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ASPECTOS RELEVANTES EM UMA GRANJA LEITEIRA PARA DIFERENTES INTERESSADOS: UM ENFOQUE NO BEM-ESTAR ANIMAL

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"Aspectos Relevantes em Uma Granja Leiteira para Diferentes Interessados: Um Enfoque no Bem-estar Animal"

Por

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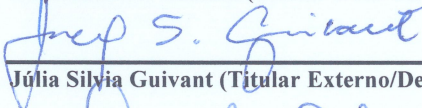
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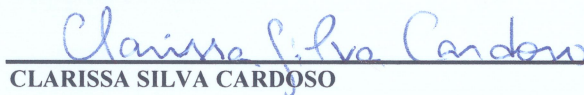
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AGRADECIMENTOS

Gostaria de agradecer aos ~650 cidadãos brasileiros não envolvidos com a produção animal, ~1.100 cidadãos estadunidenses também leigos em produção animal e ~300 profissionais das ciências agrárias no Brasil, que responderam aos nossos questionários no aeroporto e online, e participaram d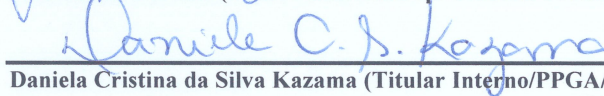as nossas entrevistas no aeroporto, pela rica contribuição com suas visões sobre os assuntos ao qual foram convidados a falar. Simplesmente esta tese não seria possível se as pessoas não contribuíssem. Nesse contexto agradeço ao Milk Point e à Revista Leite Integral por terem publicado nossos questionários online nas suas respectivas páginas e à Infraero (Empresa Brasileira de Infraestrutura Aeroportuária) por ter permitido o recrutamento dos respondentes no Aeroporto Internacional Hercílio Luz em Florianópolis. Ainda, a todos os amigos que atenderam ao meu pedido publicando o link do questionário online nas suas mídias sociais – o número de participantes foi surpreendente. Os outros interessados que fazem parte da tese, as ~20 novilhas que participaram do experimento também

mas não menor importante, muito pelo contrário, agradeço às minhas orientadoras Maria José e Nina por todas as incansáveis contribuições para lapidação (incluindo inglês) dos manuscritos, por todas as trocas de idéias em todos os estudos que entraram nessa tese e ainda outros que ficaram de fora, por todo apoio que tive nas candidaturas pra ir pro Canadá no quase 1 ano que estive lá. Essa tese foi construída em parceria e representa em conjunto nossas maneiras de ver e interpretar os assuntos individualmente; posso dizer que todas nós crescemos e aprendemos juntas no desenvolvimento desses estudos. I'm glad to have just the best ones with me; you're superstar!

RESUMO

Cada vez mais as pessoas estão interessadas no alimento que consomem, e por conseqüência, o modo como é produzido. Pesquisadores vêm investigando visões e expectativas do público sobre esses assuntos, incluindo pessoas leigas e aquelas que trabalham com agricultura. No Brasil esse tipo de pesquisa ainda é escassa, especialmente relação à produção de leite. O objetivo desta tese foi explorar os principais interesses e motivações de diferentes grupos de pessoas em relação aos sistemas de produção de leite, especialmente em relação ao bem-estar animal e outros aspectos relacionados à sustentabilidade. A tese está apresentada em duas partes com cinco estudos independentes mostrados em formato de artigo. A primeira parte envolveu três estudos sobre aspectos relevantes em uma granja leiteira para leigos e pessoas envolvidas com agricultura. Os participantes salientaram que uma granja leiteira deve produzir leite de qualidade porque na sua visão isso está relacionado com a saúde das pessoas; é importante que a granja gere lucro para os agricultores e trabalhadores porque isso afeta a qualidade de vida deles; e os participantes também mostraram preocupações com meio ambiente e bem-estar animal. Cidadãos leigos não estavam cientes sobre separação precoce da vaca e seu bezerro, sistemas sem pasto, o descarte do bezerro macho e descorna/amochamento sem mitigação para dor. Porém, quando os participantes se tornaram cientes dessas práticas, eles as rejeitaram massivamente. A segunda parte envolve dois estudos: o primeiro sobre atitudes de cidadãos leigos sobre a importância da sombra para bovinos leiteiros e o segundo sobre motivação de novilhas leiteiras criadas a pasto para acessar sombra no verão. Os cidadãos leigos avaliaram a sombra como muito importante, mostrando atitudes negativas em relação a um cenário onde vacas eram criadas a pasto sem sombra. De modo semelhante, no experimento com as novilhas elas apresentaram alta motivação para acessar sombra no verão, mostrando que esse recurso é muito importante para elas. Como conclusão, bem-estar foi um aspecto relevante para todos os grupos de participantes dos diferentes estudos e cidadãos leigos rejeitam práticas comuns na produção de leite. Outros aspectos relacionados à sustentabilidade foram relevantes para todos os grupos de pessoas – aspectos econômicos, sociais e ambientais. Um aspecto especialmente relevante para ser considerado por agricultores e outras pessoas envolvidas na cadeia leiteira é o acesso à sombra para bovinos leiteiros criados a pasto.

