L,A 1 3 1 3 1 N N N 0 5 0 2 0 2
1 0 0 1 0 0 2,3 6 B X 0 0 0 X 0 0 X 0 X X X X X X X X X X X X 0 X X X X X X X X X X S N 0 1 0
1,2,3,4 3 1 6 1 0 0 0
A 6 Erechim 20 7 5 9 2 1 0 44 0 3000 9000 0.75 6750 22 25 H S I L,A 1,2 3 2 2 3 N N N 0 2 0 1
0 2 2 0 0 0 0 0 1,2,3 2,5 B X 0 0 0 X 0 0 X 0 0 X X X X 1,2 X 0 0 0 X X 0 0 X X 0 0 0 X X 0 S N
0 1 0 1,2,4 0 1 1,5 1,2 N 0 0
A 7 Erebango 9 2 4 1 2 0 0 18 0 4000 3800 0.75 0 0 6 H,J,O,C S I L,A 1,2 2 1 3 2 N S N 0 2 0 3
0 3 0 0 0 0 0 0 2,3,4,5 2,6,13 B 0 0 0 0 X 0 0 X X 0 X X X X 0 X X 0 0 X X 0 0 X 0 X X X X X 0 S
N 0 1 0 1,2,3,6 1,3,6 2 5 2 N 0 0
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A 8 nãoentendi 38 8 8 16 0 0 0 70 0 0 14000 0.78 10920 10 20 H S I L 1 1 2 3 2 N N N 0 2 0 1 0 2 0 0 0 0 1 0 3 0 B X 0 0 0 0 0 X 0 0 0 0 0 0 0 0 0 0 0 0 0 X 0 0 X 0 0 0 0 0 0 0 S S 0 1 0 2 0 2 6 0 N 0 0
A 9 SãoJoãodaUrtiga 11 2 2 3 1 1 0 20 0 1000 4000 0.7 28000 5 8 C S V L 0 3 2 2 3 N N N 0 1 0 1 0 3 0 0 0 0 0 0 2,3 2,5 B X 0 0 0 X 0 0 X 0 X X X X X 0 X X X X X 0 0 0 X X 0 X X X 0 0 S N 0 1 0 1,2,3 0 1 5 1 N 0 0
B 10 NossaSenhoradeLurdes 12 6 5 4 2 1 0 30 0 0 5000 0.7 3500 12 50 H,J S I A 2 3 1 1 3 N N N 0 5 0 1 0 2 1 1 0 0 0 0 3 5 B X 0 0 0 X 0 X X X 0 X X 0 X 0 X X X 0 0 0 0 0 0 X X X X X X 0 S N N 1 0 1 2 2 4 0 0 0 0
B 11 Sananduva 13 3 2 6 3 2 0 29 0 0 3000 0.72 2160 4 10 H N 0 L 1 3 1 1 3 N N N 0 2 0 2 0 2 3 0 0 0 0 0 2 5 B X 0 0 0 0 0 0 0 0 0 0 X X X 0 0 0 0 0 0 0 0 0 X 0 0 X 0 X X 0 N 0 N 0 0 0 1 0 6 0 0 0 0
B 12 Marcus 10 1 1 3 3 0 0 18 0 3000 3500 0.71 2485 11 5 C S I O 1 3 1 3 1 N S N 0 1 0 3 0 3 2 0 0 0 0 0 0 0 0 X 0 0 0 0 0 X X 0 0 0 X X X 0 X X 0 0 0 X 0 0 X X 0 0 0 0 0 0 S N S 1 0 1,3,4,7 0 1 1 2 S 0 0
B 13 CaciqueDoble 12 3 5 2 2 1 0 25 0 4320 4800 0.74 0 14 4 H S I L 1 3 1 2 3 N N S 1 2 0 1 0 2 1 1 0 0 0 0 2,3 2,3,5 B X 0 0 0 X 0 X X 0 0 X X X X 0 X X 0 0 0 0 0 0 X X 0 0 0 0 0 0 S N S 1 0 1,2 1 3 6 0 0 0 0
B 14 Selbach 12 3 0 0 0 0 0 15 0 250 5000 0.7 3400 11 3 H N 0 A 1 3 1 3 1 N N N 0 3 0 2 0 4 0 0 0 0 0 0 2 1 B X 0 0 0 0 0 0 X 0 X 0 X X X 0 X X 0 0 0 0 0 0 0 X 0 X X X X 0 S S S 1 0 4,5 0 3 6 0 N 0 0
B 15 Rondinha 14 6 11 11 2 0 0 44 0 0 8500 0.75 76500 14 66 H S I L 1 3 2 3 2 S N N 0 1 0 2 0 3 1 0 0 0 0 0 2,3,5 2,5 B X 0 0 X 0 X X X 0 X X 0 X X 0 0 0 0 X X X 0 0 X X X X X X X X X S S S 1 0 1,2,3,6 0 2 6 0 N 0 0
B 16 Sananduva 7 0 3 2 1 0 0 13 0 3600 2244 0.7 1582 7 4.5 H S V O 3 2 2 3 1 S N S 5 1 0 1 0 2 1 1 0 0 0 0 2 5 C X 0 0 0 X 0 X X 0 X X X X X 0 X X 0 0 0 X 0 0 X X 0 X X X X 0 S N N 1 0 1,2,3,8 2 2 8 0 N 0 0
B 17 AltoAlegre 12 8 4 2 3 1 0 30 0 5000 6000 0.7 4200 18 15 H S I A 1 3 1 3 1 S N S 1 3 0 1 0 2 2 1 0 0 0 0 3 5,6 B,C X 0 0 0 X 0 X X 0 X X X X X 0 0 X 0 0 0 X 0 0 X X 0 X X X X 0 S N N 1 0 1 0 0 6 0 0 0 0
B 18 SaldanhaMarinha 108 20 30 310 0 0 40 508 0 360 90000 0.85 76500 200 100 H,J S I L 1,2 3 1 1 2 N N S 4 5 0 2 0 0 3 1 0 1 2 0 1,2,3 1,5,6 C X X 0 X 0 X X X 0 X X 0 X X 0 0 0 0 0 0 X 0 0 X X X X 0 X X 0 S S S 1 0 1,2,5,7 0 3 1 2 N 0 0
B 19 Não-me-Toque 5 0 7 4 0 0 0 16 0 8000 4000 0.7 2800 5 2 H S V L 0 3 1 3 3 N N N 0 1 0 2 0 2 4 0 0 0 0 0 1,2,3 5 B X 0 0 0 0 X X X 0 X X 0 X 0 X X X X X X 0 0 0 0 0 0 X X X X 0 S N S 1 0 1,2,4 0 3 6 0 0 0 0
B 20 MarcelinoRamos 20 5 4 11 12 2 0 54 0 0 8000 0.76 6080 20 5 H,C S I L 0 3 1 1 1 N S N 0 1 0 3 0 4 0 0 0 0 0 0 0 1,2,3 5,6 B X 0 0 0 X 0 0 X 0 0 X 0 X 0 0 X X 0 0 X X 0 0 X X X X X X X 0 S N N 1 0 1,6 1 1 4 0 N 0 0
B 21 ÁguaSanta 48 20 0 0 1 2 0 71 0 4590 20000 0.78 15600 26 50 H,J S I A 1 3 1 1 1 N S N 0 5 0 2 0 3 0 0 0 0 0 0 2,3,5 5,6 B X 0 0 X X 0 X X X X X X X X X X X 0 0 X X 0 0 X X 0 X X X X 0 S N S 1 0 1,2,3 0 1 5 0 N 0 0
B 22 NovaAlvorada 7 0 6 2 5 0 0 20 0 3200 1800 0.7 1200 7 8 C S I A 1 3 1 3 1 N N N 0 3 0 2 0 2 1 0 0 0 0 0 0 2 B,C X 0 0 0 X 0 0 X 0 0 X X X 0 0 X 0 0 0 0 X 0 X 0 0 X X 0 0 0 0 S N S 1 0 4,5 0 3 4,7 N 0 0 0
B 23 SaldanhaMarinha 8 0 2 1 3 0 0 14 0 6500 2000 0.76 1520 3 6 H,J,C S V A 3 2 1 1 3 N N 0 1 1 0 2 0 2 1 0 0 0 0 0 2,3 6 B X 0 0 0 0 0 0 X 0 X X 0 X 0 0 0 0 0 X 0 0 0 0 X 0 0 X 0 X X 0 S S S 1 0 4 0 2 6 0 0 0 0
B 24 PaimFilho 3 2 2 2 4 1 0 14 0 3600 40 0.7 0 5 2 C S I A 1 1 2 2 1 N S S 2 1 0 1 0 2 1 1 0 0 0 0 2 5 C X 0 0 0 0 0 X X 0 0 0 0 X 0 0 X 0 0 0 0 0 0 0 0 0 X 0 0 0 0 0 S N S 1 0 1,5,7 0 1 5 0 N 0 0
B 25 IpirangadoSul 20 5 8 6 0 0 0 39 0 9125 14200 0.72 10224 22 8 H S I L 0 3 1 3 2 N S S 3 1 0 2 0 2 1 1 0 0 0 0 2,3 12,13 B X 0 0 X 0 X 0 X 0 X X 0 X X X X X X X X X 0 X X X 0 X X X X 0 S S S 1 0 1,2,4,5 0 3 6 0 N 0 0
B 26 Sananduva 7 2 7 5 1 0 0 22 0 2666 2500 0.64 1600 9 10 H,J S I L 1 3 2 3 1 N N N 0 1 0 2 0 4 1 0 0 0 0 0 3 5 C X 0 0 0 0 0 X X 0 X X X X 0 0 0 0 0 0 0 0 X 0 0 0 X 0 X 0 X X 0 S S S 1 0 4 0 3 8 0 N 0 0

C 27 Sertão 13 2 0 0 0 0 0 15 30 0 2500 0.78 0 0 2 H,J S I L,A 1 2 2 1 2 0 N N 0 0 3 0 0 2 0 3 0 0 0 0 2,3 13 0 X 0 0 0 X 0 0 0 X X X X X X 0 0 0 0 0 X X 0 0 0 0 0 0 0 X X 0 S N 0 0 1 1,2,3,6 0 1 8 0 N 0 0
C 28 Sertão 9 3 0 0 0 0 0 12 18 0 4500 0.72 3240 0 4 H,J S I L,A 1 3 2 1 1 0 N S 0 0 3 0 0 2 0 2 0 0 0 0 2,3 5 0 X 0 0 X 0 0 0 X 0 0 X X X X 0 X X X X X X 0 0 0 0 0 X X X X X S S 0 0 1 1,2,3,4 0 2 8 1 N 0 0
C 29 Sertão 3 0 0 0 0 0 0 3 10 0 0 0 0 0 2 H S I A 1 1 0 0 0 0 S N 0 0 2 0 0 3 1 0 0 0 0 0 2,3 2 0 0 0 0 0 X 0 X X 0 X X X X 0 0 X X 0 X X X 0 0 0 0 0 X X X 0 0 S N 0 0 1 1 1 1 6 0 N 0 0
C 30 Sertão 12 8 0 0 0 0 0 20 20 0 3000 0.7 4200 0 7 H,J S I L 1 3 2 3 3 0 N S 0 0 2 0 0 2 3 0 0 0 0 0 2,3 2,5,7,10,11,12 0 X 0 0 0 0 0 X X X X X X X 0 0 0 0 0 0 X 0 0 0 0 0 X X X X X S N 0 0 2 1,2,3,4,5,7 0 1 1,8 1 N 0 0
C 31 Sertão 13 2 0 0 0 0 0 15 25 0 8500 0.75 5500 0 6 H,J,C S I L,A 1 2 2 3 1 0 N N 0 0 1 0 2 2 0 0 0 0 0 0 2,3,4,5 5,11 0 X 0 0 X 0 0 0 X 0 X X 0 X X 0 X X 0 X X X 0 0 0 0 0 X X X X 0 S S 0 0 3 1,2,3,4,5,7 0 2 8 1 N 0 0
C 32 Sertão 16 6 0 0 0 0 0 22 13 0 3000 0.6 0 0 10 H,J S I L,A 1 3 1 3 3 0 N N 0 0 1 0 0 2 1 1 0 0 0 0 3 6 0 0 0 0 0 X 0 0 X 0 X X X X X 0 X X 0 0 X X 0 0 0 0 0 X 0 X X X N N 0 0 0 0 3 0 0 0 0 6 7
C 33 Sertão 9 2 0 0 0 0 0 11 0 0 4500 0.7 3560 0 6 H S I A 1 1 2 1 2 0 N N 0 0 1 0 0 1 2 0 0 0 0 0 2,3 2,3,5,7 0 X 0 0 X 0 0 0 X X 0 X X X X 0 X X X X X X 0 0 0 0 0 X X X X X S S 0 0 1 1,2,3,4,5,6,9 0 1 8 1 N 0 0
C 34 Sertão 12 3 0 0 0 0 0 15 18 0 5000 0.7 3500 0 4 H,J S I L,A 1 2 1,2 1 3 0 N N 0 0 1 0 0 2 1 1 0 0 0 0 2,3,4,5 2,5,6,9,11 0 X 0 0 X 0 0 X X 0 X X X X X 0 X X 0 X X X 0 0 0 0 0 X X X X 0 S S 0 0 2 1,2,4,7 0 2 4 0 N 0 0
C 35 Sertão 15 7 0 0 0 0 0 22 18 0 7000 0.75 5300 0 6 H,J,C S I L,A 1,3 3 2 3 2 0 N S 0 0 1 0 0 2 1 1 0 0 0 0 1,2,3 2,3,5,7,10 0 X 0 0 0 X 0 X X 0 0 X 0 X X 0 X X 0 0 0 X 0 0 0 0 0 X X X X X S N 0 0 2 1,2,3,4,6 0 2 8 0 0 0 0
C 36 Sertão 29 6 0 0 0 0 0 35 25 0 22500 0.83 18787 0 15 H S I L 1 3 3 1 2 0 N N 0 0 1 0 0 3 1 0 0 0 0 0 1,2,3,5 3,5,10 0 X X 0 X 0 0 0 X 0 X X 0 X X 0 X X 0 X X X 0 0 0 0 0 X X X X 0 S S 0 0 2 1,2,3,4,6 0 2 8 0 N 0 0
C 37 Sertão 20 8 0 0 0 0 0 28 18 0 8000 0.8 7200 0 10 C S I L 1 3 2 0 2 0 N N 0 0 1 0 0 3 1 0 0 0 0 0 3 5 0 X 0 0 0 0 0 0 X 0 X X X X 0 0 0 0 0 0 X X 0 0 0 0 0 X X X 0 0 S S 0 0 1 1,2,3,6 0 1 8 0 N 0 0
C 38 Sertão 25 10 0 0 0 0 0 35 17 0 15000 0.81 11000 0 15 H S I L,A 1 3 1 3 3 0 S N 0 0 1 0 0 1 3 1 0 0 0 0 1,2,3,4 13 0 X 0 0 X X 0 X X X X X X X X 0 X X X X X X 0 0 0 0 0 X X X 0 0 S N 0 0 2 1,2,3,4,5,6,7,9 0 3 5 1 N 0 0
D 39 VilaGângarce 23 4 10 8 2 0 0 47 0 5000 12500 0.78 9750 24 5 H S I L 2 1 1 3 2 N S N 0 1 0 3 0 2 0 0 0 0 0 0 1,2,3,4 1,2,6 B X 0 0 0 0 0 0 X 0 X X 0 X X X X X X X X X 0 X X 0 X X X X X 0 S S S 2 0 1,2,3,5 0 1 1,5 0 N 0 0
D 40 VilaLângaro 9 1 2 1 1 1 0 15 0 6000 5000 0.75 3750 10 5 H S I O 1 2 1 3 1 N S N 0 1 0 3 0 4 0 0 0 0 0 0 0 2 2 0 X 0 0 0 X 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 S N N 1 0 1 0 2 0 0 N 0 0
D 41 VilaLângaro 5 0 2 0 2 0 0 9 0 5400 2250 0.75 1687.5 4 3 H S I A 1 1 1 3 3 N N N 0 3 0 3 0 2 0 2 0 0 0 0 2,3,5 6,13 B X 0 0 0 0 0 0 X X X X X X X 0 0 0 0 0 0 X 0 0 X 0 X X X X X X X S S S 1 0 1,2,3,4,5 0 1 6 0 N 0 0
D 42 Montauri 55 15 20 10 0 0 0 100 0 3000 35000 0.89 24000 40 50 H S I L 1 3 2 1 3 S S N 0 3 0 2 0 4 0 0 0 0 0 0 2,3,4 2,5 B X 0 0 0 0 X X X X X X 0 X X X 0 0 0 X X 0 0 0 X 0 0 X X X X 0 S S S 1 0 1,2,3,4,5,7 0 1 7 0 N 0 0
D 43 Montauri 24 6 5 5 0 0 0 40 0 0 8000 0.77 0 30 15 H S I L 1 1 1 3 1 S S S 1 2 0 2 0 1 0 0 0 0 0 0 2,3 1,2,5,6 B X 0 0 0 0 0 0 X X 0 X X X 0 0 0 0 0 0 0 X 0 0 X X 0 X 0 X X X S S N 1 0 1,2,3,4,5 0 1 4 0 0 0 0
D 44 VilaMaria 11 0 8 1 9 0 0 29 0 4000 3000 0.75 2250 8 5 J,C S I L,A 1 3 1 3 3 S N N 0 3 0 2 1 2 2 0 0 0 0 0 2,3 2 B X 0 0 0 0 0 X X 0 X X X X 0 0 X X 0 0 0 0 0 0 X 0 0 X 0 X X 0 S S S 1 0 1,2,3 0 3 6 0 N 0 0
D 45 Montauri 22 6 12 4 0 0 0 44 0 1100 0 0.8 0 12 13 H S I L 1 3 1 2 3 N N N 0 2 0 1 0 4 0 0 0 0 0 0 2,3 2,6 0 X 0 0 0 0 0 0 X 0 0 X X X 0 0 0 0 0 0 0 0 0 0 X 0 0 0 0 0 0 0 S S N 1 0 0 0 0 0 0 0 0 0