RESUMO EXPANDIDO

Introdução

Desde que a sociedade começou a discutir problemas ambientais decorrentes dos modos de agricultura praticados, pesquisadores tem trabalhado em desenhos de agroecossistemas que afetem menos os recursos naturais. O termo *agricultura sustentável* se refere a práticas que balançam equilibradamente preocupações ambientais, viabilidade econômica e justiça social entre todos os setores da sociedade. Este foi o conceito de sustentabilidade utilizado nesta tese. Por conta da preocupação da sociedade em relação aos animais surgiu a ciência do bem-estar animal. Nesta tese consideramos três principais aspectos influenciando o bem-estar dos animais: 1) o funcionamento biológico e saúde dos animais; 2) os estados afetivos, relacionado com o que os animais estão sentindo; e 3) a habilidade dos animais em realizarem seus comportamentos naturais.

Para complementar o conceito de agricultura sustentável em que se considera a preocupação social com todos os setores da sociedade e todos os seres do planeta, outros cientistas salientam que bem-estar animal é integrante da sustentabilidade social. Em seus estudos os autores argumentam que a partir do momento em que a sociedade toma conhecimento de que práticas da produção animal frequentemente prejudicam os animais, determinados sistemas de produção passam a ser considerados inaceitáveis, e então, insustentáveis do ponto de vista social (BROOM, 2010; TUCKER; MENCH; VON KEYSERLINGK, 2013).

Para que os sistemas estejam alinhados com a ética da sociedade e, portanto, se mantenham (ou se tornem) socialmente mais sustentáveis, pesquisadores vêm investigando as opiniões de pessoas leigas e daquelas que trabalham na produção animal. No Brasil esse tipo de pesquisa ainda é escassa, especialmente no que se refere à visão das pessoas em relação à produção de leite.

Objetivos

O objetivo desta tese foi explorar os principais interesses e motivações de diferentes grupos de pessoas em relação aos sistemas de produção de leite, especialmente em relação ao bem-estar animal e outros aspectos relacionados à sustentabilidade. Especificamente pretendeu-se: 1) explorar visões de cidadãos leigos e pessoas envolvidas com agricultura sobre os aspectos mais relevantes em uma granja leiteira ideal e suas razões subjacentes; 2) investigar a importância relativa da

sombra para o gado leiteiro do ponto de vista de cidadãos leigos; e 3) medir a motivação de novilhas leiteiras criadas em sistema a pasto para acessar sombra.

Aspectos metodológicos

Dos cinco estudos que compõem esta tese, quatro deles estão no campo da pesquisa social por envolverem pessoas, e um deles é um experimento a campo com animais. Todos os estudos foram aprovados por comitês de ética em pesquisa com seres humanos e animais.

Os estudos com as pessoas envolveram metodologias qualitativas e mistas através de questionários online e feitos pessoalmente, e entrevistas semi-estruturadas em profundidade (ROBSON; MCCARTAN, 2016; CRESWELL, 2009). Por não haver estudos anteriores sobre o conhecimento de brasileiros em relação a bem-estar animal e nem sobre a relevância desse aspecto, todos os estudos com as pessoas tiveram caráter exploratório. Para isso foi usada amostragem aleatória, nesse caso amostras por conveniência (GUEST; MACQUEEN; NAMEY, 2012).

Os questionários desenvolvidos para os diferentes estudos envolveram questões abertas e fechadas, que foram analisadas apropriadamente por metodologias quantitativas e qualitativas. Qualitativamente, foi usada principalmente análise temática (GUEST; MACQUEEN; NAMEY, 2012; BRAUN; CLARKE, 2006; MILES; HUBERMAN, 1994) e hermenêutico-dialética para um dos questionários e para as entrevistas em profundidade (MINAYO, 2004; 2012).