D 46 VilaLângaro 32 2 9 18 1 1 0 63 0 8280 21000 0.85 17850 15 17 H S I A 1 3 1 3 2 N S S 4,6 4 0 2 0 3 2 1 0 0 0 0 2,3 1,6,12 B X X 0 0 X X X X X X X X X X X X X X X X X X 0 X X X X X X X X X S N N 1 0 1,2,3 0 1 6 0 0 0 0
D 47 VilaLângaro 30 5 8 4 0 1 0 48 0 7000 15000 0 0 25 20 H S V A 1 3 1 3 2 N N S 1 4 0 2 0 2 0 3 0 1 0 0 2,3 1,6,12 B X 0 0 0 0 0 0 X 0 X X 0 X X 0 X X 0 0 X X 0 0 X X X X X X X X S N S 1 0 1,2,3,4,5 1 2 6 0 N 0 0
D 48 0 8 2 5 0 7 1 0 23 0 0 4500 0.74 3330 10 4 H S I A 1 3 2 3 3 N S N 0 2 0 2 0 3 1 0 0 0 0 0 2,3 5 C X 0 0 0 X 0 X X X 0 X X X 0 0 X X 0 0 X X 0 0 X 0 0 X X X X 0 S N N 1 0 1,2,3,5,6 0 2 6,8 0 S 1 7
D 49 TrêsPalmeiras 76 6 25 32 3 0 0 142 0 7200 58000 0.88 612000 65 45 H N 0 L 1 3 1 3 3 N N N 0 3 0 2 0 0 2 2 0 2 1 0 1,2,3 1,2,5 B X X 0 0 0 X 0 0 0 X X 0 X X X X X 0 X X X 0 0 0 X 0 X X X X X S S S 1 0 1,2,3 0 3 1 2 N 0 0
D 50 CamposBorges 43 9 15 29 3 0 0 99 0 0 22500 0.83 18675 50 40 H,J S I A 1,2 1 1 2 3 N N S 2 5 0 2 0 1 1 2 0 0 2 0 1,2,3 5,12 B X 0 0 0 0 0 0 X 0 X X X X X 0 X X 0 X X X 0 0 X X X X X X X X S S S 1 0 1,2,4,5,6 0 1 1 2 N 0 0
D 51 BarraFunda 11 3 5 3 1 1 0 24 0 0 4950 0.75 3731 11 1.7 H,J,C S I L,A,O 2 3 1 3 1 S N S 1,3 1 0 2 0 2 3 0 0 0 0 0 2,3 5 B X 0 0 0 X X 0 X X 0 X 0 X X X 0 0 0 0 0 X 0 0 X X X X 0 0 0 0 S N S 1 0 2,3,4 0 0 6 0 N 0 0
D 52 Camargo 12 3 3 5 4 1 0 28 0 5400 6480 0.71 4600 15 5 J S I L 1 3 2 1 3 S S S 6 2 0 3 0 2 3 0 0 0 0 0 2,3 2,5 B X 0 0 0 X 0 X X X 0 X X X X X 0 0 0 X X X 0 0 X X X X X X X X 0 S N S 1 0 1,2,4,5,9 0 2 5 0 N 0 0
D 53 TioHugo 10 3 1 2 0 0 0 16 0 3400 4585 0.78 0 8 6 H S I A 1 2 1 3 3 N S N 0 3 0 3 0 2 0 3 0 0 0 0 1,2,3,5 2,4,5,6,9,10,12,13 B X 0 0 X 0 X X X X X 0 X X X 0 0 X 0 X 0 X 0 0 X X 0 X X X X 0 S S S 1 0 1,4,5 0 1 6 0 N 0 0
D 54 Montauri 12 2 2 2 3 0 0 21 0 3900 5500 0.75 4125 10 7 J S I L 1 1 2 3 3 S S N 0 2 0 2 0 2 1 1 0 0 0 0 1,2,3 2,3,5,10 B X 0 0 0 0 0 0 X 0 0 X 0 X X 0 0 X 0 0 0 X 0 0 X X X X X X X 0 S S S 1 0 1,3,5 0 1 1,4,5 1 N 0 0
D 55 Camargo 18 3 13 12 1 0 0 47 0 6000 10800 0.71 7668 22 12 H N 0 L,O 1,2,3 3 2 1 3 S S S 6 1 0 3 0 2 2 0 0 0 0 0 1,2,3,5 1,5 B,C X X 0 0 X 0 X X 0 X X X X X X 0 0 0 X X 0 0 0 X X X X X X X X S S S 1 0 1,2,3,5,6,7 0 3 1 1,2 0 0 0
D 56 Sertão 19 3 9 6 4 0 0 41 0 7800 14500 0.79 11455 23 12 H S V L,A 1 3 1,2 1 3 N N N 0 4 0 0 1 2 0 0 0 0 0 0 1,3 1,2,5,6 B,C X 0 0 X 0 0 X X 0 X X X X X X 0 0 0 X X 0 0 0 X X 0 X X X X X S S S 1 0 1,2,3,4 0 2 8 1 N 0 0
D 57 Carazinho 10 6 10 2 1 0 0 29 0 0 5100 0.75 3825 16 15 H N 0 L 3 3 5 2 2 N N S 6 1 0 2 1 1 3 0 0 0 0 0 1,2,3 0 0 X 0 0 0 0 0 X X 0 0 X X X 0 X X 0 0 X X 0 0 0 X X 0 X X 0 0 0 S N S 1 0 1,2,7 0 1 1 2 N 0 0
D 58 Tapera 12 3 5 3 5 0 0 28 0 4320 5700 0.7 4032 11 30 H,J S I A 3 1 2 1 3 N N S 4 3 0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
D 59 LagoaVermelha 25 4 10 6 2 1 0 48 0 280 15000 0.8 12000 30 10 H S I A 1 3 1 2 3 N N N 0 5 0 2 0 2 2 0 2 0 0 0 2,3 2,5,6 0 0 0 0 0 X 0 0 X X X X X X 0 X X X 0 0 0 0 0 0 X 0 X X X X 0 X N N N 0 0 0 8 0 0 0 0 0 0
D 60 Tapera 12 3 1 0 0 0 0 16 0 5475 456.25 0.75 342.18 8 15 H S I A 1 3 2 1 1 N N S 2 3 0 2 0 0 0 5 0 0 0 0 1,2,3 5 B X 0 0 0 0 0 X X 0 X X X X X X 0 0 0 0 0 X 0 0 X 0 0 X 0 X X 0 S S S 1 0 1,2,3,9 0 2 8 1 N 0 0
D 61 Ibiraiáras 16 10 10 12 10 1 0 59 0 4380 1500 0.7 2450 18 10 H S I L 1 3 2 4 3 S S S 1 3 0 2 0 2 0 4 0 0 0 0 1,2,3,5 5 B 0 0 0 0 X 0 X X X X X X X X 0 X X X X X X 0 0 X X X X X X X X N 0 0 0 0 0 1,2,3,4,5 0 0 0 S 4 2,5,6
D 62 VilaLângaro 9 4 2 3 1 0 0 19 0 4930 4330 0.65 2814.5 5 5 H S I O 1 3 1 1 3 S S N 0 1 0 2 3 0 1 1 0 0 0 0 2,3 2,6 B X X 0 X 0 X X X X X X 0 X X X 0 0 0 0 X X 0 0 X X 0 X 0 X X 0 S S S 1 0 1,2,3,4,5,7 0 1 1 1 N 0 0
D 63 SantaCecíliadoSul 13 4 4 3 1 0 0 25 0 4500 3700 0.66 2442 10 4.5 H S V L 3 1 2 2 1 S N S 4 1 0 3 0 1 3 2 0 0 0 0 1,2,3 2,4,5,10 0 X 0 0 0 0 X 0 X 0 0 X X X X X 0 X 0 0 X X 0 0 0 X 0 X X X X 0 S S S 1 0 1,7 0 1 1 1 N 0 0
D 64 Selbach 18 1 5 2 2 0 0 28 0 0 9400 0.73 6882 15 10 H S I L 0 3 1 2 1 N S N 0 2 0 0 0 3 1 0 0 0 0 0 2,3 5 0 X 0 0 0 0 0 0 X 0 X X 0 X X 0 0 X 0 0 X X 0 0 X X 0 X X X X 0 S S S 1 0 1,2,3,4,5 0 3 6 0 N 0 0

D 65 Selbach 32 6 6 13 2 1 0 60 0 9125 28000 0.79 14220 29 23 H S I L 1 3 2 2 3 N N N 0 2 0 2 0 2 2 2 0 0 0 0 3 5 B X 0 0 0 X 0 0 X 0 0 X 0 X X 0 X X 0 0 0 X 0 0 X 0 0 0 0 0 0 0 S N S 1 0 1,2,4,5 0 3 5 2 N 0 0
D 66 VilaLângaro 8 2 3 0 2 0 0 15 0 6300 4410 0.73 3219.3 2 6 H S V O 1 2 1 4 3 S S N 0 3 0 3 0 2 2 0 0 0 0 0 2,3,5 6 B X 0 0 X 0 0 0 X 0 X X 0 X X X X X 0 0 X X 0 0 X X X X X X X 0 S S S 1 0 1,4,5 0 2 6 0 N 0 0
D 67 Marau 10 2 1 1 1 0 0 15 0 7000 5753 0.7 4027 10 3 H S I A 1 1 1 0 1 N N N 0 3 0 2 0 1 3 1 0 0 0 0 0 0 0 X 0 0 0 0 0 X 0 0 0 X X X X X X X 0 0 0 0 0 0 0 0 0 X 0 X 0 0 S S S 1 0 1,4 0 1 5 0 N 0 0
D 68 Tapejara 6 1 0 0 0 0 0 7 0 7160 4150 0.71 2946.5 7 4 H S I A 1 3 1 3 3 N N N 0 3 0 2 0 3 1 0 0 0 0 0 2,3 1,6,11 B X 0 0 0 0 0 X X X X X X X 0 0 0 0 0 0 X 0 0 0 X X X X X X X 0 S S S 1 0 1,2,3,4,5 0 3 6 0 0 0 0
D 69 Marau 14 4 2 2 6 1 0 29 0 1050 4500 0.72 3240 16 5 H S I L,A 1,2 3 2 3 1 S N S 4 3 0 2 0 2 3 1 0 0 0 0 2 2,5 0 0 0 0 0 X 0 X X 0 X X X X 0 0 X X X 0 0 0 0 0 X X 0 X 0 0 X 0 N 0 0 0 0 0 1 0 0 0 S 3 4
D 70 PassoFundo 32 1 10 11 0 1 0 55 0 3050 10000 0.7 7000 32 15 H S I 2 0 3 1 3 2 N N S 3 2 0 2 0 2 2 1 0 0 0 0 2,3 2,4,5 B,C 0 0 0 0 X 0 0 X 0 X X X X X 0 X 0 0 0 0 0 0 0 X X 0 X X X X X N 0 0 0 0 0 4,5,6 0 0 0 0 0 0
D 71 IpirangadoSul 6 0 1 5 2 0 0 14 0 4880 2000 0.65 1200 5 5 H S I L 3 3 1 3 3 N S S 6 1 0 1 0 3 0 1 0 0 0 0 2,3 2,5,6 B X 0 0 0 X 0 X 0 0 X X 0 X X 0 0 0 0 0 X 0 0 0 X 0 0 X 0 X X 0 S S S 1 0 1,4,6 1 3 6 0 N 0 0
D 72 Colorado 153 86 58 63 47 5 12 424 0 16400 191800 0.75 68860 150 3000 H,J S I L,A 1,2 3 4 3 1 S S 0 5 5 0 3 0 0 1 5 0 0 0 4 1,2,3 2,4,5,7,9,11,12 B X X X 0 X X X X X X X X X X X X X X X X X 0 0 X X X X X X X X S N S 2 0 1,2,3,4,5,6,7 0 3 6 0 N 0 0
D 73 Ciríaco 7 3 4 2 3 1 0 20 0 3942 2300 0.73 1679 12 4 C S I L 2 2 1 0 3 N N N 0 2 0 0 0 2 1 1 0 0 0 0 2 2,13 C 0 0 0 0 X 0 X X X 0 X X X X 0 0 0 0 0 0 X 0 0 X X 0 X X X 0 0 N 0 0 0 0 0 2,3 0 0 0 0 0 0
D 74 Coxilha 9 1 4 2 1 0 0 17 0 5330 4100 0.75 3075 12 10 H S I A 1 3 1 1 3 N N N 0 3 0 2 0 2 2 0 0 0 0 0 2 1,2,6 B X 0 0 X 0 0 0 X 0 0 0 0 X X 0 X 0 0 0 X X 0 0 X X X X 0 0 X 0 S S S 1 0 1,2,3,4,5,6,7 0 1 6 0 N 0 0
D 75 SaldanhaMarinha 11 3 3 1 0 2 0 20 0 3200 3127 0.71 2220.17 13 15 H S I A 1,2 3 2 3 3 S N N 0 2 0 2 0 3 1 0 0 0 0 0 2,5 2,5,7,11 B 0 0 0 0 X 0 X X X 0 X X 0 X 0 0 0 0 0 0 0 X 0 X 0 X X 0 X X 0 S N N 1 0 1,2,3,4 3 2 6 0 S 1 7
D 76 Não-me-Toque 3 0 0 1 1 0 0 5 0 3000 750 0.6 450 3 0.5 J S I A 1 2 2 3 3 N N N 0 1 0 2 0 3 1 0 0 0 0 0 2 0 0 0 0 0 0 X 0 X X 0 X X X 0 0 0 0 0 0 0 0 X 0 0 X 0 X X 0 0 0 0 N 0 0 0 0 0 1 0 0 0 0 0 0
D 77 Ibiraiáras 17 1 1 2 0 1 0 22 0 4400 7600 0.73 5550 20 10 H S I L 1,3 3 2 1 2 N N S 4 3 0 2 0 1 2 0 0 0 0 0 1,2,3 2,5 B X 0 0 0 X 0 X X 0 X X X X X 0 X X 0 0 0 X 0 0 X X 0 X X X 0 0 S N N 1 0 1,3,8 0 1 5 0 N 0 0
D 78 Ibiaça 11 2 4 6 0 0 0 23 0 7500 9240 0.74 6837.6 11 10 H S I A 2 2 1 1 2 N N N 0 5 0 3 1 0 1 1 0 0 0 0 1,2 1,2,5,8 B X X 0 0 0 X 0 X X X X X X X 0 X X 0 X X 0 0 0 X X 0 X X 0 X 0 S S S 1 0 1,2,4,5,6,7 0 0 5 0 N 0 0
D 79 NicolauVergueira 8 2 5 2 3 1 0 21 0 5185 3888 0.8 3111 12 30 H S I A 1 3 1 3 2 N N N 0 5 0 2 0 2 1 1 0 0 1 0 2,3 2 B 0 0 0 0 X 0 0 X 0 X X X X 0 0 X X 0 0 0 X 0 0 X X 0 X X 0 0 X S N N 1 0 1 0 2 4 0 N 0 0
D 80 SantaCecíliadoSul 3 0 2 3 0 0 0 8 0 3600 1800 0.7 1260 3 3 H,J S I O 3 2 1 3 2 N N S 1 1 0 3 0 2 1 0 0 0 0 0 2 13 C X 0 0 X 0 0 0 X 0 X X 0 X X X X 0 0 0 0 0 0 0 X 0 0 X X X X 0 S S S 1 0 1,2,4,5 0 1 6 0 N 0 0
D 81 Gaurama 10 2 3 4 1 0 0 20 0 5000 4800 0.7 3360 12 10 H,J S I L 0 2 1 3 2 S N N 0 1 0 2 0 2 0 4 0 0 0 0 1,2 1,2 0 X 0 0 X 0 0 0 X 0 0 X X X X 0 X 0 0 0 X 0 0 0 X 0 0 0 0 X 0 0 S S S 1 0 1,2 0 1 4 0 N 0 0
D 82 Sananduva 15 3 2 2 3 1 0 26 0 300 3000 0.72 2160 20 7 C S V L 1 3 2 1 1 N N N 0 2 0 3 0 2 1 0 0 0 0 0 1,2,3 5 B,C 0 0 0 0 X X X X 0 0 X X X X X X X 0 0 0 X 0 0 X 0 0 X X X 0 0 N N N 0 0 1,2,3,5 0 0 0 0 S 6 1,2,5
D 83 Erebango 11 4 5 3 1 1 0 25 0 4270 4600 0.8 3680 5 10 H S I A 1 1 2 1 2 N S N 0 2 0 3 1 1 0 4 0 0 0 0 5 5 B 0 0 0 0 X 0 0 X 0 X X 0 X X X 0 0 0 0 0 0 0 0 0 0 X X 0 X 0 X N N 0 0 0 0 1 0 0 0 0 0 0

D 84 VilaLângaro 10 0 3 3 0 0 0 16 0 6480 3000 0.72 2160 1 5.5 H S I O 1 2 1 2 2 N S S 1 1 0 2 0 3 1 1 0 0 0 0 3 6 B X 0 0 0 0 0 0 X 0 X X X X X 0 X X 0 X X 0 0 0 X X 0 X 0 0 X 0 S S S 1 0 1,2,7 0 2 1 1 N 0 0
D 85 SantaCecíliadoSul 15 3 3 2 1 1 0 25 0 7300 2250 0.8 1800 10 20 H S I O 1 3 1 1 1 N S N 0 3 0 3 0 1 3 0 0 0 0 0 1,2,3 6,7 C X 0 0 X X 0 X X X X X X X 0 0 0 X 0 X X X 0 0 X 0 0 X 0 X X X S N N 1 0 1,3,6 3 1 3,5 0 N 0 0
D 86 IpirangadoSul 13 0 7 1 1 0 0 22 0 1750 300 0.61 183 1 8 H,J,C S I L,A 1,3 1 2 2 3 S N S 4 1 0 3 0 4 0 1 0 0 0 3 2,3 5 B X 0 0 0 0 0 0 X 0 X X X X X X X X 0 0 X X 0 0 X 0 0 X X X X 0 S S S 1 0 1,2,3 0 1 2,6 1 N 0 0
D 87 Sertão 10 2 4 2 2 0 0 20 0 5490 6000 0.7 4200 12 4 H S I A 1 3 1 2 3 N N N 0 5 0 2 0 2 2 0 0 0 0 0 2,3 1,2,13 B X 0 0 0 0 0 0 X 0 X X 0 X X X X X X X X X 0 0 X 0 0 X X X X 0 S S S 1 0 1,2,7 0 1 1 1 N 0 0
D 88 Ernestina 12 4 2 2 2 0 0 22 0 7300 6024 0.73 4398.25 16 10 H S I L 0 1 1 3 3 N N N 0 1 0 2 0 1 1 1 0 0 0 0 2,3 5,6 C X 0 0 0 0 0 X X X X X 0 X X 0 X X 0 0 0 X 0 0 X X X X X X X 0 S S S 1 0 1,2 0 1 8 0 N 0 0
D 89 SãoDomingosdoSul 36 5 12 19 2 1 0 75 0 6500 21600 0.82 17712 35 40 H S I L 1 2 2 2 3 N S N 1 4 0 2 0 0 1 2 0 1 0 0 2,3 1,2,5 C X 0 0 X X X X X 0 X X X X X X X X X 0 0 X 0 0 X X X X X X X X S N S 1 0 1,2,3,4,7 0 2 1 2 N 0 0
D 90 Sananduva 18 6 3 1 2 0 0 30 0 3000 6500 0.78 5070 5 10 H S I L 3 3 2 1 2 S N S 2,4 3 0 2 0 1 1 1 0 0 0 0 2 5 B X X 0 0 0 0 0 X 0 X X 0 X X X X X 0 X X 0 0 0 X X 0 X X X X 0 S S S 1 0 1,2,5,7,8 0 0 1 2 N 0 0
D 91 Jacutinga 23 3 4 3 4 1 0 38 0 5400 11000 0.81 8910 26 9 H,J,C S I L 1,2 3 1 1 3 N N N 0 3 0 3 0 3 0 1 0 0 0 0 2,3 2,6 B X 0 0 0 X 0 0 X 0 X X X X X 0 X X 0 X X X 0 0 0 X X X X X X 0 S S S 1 0 1,2,3,6 0 1 2 0 N 0 0
D 92 Tapejara 18 3 6 4 1 1 0 33 0 7300 10800 0.8 8640 8 20 H S I L 1 3 1 2 2 N N S 6 3 0 3 0 1 1 1 0 0 0 0 3 1,6 B X 0 0 0 0 0 0 X 0 X X 0 X X X 0 0 X X X 0 0 0 X X 0 X X X X 0 S N S 1 0 1,2,3 0 2 6 0 N 0 0
D 93 NovaAlvorada 14 3 6 3 4 2 0 32 0 5475 6300 0.6 3780 14 12 C S I A 3 3 1 3 1 N N S 1 4 0 2 0 1 2 1 0 1 0 0 2,3 6 B 0 0 0 0 X 0 X X 0 0 0 X X 0 0 X X 0 0 0 X 0 0 0 X 0 0 0 X 0 0 N N N 0 0 0 8 0 0 0 0 0 0
D 94 IpirangadoSul 3 2 3 1 2 0 0 11 0 2920 1000 0.65 650 3 4 H,J S 0 L,A 1 3 5 1 3 0 S S 6 2 0 3 0 1 3 0 0 0 0 0 1,2,3 2 B X 0 0 0 0 0 0 X X 0 0 0 X X 0 X X 0 X X 0 0 0 X X 0 X X X X 0 S S S 1 0 4,5,9 0 3 8 0 N 0 0
D 95 Sertão 12 4 5 7 4 0 0 32 0 4500 6000 0.75 4500 16 25 H,C S I A 1,2 3 2 4 1 S N N 0 4 0 3 0 3 1 0 0 0 0 0 1,2,3 5 C X 0 0 X 0 0 X X X 0 X X X 0 0 X X 0 X X 0 0 0 X X X X X X X X X S S S 1 0 1,2,3,4,5,6 0 3 8 0 N 0 0
D 96 VilaMaria 15 3 13 10 1 0 0 42 0 5645 8550 0.78 6669 8 15 H S I L 1 3 2 3 0 N N N 0 2 0 0 0 3 1 0 0 0 0 0 1,2,3 5 B X 0 0 0 0 0 0 X 0 X X 0 X X X X X 0 X X 0 0 0 X X 0 X X X X 0 S S S 1 0 1 0 0 8 0 N 0 0
D 97 CapãoBonitodoSul 30 10 8 11 2 0 0 61 0 4575 13500 0.75 3375 10 40 H,J S I L,A 2 2 1 1 3 N N N 0 4 0 2 0 3 2 0 0 1 0 0 3 5 B X 0 0 0 0 0 X X X 0 X X X X X X X 0 0 0 X 0 0 X X 0 X 0 X X 0 S N N 1 0 1,3,4 0 2 6 0 N 0 0
D 98 ÁguaSanta 10 0 6 5 2 0 0 23 0 24000 2000 0.7 1800 7 6 J S I L 1 2 1 3 3 s N N 0 1 0 1 3 2 0 1 0 0 0 0 2,3,4 2,4,5,6 B X 0 0 0 0 0 X X 0 X X 0 X X X X X 0 0 0 X 0 0 X 0 0 X X X X 0 S S S 1 0 1,2,6,7 0 1 1 1 N 0 0
E 99 Não-me-Toque 7 1 5 2 3 0 0 18 0 6000 3600 0.7 2520 6 14 H,J S I L 1,3 3 1 4 3 N N S 6 1 0 3 0 2 1 1 0 0 0 0 2,3 5,6 B X 0 0 0 0 0 X X X X 0 0 X X 0 0 0 0 0 0 0 0 0 X X X X X X X 0 S S S 1 0 1,2,3,4,5 0 3 6 0 0 0 0
E 100 Montauri 15 2 3 1 1 0 0 22 0 3800 6200 0.69 4278 9 7 J S I L 2 2 2 3 3 S N N 0 2 0 2 0 3 0 1 0 0 0 0 2,3,5 3,5,10 B X X 0 0 X X 0 X 0 0 X X X X X X X 0 0 X X 0 0 X X X 0 0 X 0 X S N S 1 0 2,3,5 0 2 4,5 0 0 0 0
E 101 Sertão 19 4 12 7 3 0 0 45 0 8000 13000 0.79 10270 18 12 H,C S V L,A 1 2 1,2 1 3 N S N 0 3 0 2 1 2 1 0 0 0 0 0 1,2,3 1,2,6,7 B,C X 0 0 X 0 0 X X X X X X X X X X X 0 0 X X 0 0 X X X X X X X X 0 S S S 1 0 1,2,3,4,5,7 0 2 8 0 N 0 0
E 102 Camargo 16 3 13 10 1 0 0 43 0 7000 10000 0.72 7100 20 15 H S I L 1,3 3 2 1 3 S S S 6 1 0 3 0 2 2 0 0 0 0 0 1,2,3 1,5 B,C X X 0 0 0 X X X 0 X X X X X 0 X X 0 X X X 0 0 X X X X X X X X S S S 1 0 1,2,3,4,5,6,7,8 0 3 1 1,2 N 0 0