Nos primeiros três estudos conduzidos os participantes foram convidados a responder a mesma pergunta, sobre quais características compunham uma granja leiteira ideal e por que tais características seriam importantes. No primeiro, brasileiros envolvidos com agricultura (n=277) e cidadãos leigos através de um questionário (n=280). No segundo, cidadãos leigos através de entrevistas (n=40), e como complemento do mesmo estudo, outros participantes (n=300) foram questionados sobre quais características deveria haver em uma granja leiteira ideal que se preocupa com o bem-estar dos seus animais, e sobre seu conhecimento e apoio em relação a quatro práticas comuns na produção leiteira: separação precoce da vaca-bezerro; sistemas em que os animais não acesso ao pasto; amochamento de bezerras sem mitigação para a dor; e o abate do bezerro macho. No terceiro, cidadãos dos Estados Unidos (n=493) responderam a mesma pergunta através um questionário. No último questionário, cidadãos dos Estados Unidos

(n=581) responderam a um questionário avaliando quatro diferentes cenários onde um grupo de vacas estava no pasto ou num galpão, sofrendo ou não por estresse térmico.

O último estudo da tese, o experimento a campo com novilhas leiteiras foi feito usando-se a motivação como uma ferramenta para investigar a importância de determinados recursos para os animais (KIRKDEN; PAJOR, 2006). Considera-se que quanto mais forte a motivação dos animais para realizar um comportamento ou acessar um recurso, maior é a importância daquilo para eles (JENSEN; PEDERSEN, 2008; DAWKINS, 1983). Para isso utilizou-se o condicionamento operante, uma técnica experimental comum para avaliar motivação (DAWKINS, 1988; JENSEN; PEDERSEN, 2008). Nesta técnica os animais devem realizar um comportamento para receber uma recompensa (SØRENSEN et al., 2001). No experimento em questão as novilhas aprenderam a associar empurrar um portão (tarefa), com acessar a sombra (recompensa). A partir dessa associação, as novilhas tiveram que empurrar pesos crescentes no portão para continuar acessando a sombra. A motivação (aqui traduzida como o peso empurrado) para acessar sombra no verão foi comparada com a motivação para acessar sombra no outono.

Resultados e discussão

Em conjunto, na opinião das pessoas que participaram dos três primeiros estudos, uma granja leiteira deve produzir leite de qualidade, principalmente porque isso afeta a saúde das pessoas que o consomem; também deve ser justa e rentável para aqueles envolvidos na atividade, garantindo uma vida digna para eles; deve estar preocupada com questões ambientais, e de bem-estar dos animais. Essas características foram pesadas diferentemente entre leigos do Brasil e dos Estados Unidos e também entre brasileiros leigos e aqueles envolvidos na produção animal, mostrando uma distância entre esses dois grupos de pessoas. Ainda, o termo bem-estar animal foi frequentemente citado entre as pessoas envolvidas com agricultura, mas não ficou claro qual o seu entendimento sobre o significado do termo. Isso foi identificado como uma potencial barreira para a melhoria do bem-estar dos animais, e salienta-se a importância da inclusão da disciplina de bem-estar animal nos currículos dos cursos de Ciências Agrárias no Brasil, a fim de que esses profissionais passem a internalizar o assunto. A educação de veterinários, principalmente, foi apontada em outros estudos como um aspecto importante para melhoria do bem-estar dos animais (VENTURA et al. 2016b; MEIJBOOM, 2017).

Em relação a bem-estar animal, nossos participantes do público leigo mostraram preocupação com a saúde e o funcionamento biológico dos animais, seus estados mentais e o tratamento dado a eles, além da naturalidade (ou falta dela) nos sistemas de produção. Os grupos de participantes citaram características associadas à qualidade do leite, bem-estar animal, questões econômicas, sociais e ambientais. Em relação às quatro práticas citadas (separação vaca-bezerro; sistemas em que os animais não acesso ao pasto; amochamento de bezerras sem mitigação para a dor; e o abate do bezerro macho), a maioria das pessoas as desconhecia, mas quando tomou conhecimento, massivamente as rejeitou. Bem-estar animal não foi a característica mais importante em uma granja leiteira segundo os participantes brasileiros, mas quando questionadas especificamente sobre isso as pessoas mostraram grande preocupação com uma variedade de aspectos que podem comprometer o bem-estar dos animais. Portanto, o tema bem-estar na produção de leite é um assunto importante para cidadãos leigos brasileiros.