E 103 ProtásioAlves 4 2 3 1 1 0 0 11 0 5000 2000 0.7 1400 7 9 H,J S I O 1 3 2 1 3 N S N 0 1 0 2 0 3 0 2 0 0 0 0 2,3 2,5 0 X 0 0 0 0 0 0 X 0 0 0 X 0 X 0 0 0 0 X 0 0 0 0 X X 0 X X X 0 0 S S S 1 0 1,2,3,4,5,6 0 2 4,5,8 0 0 0 0
E 104 Muliterno 15 5 9 6 1 0 0 36 0 8000 7000 0.7 4900 20 10 H,O,C S V L 1 3 2 3 3 N N N 0 2 0 1 0 1 3 1 0 0 0 0 2,3 1,5 B X 0 0 X 0 X X X 0 0 X X X X 0 X X 0 X X X 0 0 X X 0 X X X X 0 S S S 1 0 1,2,4,5,6,7,8 0 2 1,4,5 1 N 0 0
E 105 Vanini 11 1 6 2 2 0 0 22 0 7300 4500 0.74 4023 9 4 H S I O 1 3 2 4 2 N S N 0 1 0 1 0 3 1 0 0 0 0 0 1,2,3 2,5 B X 0 0 0 0 0 0 X X 0 X X X X X X X 0 0 0 X 0 0 X X 0 X X X X 0 S S S 1 0 1,2,3 0 3 6 0 N 0 0
E 106 Gentil 10 3 8 10 25 2 0 58 0 6570 5400 0.75 4050 12 50 H,O S I A 1,2 3 2 1 3 N S S 6 5 0 2 0 2 0 2 0 2 0 0 2,3,5 2,5,6,7,12 C 0 0 0 0 X 0 0 X X 0 X X X X X X X X 0 0 X 0 0 X X X X X X X X N N N 0 0 0 1,3,5,7 0 0 0 S 6 1,2,5
E 107 SantaCecíliadoSul 24 8 13 9 1 0 0 55 0 5400 12300 0.84 10332 28 20 H,J S I A 1 2 1 3 1 S N N 0 3 0 3 0 3 1 0 0 0 0 0 2,3,5 6 B,C X 0 0 0 0 0 0 X 0 X X X X X X X X X X X X 0 0 X X X X X X X X S S S 1 0 1,2,3,4,7 0 1 1 1 N 0 0
E 108 VilaLângaro 22 5 0 2 3 1 0 33 0 6000 13200 0.76 10032 12 11 H,J S V L 0 3 1 3 2 N N N 0 1 0 3 0 3 1 0 0 0 0 0 2,3 2,6 B X 0 0 X X X 0 X 0 X X X X X X X X 0 X X X 0 0 0 0 0 X X X X X S N N 1 0 1,2,3,4,5,9 3,6,8 3 6 0 S 1 7
E 109 Muliterno 10 2 1 2 1 1 20 37 0 5400 4500 0.7 3150 10 5 H S I A 1 1 2 1 3 N N S 6 1 0 1 0 5 1 0 0 0 0 0 1,3 5 B X 0 0 0 X X 0 X 0 0 X 0 X X 0 X X 0 0 0 X 0 0 X X 0 X 0 X 0 0 S N N 1 0 1,2,4,6 5,7,8 1 6 0 N 0 0
E 110 Sertão 15 5 4 8 2 0 0 34 0 9000 13000 0.78 10140 8 15 H S V L,A 0 3 2 3 2 N N N 0 5 0 3 1 1 1 1 0 0 0 0 2,3 5 0 X X 0 0 0 0 0 X 0 X X 0 0 X X 0 0 0 X X X 0 0 X X 0 X X X X X S S S 1 0 1,2 0 2 8 0 N 0 0
E 111 Rondinha 18 1 9 1 3 1 2 35 0 4500 7200 0.78 5616 0 15 H,J,O,C S V L 2 2 1 1 3 N N N 0 1 0 2 1 2 1 0 0 0 0 0 2,3 2 B X 0 0 0 X 0 0 X 0 0 X X X X 0 0 0 0 X X X 0 0 X X 0 X 0 X X 0 S N N 1 0 1,2,3,6 0 2 6 0 N 0 0
E 112 Marau 12 3 8 10 15 1 0 49 0 5000 450 0.75 0 12 20 H,J,C S I A 0 3 1 1 3 N N S 6 3 0 3 0 2 1 0 0 0 0 0 3 2 B X 0 0 0 0 0 0 0 0 0 X X X 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 S N N 1 0 1,6 0 1 1 2 N 0 0
E 113 Coxilha 33 10 13 10 2 1 1 70 0 8500 19500 0.86 16770 13 10 H S I L,A 1 1 2 1 2 N N N 0 5 0 0 0 1 2 0 0 0 0 0 0 2 5 B X 0 0 X X X 0 X 0 0 X 0 X 0 X X X 0 X X X 0 0 X 0 0 X X 0 0 0 S N N 1 0 7 0 1 1 2 0 0 0
E 114 CaciqueDoble 6 2 1 4 2 0 0 15 0 4950 2475 0.68 1683 4 3.5 C S V L 1 3 1 3 3 N N N 0 1 0 2 0 2 1 0 0 0 0 0 2,3 0 B X 0 0 0 0 0 0 X 0 X X 0 0 X X X X 0 X X X 0 0 X X 0 X X X X X S S N 1 0 1,2,3 0 1 6 0 N 0 0
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E 116 VictorGraeff 8 4 5 0 0 1 0 18 0 4500 3000 0.61 1800 11 10 H,J S V L 0 3 2 3 0 N N N 0 1 0 2 0 1 2 0 0 0 0 0 2 2,5 B 0 0 0 0 X 0 X X 0 X X X X X 0 X X 0 X X X 0 0 X 0 0 X X X X 0 N N N 0 0 0 1 0 0 0 S 6 7
E 117 NovaBassano 13 2 7 2 2 1 0 27 0 4700 5100 0.7 3500 8 5 H S V L 0 3 2 3 2 N S N 0 2 0 2 0 3 1 0 0 0 0 0 1,2,3 2,5,7 B X X 0 0 X 0 X X 0 0 X X X 0 0 0 0 0 0 0 0 X 0 0 X X X X X X X X S N S 1 0 1,2,4,5,6 5 3 8 0 N 0 0
E 118 VilaLângaro 12 3 6 2 1 0 0 24 0 6000 3200 0.7 2240 6 3.5 H S I O 1 3 1 1 3 S S N 0 1 0 2 3 0 1 1 0 0 0 0 1,2,3 2 B X 0 0 X 0 X 0 X X X X X X X X 0 0 0 0 X X 0 0 X X 0 X X X X X S S S 1 0 1,2,3,4,5,7 0 1 1 1 N 0 0
E 119 Tapera 15 3 6 3 7 0 0 34 0 4500 345 0.7 2415 0 20 H S V A 1,3 1 2 3 3 N N S 6 3 0 2 0 0 3 1 0 0 0 0 2,3 1,5 B X 0 0 0 0 X X X X X X X X X 0 0 0 0 0 0 X 0 0 X X 0 X X X X 0 S S S 1 0 1,2,3 0 1 6 0 N 0 0
E 120 Tapera 11 2 1 1 2 0 0 17 0 5475 450 0.7 3465 11 10 H S I A 1 3 2 1 1 N N S 2 3 0 2 0 1 2 2 0 0 0 0 2,3 5 C X X 0 0 0 0 X X 0 X X X X X X X X 0 0 0 X 0 0 X X X X 0 0 0 0 S S S 1 0 1,2,3,4,5 0 3 6,8 0 N 0 0
E 121 Carazinho 12 8 14 8 2 0 0 44 0 0 0 0 0 20 15 H S V L 3 3 1 1 2 N N S 6 3 0 2 1 1 3 0 0 0 0 0 2,3 1,2,5,6,10 B X 0 0 X X 0 X X X X X X X X 0 0 0 0 X X X 0 0 X X 0 X X X X X S N S 1 0 1,2,3,4,6,7 0 1 1 2 N 0 0