O acesso ao pasto e ao ar livre foram questões específicas levantadas por todos os grupos de participantes dos três estudos relatados anteriormente, relacionadas tanto à naturalidade e possibilidade dos animais realizarem comportamentos naturais, quanto a questões ligadas a fatores econômicos, justificadas na idéia de que a produção a pasto é mais rentável. Mas uma questão não abordada pelos participantes dos três estudos foi o potencial problema de vacas criadas a pasto sofrerem por estresse calórico devido à falta de sombreamento. No quarto estudo desta tese, em que descrevemos quatro diferentes cenários de um grupo de vacas na produção leiteira para cidadãos leigos dos Estados Unidos, os participantes avaliaram a sombra como muito importante para os animais, mostrando atitudes negativas em relação ao cenário pasto sem sombra. De modo similar, ao medir a motivação de novilhas leiteiras (n=18) para acessar sombra concluímos que este é um recurso muito valorizado por elas no verão, já que elas fizeram mais esforço empurrando mais peso no portão para acessar a sombra no verão em relação ao outono quando a temperatura foi mais baixa. Conjuntamente, pode-se dizer que a sombra é um recurso valorizado por cidadãos leigos e pelos próprios animais, devendo ser considerada em sistemas de produção de leite a pasto.

A naturalidade na granja ideal foi um aspecto marcante em todos os estudos. Tanto a rejeição a químicos de vários tipos, como antibióticos e agrotóxicos, quando a importância dos animais realizarem comportamentos naturais foi citada. A redução do uso de antibióticos na produção animal é uma política sugerida pela Organização Mundial da

Saúde (WHO, 2015) e provavelmente a falta de opinião sobre esse assunto entre os participantes envolvidos com agricultura não será barreira para mudança. A criação a pasto, por ser o ambiente de evolução dos bovinos, foi vista pelos participantes como um aspecto relevante para os animais. Nos Estados Unidos a produção de leite orgânico inclui o acesso dos animais ao pasto (USDA, 2014), e no Brasil apesar da maior parte do gado ser criado a pasto (IBGE, 2009) há uma tendência a diminuição desse sistema para confinamentos (SPERS; WRIGHT; AMEDOMAR, 2013). Juntando isso aos outros aspectos salientados pelos participantes, pode-se dizer que eles esperam uma granja leiteira dentro do que é proposto como agricultura sustentável, ou agroecológica (CAPORAL; COSTABEBER, 2002).

Consierações finais

Bem-estar animal é uma característica importante em uma granja leiteira para cidadãos leigos no Brasil, assim como para o mesmo público nos Estados Unidos, e foi uma característica citada por participantes envolvidos com agricultura, incluindo produtores de leite. Particularmente cidadãos leigos rejeitaram massivamente a separação precoce vaca e bezerro, sistemas em que os animais não têm acesso ao pasto, amochamento de bezerros, e abate do bezerro macho, práticas frequentemente usadas na produção leiteira. Apesar dos participantes citarem bem-estar como um aspecto relevante na produção de leite, houve diferenças no entendimento sobre esse assunto entre cidadãos leigos e aqueles envolvidos com agricultura, o que sugere uma potencial barreira para a melhoria no bem-estar dos animais na produção de leite.

A produção de leite a pasto parece ser uma oportunidade para agricultores mudarem ou melhorarem seus sistemas para que se tornem socialmente mais aceitáveis, tornando a produção de leite mais sustentável. Dentro da produção a pasto, a oferta de sombra é um elemento importante a ser considerado, por ser altamente valorizada pelos animais e por cidadãos leigos. Pelo fato dos cidadãos leigos também terem apontado preocupações em relação a outros aspectos relacionados à sustentabilidade como preservação ambiental, preocupação com aspectos econômicos e sociais, e a diminuição no uso de químicos na produção de leite, a produção orgânica ou agroecológica de leite parece ter um grande potencial para um futuro próximo, por ser mais ética para todos os elos envolvidos na cadeia leiteira.

Palavras-chave: Visão do público. Sustentabilidade. Pasto. Motivação. Sombra. Ética.