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E 122 BarraFunda 8 3 6 4 3 1 0 25 0 3600 3840 0.7 2688 8 3.3 H,J,O S V L,O 1 3 1 1 2 S N S 3 1 0 3 0 2 3 0 0 0 0 0 2,3 2,5 B X 0 0 0 X X X X 0 X X 0 X X X X 0 0 0 X 0 0 0 X X 0 X X X 0 X S N S 1 0 1,2,3,4,5 0 1 6 0 N 0 0
E 123 GetúlioVargas 10 3 0 0 0 0 0 13 0 360 3500 0.71 2500 1 1.5 H,J S V L 1 3 2 1 1 N N N 0 1 0 3 0 2 0 0 0 0 0 0 2 2,5 B X 0 0 0 0 0 0 X X 0 0 X X X X 0 X 0 X X 0 0 0 0 0 0 X X 0 X 0 S S S 1 0 1,2,3,5,6 0 3 6,8 0 0 0 0
E 124 Pontão 18 4 10 11 4 1 0 48 0 6000 14000 0.78 10920 22 10 H N 0 L 1 3 1 3 3 N S N 0 2 0 2 0 3 1 1 0 0 0 0 2,3 5,9,10 B,C X 0 0 0 X X 0 X 0 0 X X X X 0 0 0 0 0 0 X 0 0 X X X X X X X X S N S 1 0 1,2,3,4,7 0 3 1,5,8 1 N 0 0
E 125 Tapera 16 4 4 3 0 1 0 28 0 5500 8500 0.74 6300 21 35 H S I L 1 3 1 3 1 S N S 3 3 0 2 0 3 0 1 0 0 0 0 2,3,5 5,6,12 0 X 0 0 0 X X 0 X 0 X X X X X 0 0 0 0 X X X 0 0 X X X X X X X 0 S N S 1 0 1,2,3,4,5,6 0 1 6 0 N 0 0
E 126 IpirangadoSul 28 4 9 11 0 0 0 52 0 7300 17033 0.83 14137 31 17 H S I L 2 3 5 1 2 N N S 3 1 0 2 0 2 1 1 0 0 0 0 1,2,3 1,2 B X 0 0 0 0 0 0 X 0 X X 0 X X X 0 0 0 X X X 0 0 X X X X X X X 0 S S S 1 0 1,2,3,4,5,7,8 0 3 1,5 1 N 0 0
E 127 Gentil 9 4 3 5 1 1 0 23 0 3200 360 0.63 2041 14 10 H,J,C S I A 3 3 2 1 2 S N S 3 2 0 3 0 2 1 1 0 0 0 0 3,5 2,7 B,C 0 0 0 0 0 0 X X X 0 X X X X X X 0 0 0 0 0 0 0 X 0 0 X X X X 0 S N N 1 0 2 1 1 7 2 N 0 0
E 128 Gentil 14 5 6 5 0 0 0 30 0 5000 8300 0.73 6059 17 15 H S I L 1 3 2 4 2 N N N 0 3 0 3 0 2 1 0 0 0 0 0 1,2,3,5 5,13 B,C X 0 0 0 X 0 0 X 0 X X 0 X X 0 X X 0 0 0 X 0 0 0 0 X X 0 X 0 0 S N N 1 0 1,2,3,4,5,7 8 1 1 1 N 0 0
E 129 Ibiraiáras 13 2 4 8 0 1 0 28 0 5530 6000 0.7 4200 14 10 H S I L 1 3 2 3 3 N N N 0 1 0 2 0 2 2 0 0 0 0 0 1,2,3 5 B X 0 0 0 X 0 0 X 0 X X X X X 0 X X 0 X X X 0 0 X X 0 X X X X X S N N 1 0 1,2,3,9 0 3 5 0 S 1 7
F 130 GetúlioVargas 28 4 0 0 0 0 0 32 21 0 18500 0.83 15200 0 12 H 0 0 A 1 1 1 4 2 0 N N 0 0 3 0 0 2 2 1 0 2 0 0 1,2,3,5 2,3,6,10 0 X 0 0 0 0 0 0 X 0 X X 0 X X 0 X X 0 0 X X 0 0 0 0 0 X X X X X S 0 0 0 0 1,2,3 0 1 6 1 N 0 0
F 131 GramadodosLoureiros 20 5 0 0 0 0 0 25 18 0 10000 0.83 8300 0 12 H 0 0 L 1 3 1 4 3 0 N S 0 0 1 0 0 2 0 2 0 0 0 0 2,3 6 0 X 0 0 0 X 0 0 X 0 0 X X X X 0 X 0 0 0 0 X 0 0 0 0 0 X X X X 0 S 0 0 0 0 1,2 0 1 6 0 N 0 0
F 132 Ibiraiáras 8 3 0 0 0 0 0 11 17 0 4080 0.72 2937 0 6 H,J 0 0 A 1 3 1 4 3 0 N S 0 0 1 0 0 3 1 0 0 0 0 0 2,3 5,6 0 X 0 0 X 0 0 0 X X 0 X X X X 0 X X 0 X X X 0 0 0 0 0 X X X X 0 S 0 0 0 0 1,2,3,4,5 0 3 2,6 1 N 0 0
F 133 VilaMaria 12 5 0 0 0 0 0 17 12 0 7000 0.72 5040 0 8 H,J 0 0 A 1 2 1 4 3 0 N S 0 0 1 0 0 3 0 0 0 0 0 0 3 2,5 0 X 0 0 0 0 0 0 X 0 X X X X 0 0 X X X X X X 0 0 0 0 0 X 0 0 X 0 S 0 0 0 0 1,2,3 0 1 5 2 N 0 0
F 134 Pontão 17 8 0 0 0 0 0 25 20 0 11000 0.8 8800 0 6 H 0 0 A 1 2 2 4 1 0 N N 0 0 3 0 0 2 1 0 0 0 0 0 1,2,3,4,5 3,5,6,10 0 X 0 0 X 0 0 0 X 0 X X X X X 0 X X 0 X X X 0 0 0 0 0 X X X X X S 0 0 0 0 1,2,3,4,5,6,9 0 2 8 0 N 0 0
F 135 NovaBassano 42 10 0 0 0 0 0 52 23 0 0 0.82 22632 0 15 H 0 0 L,A 1 3 1,4 4 3 0 N 0 0 0 1 0 0 2 1 1 0 0 0 0 2,3 2,8 0 X X 0 X 0 0 X X 0 X X 0 X X 0 X X 0 X X X 0 0 0 0 0 X X 0 X X S 0 0 0 0 1,2,3,4,5,6,7,9 0 3 6 1 N 0 0
F 136 Viadutos 8 4 0 0 0 0 0 12 10 0 2500 0.7 1750 0 5 H,J 0 0 L 1,3 2 1 4 3 0 N S 0 0 1 0 0 1 2 0 0 0 0 0 1,2,3 2,6,7 0 X 0 0 X 0 0 X X 0 X X 0 X 0 0 X X X X X X 0 0 0 0 0 X X X X X S 0 0 0 0 1,2,3,4,5 0 1 3,4 1 N 0 0
F 137 Viadutos 15 3 0 0 0 0 0 18 28 0 12500 0.8 10080 0 8 H 0 0 L 1 3 1 4 3 0 S N 0 0 1 0 0 1 2 0 0 0 0 0 1,2,3 3,6,7,10 0 X 0 0 X 0 0 0 X 0 X X X X X 0 X X 0 X X X 0 0 0 0 0 X X X X 0 S 0 0 0 0 1,2,3,4,5,7 0 3 1 1 N 0 0
F 138 Sananduva 7 2 0 0 0 0 0 9 12 0 2000 0.7 1400 0 5 H 0 0 O 1 3 1 4 3 0 S N 0 0 1 0 0 2 1 2 0 0 0 0 1,2,3,5 5,6,7,10 0 X 0 0 0 0 0 X X 0 0 X X X X 0 X X 0 0 0 X 0 0 0 0 0 X X X X X S 0 0 0 0 1,2,3,4,5,9 0 3 3,6 1 N 0 0

ods graphics on;

proccorresp mca;
tables ex_epoc feno ia usa_ia qt_dos1;
/*
proc means;
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proc corr;
proc freq;
tables munic   raca   ex_epoc   epoca   mai_rem   out_rec   tpo_lei   lt_vend   cont_lt   dist_lt
par_exp   ati_pec   emp_fora
emp_area   tam_pro1   tam_pro2    val_ter   fam_anal   fam_1gr   fam_2gr    fam_3gr
emp_anal   emp_1gr   emp_2gr
emp_3gr   part_ev   ap_cap   ap_fin   ia   sinc_ia   tra_emb   sem_sex    mon_nat   dia_pre
pas_cn   pas_cul
res_lav   feno   silag   sal_com   sal_min   conc   raiva   car_hem   car_sin   gang   bvd   ibr
outras
n_vac   rec_3a   rot_pas   sel_pro
sel_ipr   fertil   corret   def_agr   cont_pr   uni_arm   usa_ia   td_ins   pri_met   qt_dos1  qt_dos2
pq_usa   pq_nusa   temp_us
qm_ins   ond_cur   dei_usa   qt_temp  pq_dei ;

proc factor r=varimax plot;
var vc_lac total lt_ano partos ha qt_dos1 ;

proc fastclus maxc=3 out=outc;
var vc_lac total lt_ano partos ha qt_dos1 ;

proc freq;
tables cluster*(raca   ex_epoc   epoca   mai_rem   out_rec   tpo_lei   lt_vend   cont_lt   dist_lt
par_exp   ati_pec   emp_fora
emp_area   tam_pro1   tam_pro2    val_ter   fam_anal   fam_1gr   fam_2gr    fam_3gr
emp_anal   emp_1gr   emp_2gr
emp_3gr   part_ev   ap_cap   ap_fin   ia   sinc_ia   tra_emb   sem_sex    mon_nat   dia_pre
pas_cn   pas_cul
res_lav   feno   silag   sal_com   sal_min   conc   raiva   car_hem   car_sin   gang   bvd   ibr
outras
n_vac   rec_3a   rot_pas   sel_pro
sel_ipr   fertil   corret   def_agr   cont_pr   uni_arm   usa_ia   td_ins   pri_met   qt_dos1  qt_dos2
pq_usa   pq_nusa   temp_us
qm_ins   ond_cur   dei_usa   qt_temp  pq_dei )/chisq nocol nopercent nofreq;

proc means ;
class cluster;

run;

data dois;
set cap2;
if ia = . then delete;
npttotal=nptIA_99+nptIA_00+nptIA_01+nptIA_02+nptIA_03+nptIA_04+
nptIA_05+nptIA_06+nptIA_07+nptIA_08+nptIA_09+nptIA_10+nptIA_11+nptIA_12;
if epoca = "I" then ep = 1;
if epoca = "V" then ep = 2;
if epoca = "0" then ep = 0;
/*
proc freq;

proc glm;
class meso munici;
model vc_lac vc_sec tern novil macho touro ani_trab
total lt_ano lt_mes prec_lt prec_t partos ha
= meso munici(meso);
*/
procfastclus maxclusters= 4 out=clusters;
```

```
var vc_lac total  lt_ano   ha;

data cluster;
set clusters;
if cluster = 2 then delete;
procmeans data=cluster;
class cluster;

procdiscrim;
class cluster;
ods graphics on;

procreg;
model lt_ano = vc_lac total ha / selection = stepwise;

*envel folha munic estado meso micro munici qt_pro tot_pro
mean_pro tbf tbf_12 tbf_24 tbf_36 tbf_+36 tbm tbm_12 tbm_24
tbm_36 tbm_+36 tblf tblf_12 tbf_24 tbf_36 tbf_+36 tblm
tblm_12 tblm_24 tblm_36 tblm_+36 nptIA_98 nptIA_99
nptIA_00 nptIA_01 nptIA_02 nptIA_03 nptIA_04
nptIA_05 nptIA_06 nptIA_07 nptIA_08 nptIA_09
nptIA_10 nptIA_11 nptIA_12 npl_03 ll_03 npl_04 ll_04 npl_05
ll_05 npl_06 ll_06 npl_07 ll_07 npl_08 ll_08 npl_09 ll_09
npl_10 ll_10 npl_11 ll_11 erbl_74 erbl_75 erbl_76 erbl_77
erbl_78 erbl_79 erbl_80 erbl_81 erbl_82 erbl_83 erbl_84 erbl_85
erbl_86 erbl_87 erbl_88 erbl_89 erbl_90 erbl_91 erbl_92 erbl_93
erbl_94 erbl_95 erbl_96 erbl_97 erbl_98 erbl_99 erbl_00 erbl_01
erbl_02 erbl_03 erbl_04 erbl_05 erbl_06 erbl_07 erbl_08 erbl_09
erbl_10 erbl_11 vco_74 vco_75 vco_76 vco_77 vco_78 vco_79 vco_80
vco_81 vco_82 vco_83 vco_84 vco_85 vco_86 vco_87 vco_88 vco_89
vco_90 vco_91 vco_92 vco_93 vco_94 vco_95 vco_96 vco_97 vco_98
vco_99 vco_00 vco_01 vco_02 vco_03 vco_04 vco_05 vco_06 vco_07
vco_08 vco_09 vco_10 vco_11 nep50 nepl50 nvt50 nvl50 nep50_IA
nepl50_IA nvt50_IA nvl50_IA vc_lac vc_sec tern novil macho
touro ani_trab total lt_ano lt_mes prec_lt prec_t partos
ha raca ex_epoc epoca mai_rem out_rec tpo_lei lt_vend cont_lt
dist_lt par_exp ati_pec ati_gra emp_fora emp_area tam_pro2 prop
val_ter tip_cons tip_eq fam_anal fam_1gr fam_2gr fam_3gr emp_anal emp_1gr emp_2gr
emp_3gr part_ev ap_cap ap_fin ia sinc_ia tra_emb sem_sex mon_nat dia_pre pas_cn pas_cul
res_lav feno silag sal_com sal_min conc raiva car_hem car_sin gang bvd ibr outras n_vac
rec_3a rot_pas sel_pro sel_ipr fertil corret def_agr cont_pr uni_arm usa_ia td_ins pri_met
qt_dos1 pq_usa
pq_nusa temp_us qm_ins ond_cur dei_usa qt_temp pq_dei;

procfactor;
var vc_lac total lt_ano lt_mes prec_lt prec_t partos
ha npttotal;

proccorresp;
var  raca  mai_rem out_rec tpo_lei lt_vend cont_lt
dist_lt par_exp;

proccorresp;
var ati_pec       ati_gra  emp_fora tam_pro2       prop       val_ter  tip_cons            tip_eq
        fam_anal          fam_1gr           fam_2gr           fam_3gr           emp_anal
        emp_1gr           emp_2gr           emp_3gr;

proccorresp;
```

```
var part_ev      ap_cap ap_fin   ia;

proccorresp;
var ia pas_cn    pas_cul res_lav feno    silag   sal_com         sal_min conc;

proccorresp;
var raiva        car_hem         car_sin gang    bvd     ibr     outras;

proccorresp;
var rec_3a       rot_pas sel_pro sel_ipr;

proccorresp;
var fertil       corret  def_agr cont_pr uni_arm;
/*
proc corresp;
var usa_ia       td_ins  pri_met qt_dos1         pq_usa pq_nusa          temp_us
qm_ins ond_cur           dei_usa qt_temp         pq_dei;
*/