ABSTRACT

People are becoming more aware and interested about animal living conditions of farm animals. Researchers are investigating views and expectations of the public about these issues, including lay people and people involved with agriculture. In Brazil this type of research is scarce, especially about dairy production. The aim of this thesis was to explore the main interests and motivations of different stakeholders regarding dairy production systems, especially regarding animal welfare and other aspects of sustainability. We conducted five studies that are organized in two chapters. The first chapter contains three studies about relevant aspects on a dairy farm for both lay citizens and people involved with agriculture. Participants pointed that a dairy farm should produce high quality milk, because in their views that is related to people's health; is also important for them that a dairy farm generates profit for farmers and workers, because that would affect their quality of life; they also showed concerns about environmental issues and animal welfare. Lay citizens were unaware about early cow-calf separation, zero-grazing system, the culling of newborn male calf and dehorning/disbudding without pain mitigation. However, when the participants became aware of these practices, they massively rejected them. The next chapter contains two studies: the first was about the attitudes of lay citizens on the importance of shade for dairy cattle, and the second was about motivation of pasture-based reared dairy heifers to access shade in summer. Lay citizens evaluated shade as very important, showing negative attitudes towards a scenario where cows were pasture-based reared without shade. Similarly, in the experiment that took place, dairy heifers presented high motivation to access shade in summer, showing that this resource is very important for them. In conclusion, animal welfare was a relevant aspect for all stakeholders that participate of these studies, and lay citizens rejected common practices in a dairy farm. Other aspects of sustainability were also relevant for all stakeholders – economic, social and environmental aspects. One especially relevant aspect to be considered by dairy farmers and other stakeholders of dairy chain is access to shade for dairy cattle reared on pasture.

Keywords: Public view. Sustainability. Pasture. Motivation. Shade. Ethics.

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SUMÁRIO

OVERVIEW

This thesis is part of a larger project funded by the Brazilian government through the Program Science Without Borders (Grant MEC/MCTI/CAPES/CNPq/FAPsn°71/2013) that promoted cooperation between Brazilian universities and others around the world. He present, Animal welfare: *A necessary component for sustainability of Brazilian dairy industry* (Bem-estar animal: Um componente necessário para a sustentabilidade da indústria leiteira brasileira) was a cooperation between the Federal University of Santa Catarina, Brazil and the University of British Columbia, Canada. The project started at 2014 and finished at the end of 2017.

In 2014 I received a scholarship funded by the Emerging Leaders in the Americas Program (ELAP) to spend six months in Canada as a visiting researcher to conduct a study in association with prof. Marina von Keyserlingk in the Animal Welfare Program. In that occasion we developed the idea to conduct an online study with United States (U.S.) citizens with the aim to replicate it later with Brazilians citizens. In 2017 I received a scholarship funded by the Brazilian government (Sandwich Doctorate Scholarship – Grant Capes/PDSE/23038.014005/2016-63) to visit the same research group for five months, where I was supervised by Professors von Keyserlingk and Dan Weary. There, I carried out a complementary study for my thesis, again with U.S. lay citizens.

This thesis is organized in the following way: a general introduction; the general aims of the thesis; a brief contextualization of the dairy chain in Brazil and in the U.S. and how some practices on dairy production can negative influence cattle welfare; two chapters with the studies conducted for the thesis – three in the first part and two in the second part, totalizing five independently studies organized as journal articles; a general discussion covering the results of all the studies; and a general conclusion. In Appendix I present some methodological issues that guided the theoretical field and could be an interesting brief explanation for researchers not familiar with social science.

We began this thesis with the study presented here in the item 5.3 when I was in Canada. Almost at the same time we worked on data collection for the study with the specialists (and after lay citizens) presented here as the first study (item 5.1), and then when I came back to Brazil we at the same time we worked on data collection for the study of the item 5.2 (the airport interviews and questionnaires). In the middle

of all of these data collection for the surveys in Brazil, we started to plan the experiment on motivation of dairy heifers to use shade (item 6.2, the last study presented here). The last study (in chronological order) was performed during my second visit to Canada and here is presented as the item 6.1. At the moment of the defense of my Thesis, two of the studies were already published, one was under review, one had been submitted, and the last study was being prepared for submission.

This thesis is an interdisciplinary effort to contribute with knowledge about animal welfare and sustainability of dairy cattle production. We used a mix of methodologies and knowledge fields that is explained in more detail in the Appendix 1 (methodological issues). The data collection where we had to interact with people to make the interviews and the questionnaires was a personal effort, but that allowed us to explore and understand many different point of views. The knowledge and understanding of opinions, views, beliefs and attitudes of people regarding animal welfare issues is considered essential to improve the quality of life of farm animals because people are responsible by the animals and only we can change the currently practices on farms.

1 GENERAL INTRODUCTION

Agriculture is a millennial activity, but since the "green revolution" (~1930-1960), which was followed by intensification of agriculture, this activity is degrading the natural resources and, not surprisingly, the way food is produced is increasingly questioned by society. The intensification of agriculture – that is, high-yielding crop varieties, chemical fertilizers, agrochemicals such pesticides, irrigation, and mechanization – is harming the environment, causing water pollution, soil degradation, eutrophication of rivers and lakes, greenhouse gases and other negative effects on ecosystems (MATSON et al., 1997).

The intensification of animal production, because of the concentration of animals, has an important role in generating some problems. We will use the term *intensification of animal production* as suggested by Fraser (2008), which involves three elements: 1) increased number of animals and decreased number of farms; 2) the confinement of animals; and 3) cost-cutting to maximize profit. Animal concentration can negatively affect natural resources due to manure deposited in the rivers and soils, as well may cause catastrophic epidemics affecting people's health (TILMAN, 1998). Also, it affects public health through the well known problem of antibiotic resistance (WHO, 2015), and many seriously negative effects for animal's quality of life (FRASER, 2008).

Beyond the debate about environment degradation (the issue gained force through Rachel Carson's book: "Silent Spring", 1962), currently the society is debating the way the farm animals are reared (the issue gained force through Ruth Harrison's book, "Animal Machines", 1964). More than a likely shortage of resources to keep doing agriculture, the debate about animals is an ethical issue because the fact that animals are sentient beings brings a reflection by society about the use of animals for consumption and other activities (see Bernard Rollin, "Farm Animal Welfare", 1995 and Peter Singer, "Animal Liberation", 1975). This was the basis for the social concern about welfare of farm animals, which currently is observed among societies around the world (CLARK et al., 2016). Animal welfare can be considered an intrinsic characteristic of the animal and depends of its attempts to cope with its environment and the degree of stress that these attempts cause to that individual (BROOM, 1986). Broom based this concept with the aim to be useful to assess animal welfare through direct or indirect

measurements in the field to improve poor welfare situations (for more, see BROOM, 1991). Other concept of animal welfare, more applied scientifically, was suggested by Fraser et al. (1997) and encompasses three aspects: 1) *biological functioning*, referred to basic health; 2) *affective states*, related to animal's feelings, such as bad like pain or good like pleasure; and 3) *naturalness*, related to the ability of animals to perform natural behaviors. To be more scientifically applied and easy to identify features in a scientific way, we will use this second approach over this thesis.

Since people become aware about the negative effects of intensive agriculture, scientists are working on ways to make agroecosystems that affect less the natural resources. *Sustainable agriculture* can be defined as "meeting current production goals without compromising the future in terms of resource degradation or depletion" (MATSON et al., 1997). As reviewed by Allen et al. (1991), until 1990's the authors emphasize the sustainability concept on *farm-level resource conservation* and profitability. Thus, these authors proposed a third component in sustainability definition, the social sustainability, arguing that welfare is important not only for the future generations but for all people living now and all species. They proposed that "sustainable agriculture is one that equitably balances concerns of environmental soundness, economic viability, and social justice among all sectors of society", focused on social justice and equity. So in our point of view, citizens not familiar or not involved with agriculture would be included in this definition, as well actors who consume the agriculture products. In fact, the authors highlight that the social component of the sustainability concept refers "not only [to] farmers and future generations, but also farmworkers, consumers, nonfarm rural residents (…)".

Complementary to that some animal welfare researchers have been working with the concept of sustainability (BOOGAARD; OOSTING; BOCK, 2008; BROOM, 2010; TUCKER; MENCH; VON KEYSERLINGK, 2013), arguing that animal production systems could be unsustainable in the future if they are no longer acceptable for society. The perception that a given system may harm other people, the environment or animals, may lead people to consider some systems unacceptable and disapprove that (BROOM, 2010). So people will determine if the current husbandry practices should or not be maintained (TUCKER; MENCH; VON KEYSERLINGK, 2013). A result of that may be a boycott to some products considered unacceptable by this public: some people become vegetarian but the majority of them just

change their purchase choices (BROOM, 2010; VON KEYSERLINGK et al., 2013). According to these authors, animal welfare should be included as a conceptual aspect of social sustainability. Environmental and animal welfare concerns emerged from the same problem, the intensification of agriculture, and probably if treated altogether, all of us will achieve better results on sustainability terms (HÖTZEL, 2014). In this thesis we adopted the Allen's et al. (1991) concept of sustainability that embraces three aspects: the environmental, the economic and the social, and considered animal welfare as a part of the social sustainability, according to the authors cited before.