run;
```

CAPÍTULO IV

Annex 11 – Data obtained with monitoring of factors related to production and questionnaires with their acronyms, source extraction and measures

	Variáveis	Sigla	Fonte Dados	Unidade
Productive	area of the property	AP	Properties	há
	area used for dairy farming	ADF		há
	perennial pasture rotation area	APPR		há
	Total milk production	TMP		L/year
	Milk sold in the year	MSY		L/year
	Cow in milk	CM		heads
	dry cows	DC		heads
	Total animals	TA		heads
	Total UA	UA		UA
	animals born	AB		heads
	purchased animals	AP		heads
	animals Sold	AS		heads
	dead animals	AD		heads
	Capacity rotational grazing	CRG		Lac cow/há
	Productivity milk rotational grazing	PMRG		L/há/year
	Stocking area milk	C_ha		heads/há
	Stocking area milk	UA_ha		UA/há
	Stocking area milk	CT_ha		heads
	Lactating cows relationship / Total cows	LC_LT		%
	Cows relationship / Total herd	LC_LH		%
	milk production	MP		L/year
	milk productivity	MPC		L/lac cow./year
	milk productivity	MPT		L/total cow/year
	Milk productivity area	MPA		L/ha/year
Nutritional	L milk / kg concentrate	L_MC	Properties	L
	Kg concentrated / L milk	C_LM		Kg
	Concentrated amount	CA		Kg
Economic	Value Liter / milk	VLM	Properties	R$
	Income from sale of milk	ISM		R$
	Total income of dairy farming	TIDF		R$
	Total OperatingAnnual Expenses	TOE		R$
	Expenses with Concentrate	EC		R$
	Investment in purchase Animals	IPA		R$
	Total investment	IT		R$
	Annual income	INA		R$
	Annual expenses	EA		R$
	Annual investment	IA		R$

“continuação” Dados obtidos com acompanhamento dos fatores relacionados a produção e aplicação de questionários com respectivas siglas, fonte de extração e de medidas.

	Gross margim	MG		R$
	Annual balance	AB		R$
	Profitability	Profit		%
Technologies	Uses Insemination	AI		nº
	Every Herd	AI_HE		nº
	Do pass with bulls	DP_B		nº
	How long does insemination	HL_AI	Questionnaire	nº
	TAI uses	TAI		nº
	TE uses	TE		nº

Annex 12 – **Economic indicators for agricultural activity**

a) **Custo operacional efetivo (COE) de produção–** Obtido pelo somatório das despesas normais para a obtenção da produção no período considerado, tais como: ração, concentrados, mão-de-obra, transportes, produtos veterinários;

b) **Custo operacional total (COT) –** Somatório do COE e de outros custos operacionais, como depreciação de bens duráveis;

c) **Custo total (CT) –** Compreende o COT mais os juros ou renumeração do capital estável e a remuneração da terra;

d) **Custo médio (CMe) –** Calculado pela razão entre o CT e a quantidade (Q) obtida do produto:

CMe = CT/Q

e) **Renda bruta total (RBT)–** Compreende o valor de todos os produtos obtidos como resultado do processo de produção durante um ano agrícola:

$$RBT = \sum_{i=1}^{n} Pi \times Qi$$

Em que, Pi é preço do produto i e Qi é a quantidade produzida i.

f) **Margem bruta (MB) –** É o resultado do valor da produção obtida na exploração menos o custo operacional efetivo atribuído à atividade.

MB = RBT - COE

g) **Margem líquida (ML) –** Diferença entre RBT e COT:

ML = RBT - COT

h) **Lucro (L) –** Obtido pela diferença entre RBT e CT:

L =RBT – CT

i) **Lucro médio (Lm) –** Obtido pela razão entre L e produção (kg) final, em equivalente leite:

Lm = L/Produção (Kg)

j) **Rentabilidade (R)) –** Razão entre L e capital investido

R = (L/capital investido) x 100

k) **Lucratividade (Lucr) –** Razão entre MB e RBT

Lucr = (MB/RBT) x 100

Annex 13– Form of remuneration of milk charged by RASIP Company

Unidade Láctea
Pagamento de Leite por Qualidade
Janeiro/2012
Produtor:________________________

Para pagamento por qualidade a partir dos padrões pré-determinados, conforme segue:

Padrão:

* Contagem de Células Somáticas (CCS)	300.001	a	350.000
* Contagem Total de Microorganismos (CTM)	20.001	a	45.000
* Contagem de Coliformes Totais (CCT)	301	a	500
- Gordura	3,30	a	3,50 %
- Proteína	3,10%		

Se CCT maior que 1.000 se tira 100% da bonificação aplicada a gordura e a proteína.
Se CCS maior que 500.000 se tira 100% da bonificação e aplicada a gordura e a proteína.

Variação do pagamento por qualidade **(Preço de Contrato)**: Bonificação **10 %**
Penalização **9,5 %**

Contagem **de Células Somáticas**

Parâmetro	≥ 450.001	440.001 450.000	420.001 440.000	400.001 420.000	350.001 400.000	**300.001 a 350.000**	287.501 300.000	275.001 287.500	262.501 275.000	250.001 262.500	≤ 250000
Valor pago %	-2,5	-2,0	-1,5	-1,0	-0,5	**0**	0,5	1,0	1,5	2,0	2,5
Resultado											

Contagem de Total de Microorganismos

Parâmetro	≥ 60.001	57.501 60.000	55.001 57.500	52.501 55.000	45.001 52.500	**20.001 a 45.000**	17.501 20.000	15.001 17.500	12.501 15.000	10.001 12.500	≤ 10.000
Valor pago %	-0,5	-0,4	-0,3	-0,2	-0,1	**0**	0,2	0,4	0,6	0,8	1,0
Resultado											

Contagem de Coliformes Totais

Parâmetro	≥ 751	701 750	651 700	601 650	501 600	**301 a 500**	251 300	201 250	151 200	101 150	≤ 100
Valor pago %	-2,0	-1,6	-1,2	-0,8	-0,4	**0**	0,4	0,8	1,2	1,6	2,0
Resultado						**463**					

Gordura

Parâmetro	≤ 3,09	3,14 3,10	3,19 3,15	3,24 3,20	3,29 3,25	**3,30 a 3,50 %**	3,51 3,56	3,57 3,62	3,63 3,68	3,69 3,74	≥3,75
Valor pago %	-3,0	-2,4	-1,8	-1,2	-0,6	**0**	0,6	1,2	1,8	2,4	3,0
Resultado						**3,47**					

Proteína

Parâmetro	≤2,89	2,94 2,90	2,99 2,95	3,04 3,00	3,09 3,05	**3,10**	3,11 3,15	3,16 3,20	3,21 3,25	3,26 3,30	≥3,31
Valor pago %	-1,5	-1,2	-0,9	-0,6	-0,3	**0**	0,3	0,6	0,9	1,2	1,5
Resultado											

Resultado no mês: **Bonificação:**
Penalização:
Total:

Annex 14 – Normas para preparação de trabalhos científicos para publicação na Agricultural Systems

Article structure

AGRICULTURAL SYSTEMS
AUTHOR INFORMATION PACK
TABLE OF CONTENTS .

ISSN: 0308-521X

DESCRIPTION .

Agricultural Systems is an international journal that deals with interactions - among the components of agricultural systems, among hierarchical levels of agricultural systems, between agricultural and other land use systems, and between agricultural systems and their natural, social and economic environments. Manuscripts submitted to Agricultural Systems generally should include both of the following:

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The scope includes the development and application of systems analysis methodologies in the following areas:

Systems approaches in the sustainable intensification of agriculture; pathways for sustainable intensification; crop-livestock integration; farm-level resource allocation; quantification of benefits and trade-offs at farm to landscape levels; integrative, participatory and dynamic modelling approaches for qualitative and quantitative assessments of agricultural systems and decision making; The interactions between agricultural and non-agricultural landscapes; the multiple services of agricultural systems; food security and the environment; Global change and adaptation science; transformational adaptations as driven by changes in climate, policy, values and attitudes influencing the design of farming systems; Development and application of farming systems design tools and methods for impact, scenario and case study analysis; managing the complexities of dynamic agricultural systems; innovation systems and multi stakeholder arrangements that support or promote change and (or) inform policy decisions.

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(particularly cross-sectional adoption or economic efficiency studies), landscapes (including the development of typologies), land use change studies, results from crop or livestock trials or other economic analyses without substantive natural science content; Conceptual frameworks without empirical implementation (unless submitted as a short communication) Studies focusing on specific chemical constituents ofAUTHOR INFORMATION PACK 6 Nov 2014 www.elsevier.com/locate/agsy 2 plant or animal species or their products; Studies of the operation or efficiency of agricultural or food processing machinery, or of agricultural supply chains without a substantive biological component;
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INTRODUCTION

Agricultural Systems is an international journal that deals with interactions - among the components of agricultural systems, among hierarchical levels of agricultural systems, between agricultural and other land use systems, and between agricultural systems and their natural and social environments. In particular, its aim is to encourage integration of knowledge among those disciplines that underpin agriculture. Many contributions will therefore be multi- or inter-disciplinary. Papers enerally focus on either methodological approaches to understanding and managing interactions within or among agricultural systems, or the application of holistic or quantitative systems approaches to a range of problems within agricultural systems and their interactions with other systems. Because of the nature of the readership of Agricultural Systems, the contents of papers should be easily accessible (properly introduced, presented and discussed) to readers from a wide range of disciplines.

The scope includes the development and application of systems methodology, including system modeling, simulation and optimization; ecoregional analysis of agriculture and land use; studies on natural resource issues related to agriculture; impact and scenario analyses related to topics such as GMOs, multifunctional land use and global change; and the development and application of decision and discussion support systems; approaches to analyzing and improving farming systems; technology transfer in tropical and temperate agriculture; and the relationship between agricultural development issues and policy.

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• Introduction
• Material studied, area descriptions, methods, techniques
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Abstract

A concise and factual abstract of no more than 400 words is required. The abstract should state briefly the objective the research, methods used, principal results and major conclusions. An abstract is often presented separately from the article, so it must be able to stand alone. For this reason, References should be avoided. Also, non-standard or uncommon abbreviations should be avoided, but if essential they must be defined at their first mention in the abstract itself.

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Anexo15 – **Comando do SAS e dados apresentados no Capítulo IV**

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TioHugo 25 4.92 . 8 1 19 12.81 . . 3 . . . 3.86 2.60 1.83 88.89 47.37 41626.00 5203.25 14.26 4625.11 12.67 8460.57 23.18 4.92 0.203 976.15 0.526 20988.03 23230.66 15857.49 8460.00 0.00 1590.00 23230.66 15857.49 7373.17 1590.00 5783.17 4721.68 3223.07 1498.61 323.17 1175.44 0.56 0.38 0.18 0.04 0.14 2581.18 1761.94 819.24 176.67 642.57 31.74 S S N 2 N N
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4235.15 11.60 3675.79 10.07 5729.91 15.70 3.93 0.255 1078.91 0.6 16143.54 17643.54 10988
7090.00 0.00 7.50 17643.54 10988.00 6655.54 7.50 6648.04 3632.49 2262.24 1370.26 1.54
1368.71 0.63 0.39 0.24 0.00 0.24 2330.28 1451.25 879.03 0.99 878.04 37.72 S S S 2 N N

procfastclusmaxc=3out=clus;
var Vlac Tot;

data dois; set clus;
if cluster = 3then cluster = 1;

procmeans;
class cluster;

procprincomp;
var Tam Ar_lei  Vlac Vsec Tot UA  Vlac_rot
Prodade_rot Cab_ha UA_ha Vtot_ha pVL Vtot_Retot Quantlei Prodade_Vlac PVO
Prodade_Vtot PTV Prodade_ha
PHA Quantlei_con Con_quantlei Con_Vlac ;

procprincomp;
var Tam Ar_lei  Vlac Vsec Tot VLL VLT TAT DT DC ICA IT R_ano D_ano MB_ano I_ano
SL_ano
R_ha D_ha MB_ha I_ha SL_ha R_LL D_LL MB_LL I_LL SL_LL R_Vtot D_Vtot MB_Vtot I_Vtot
SL_Vtot Lucr ;

procglm;
class cluster IA  IA_TdRe  Rep_Tou Tem_IA IATF  TE ;
model Tam Ar_lei  Vlac Vsec Tot VLL VLT TAT DT DC ICA IT R_ano D_ano MB_ano I_ano
SL_ano
R_ha D_ha MB_ha I_ha SL_ha R_LL D_LL MB_LL I_LL SL_LL R_Vtot D_Vtot MB_Vtot I_Vtot
SL_Vtot Lucr = cluster IA  IA_TdRe  Rep_Tou Tem_IA IATF  TE /ss3;
means cluster IA  IA_TdRe  Rep_Tou Tem_IA IATF  TE /duncanlines;

procfreq;
tables  cluster *(IA  IA_TdRe  Rep_Tou Tem_IA IATF  TE)/chisq;

run;
```

VITA

Heitor José Cervo, filho de Albino Cervo e Lucila Rapachi Cervo, nascido em 04 de setembro de 1963, em Faxinal do Soturno – RS. Cursou ensino fundamental na Escola Estadual São Domingos Sávio (primeira a quarta série). Na Escola Dom Antônio Reis, cursou da quinta a oitava série e também ensino médio, em Faxinal do Soturno – RS.

Em 1983, ingressou no Curso de Medicina Veterinária da Universidade Federal de Santa Maria (UFSM), e em 1985, como servidor técnico administrativo desta Universidade. Formou-se um julho de 1988, e em março de 1990, ingressou no Curso de mestrado do Programa de Pós-Graduação de Medicina Veterinária, onde desenvolveu trabalho de dissertação, sobre o efeito da transfaunação do fluído rumenal para bovinos não adaptados a pastagem *lolium multiflorum*.

Em maio de 1998, assumiu como docente no Instituto Federal do Rio Grande do Sul (IFRS,) e em março de 2011, ingressou como doutorando no Programa de Pós-Graduação de Zootecnia - UFRGS, desenvolvendo trabalho de tese, sobre avaliação da exploração leiteira na Mesorregião Noroeste do Estado do Rio Grande do Sul.