Changes in the way animals are reared are in general top-down and happen through consumers' or activists' pressure, or regulations forcing farmers to adapt their practices to society's values. To make regulations that accommodate these values, it is necessary to know the opinion of people, their knowledge, discontent and expectations about how food is produced. Thus, researchers are working with opinions of different stakeholders about food and animal production. Specifically about animals, researchers are investigating lay public's views and expectations towards animal production, especially about animal welfare (CLARK et al., 2016; VARGAS-BELLO-PÉREZ et al., 2017). This is important considering the context above: if people are not comfortable with some aspects of animal production, this could create pressure to make regulations and thus, change the way the animals are reared so they are more aligned with societal expectations and then, more socially sustainable. It has been suggested that participatory strategies between different stakeholders to discuss animal welfare issues and identify common concerns are need in order to accommodate different points of view regarding animal production practices, and perhaps improve social sustainability (POLETTO; HÖTZEL, 2012; TUCKER; MENCH; VON KEYSERLINGK, 2013; VON KEYSERLINGK et al., 2013).

This is the way some livestock production practices started changing: by society' pressure, governmental regulations about farm animal systems are being created, and/or companies of food chain demanding changes on management of their animal products' suppliers (TUCKER; MENCH; VON KEYSERLINGK, 2013). For example, the banning of cages specially for hosuing sows are being required in many countries: the European Union banned cages sows since 2013 (STEVENSON, 2012), Canada since 2014 (NFACC, 2014), New Zealand since 2015 (MINISTRY OF PRIMARY INDUSTRIES, 2015) and 10 States of U.S. have stopped or are stopping to use it until 2018 (ASPCA, 2018). Other examples come from the pork industry: in

Australia they are transitioning starting in 2017 (AustralianPork), and South Africa expects to stop until 2020 (SAPPO, 2011). Other changes are coming from the corporations of food chain that became aware that they could lose consumers because of the conditions the animals were reared by their suppliers. Some big fast food companies announced changes in their purchase policies, forcing suppliers to change some production practices. In the U.S. and Europe, for example, Burger King only buys eggs and meat pork of caged free (not confined) (MARTIN, 2007); McDonald's announced many practices ongoing global with their global suppliers (MCDONALD'S, 2018), following the regulation requirements, like the gestation stalls for pregnant sows in European Union. Similarly, some companies in Brazil are following the same trend, according to announcements of three main companies of pork, that they are transitioning from sow gestation stalls to group gestation housing (AURORA, 2015; BRF, 2017; JBS, 2016), a corporate initiative, because Brazil does not have any regulation (CASSUTO; ECKHARDT, 2016), except for guidelines for organic production (BRASIL, 2011a).

Based on research done mainly in Europe and North America, we know, for example, that lay citizens are dissatisfied with animal production systems (TE VELDE; AARTS; VAN WOERKUM, 2002); they tend to prefer more natural systems (LASSEN; SANDØE; FORKMAN, 2006; VERBEKE et al., 2010; PRICKETT; NORWOOD; LUSK, 2010), with pasture-reared cattle (SCHUPPLI; VON KEYSERLINGK; WEARY, 2014). North Americans rejects painful procedures like cows' tail docking (WEARY; SCHUPPLI; VON KEYSERLINGK, 2011) and dehorning of dairy calves (ROBBINS et al., 2015) and cow-calf separation practice (VENTURA et al., 2013). In Brazil and Latin America the issue of public opinions is beginning to be explored (VARGAS-BELLO-PÉREZ et al., 2017). In Brazil, recent publications show, for example, that citizens believe that farm animals are not well treated, which may explain a preference for free-range or cage-free systems because of naturalness and ethics (YUNES; VON KEYSERLINGK; HÖTZEL, 2017); they reject zero-grazing systems for cows as well cow-calf separation because it harms animal welfare and is not natural (HÖTZEL et al., 2017); and they perceived fish as sentient animals (RUCINQUE; SOUZA; MOLENTO, 2017).

Although it is well known that cattle contributes with most greenhouse gas emissions (GERBER et al., 2013, p. 23), dairy production seems to enjoy a good image among lay citizens (CLARK et al., 2016; VENTURA et al., 2013). Maybe because gas emissions are

more related to beef than dairy (GERBER et al., 2013, p. 23), some people stop eating meat moved by ethical and environmental reasons, but keep consuming dairy products. But slowly and also maybe because of the allergies related to dairy, currently the consumption of dairy is being questioned by society. Scientists also raise some negative aspects of dairy cattle welfare; for example calf dehorning resulting pain, calves housing and feeding possibly causing frustration and hungry, lameness on cows resulting pain (VON KEYSERLINGK et al., 2009), and heat stress that affects physiology and causes discomfort (SCHÜTZ et al., 2010; STEIGER BURGOS et al., 2001). The Food and Agriculture Organization of the United Nations (FAO) recommends that dairy farmers apply Good Agricultural Practices to achieve "production of safe, quality milk from healthy animals under generally acceptable conditions", which includes animal health, milking hygiene, nutrition, animal welfare, environmental concerns and social responsibility including economic sustainability (FAO, 2018b) – all aspects of sustainability cited here.

Thus, instead of making changes in farm animal production systems simply following the steps of other countries (VON KEYSERLINGK; HÖTZEL, 2015), which may not necessarily align with the values and expectations of Brazilian citizens and consumers, it seems interesting to base them on culturally and relevant demands. To do that, it is interesting to investigate Brazilian citizens' opinions about dairy cattle welfare. We argue that these issues should be discussed with the Brazilian society to avoid changes that are not sustainable, either because they are not aligned with society's expectations or economic and production realities.

In this thesis we consider that not only those with "purchase power" should give their opinions about their discontents and expectations regarding animal production. Considering this, we worked with citizens, not with consumers. These two actors play different roles: consumers are only focused on economic aspects of the products, simply making choices; citizens, instead, are engaged with society, can actively participate of governmental decisions (LEWIS; INTHORN; WAHL-JORGENSEN, 2005) and consider other elements than the economical, like social and environmental impacts related to products, that could affect society (JOHNSTON, 2008). This implies, in our view, that only individual choices of purchase for *alternative* products (the *ethical consumption*, or the hybrid citizen-consumer) will not change political decisions about animal production; indeed, changes on farm practices to improve animal welfare need also people in their role as citizens

(AERTS, 2013; JOHNSTON, 2008). We agree with Johnston (2008) when he says, "while consumerism maximizes individual self-interest though commodity choice, the citizen-commons ideal prioritizes the collective good, which means that individual self-interest and pleasure can be trumped in the interest of improving sustainability or access to the commons". We consider that not only the opinions of those not involved with agriculture are important, so we included dairy farmers and agricultural professionals in our research. These stakeholders may potentially be affected by animal welfare regulation and play a role to change practices. Finally, considering that the animals are most affected by production, we also asked with these "stakeholders" to "give their opinions" about aspects on a dairy farm.

1.1 GENERAL OBJECTIVES

The objective of this thesis was to explore the main interests and motivations of different stakeholders regarding dairy production systems, especially regarding animal welfare and other aspects of sustainability. Specifically, we aimed to 1) explore the views of lay citizens and stakeholders involved with agriculture about the most relevant aspects on an ideal dairy farm and their associated reasons; 2) investigate the relative importance of shade for dairy cattle for lay citizens; and 3) measure the motivation of dairy heifers in a pasture based system to access shade.

2 DAIRY PRODUCTION IN BRAZIL AND IN THE UNITED STATES

Milk production is an important activity around the world that contributes with livelihoods of many smallholders in developing countries through monthly income, and also with food security and nutrition (FAO, 2018c). In the last three decades, global milk production increased more than 50%. India, the largest milk producer in the world, produces 18% of all this milk, followed by the U.S., China, Pakistan and Brazil (FAO, 2018c). However, considering only cows' milk, which according to the FAO is the specie that produces 85% of the global milk, in 2016 the U.S. was the largest world producer, followed by India, China, and Brazil (FAOSTAT, 2016) (Figure 1).
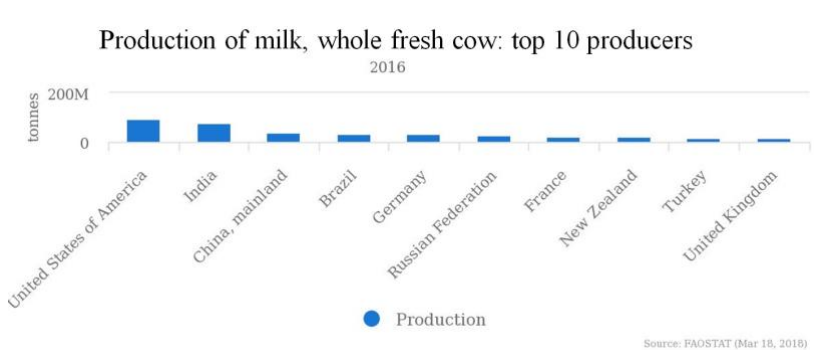
Figure 1. The 10 major countries producers of whole fresh cow milk in 2016. Source: FAOSTAT.

In Brazil, 16% of population lives in rural areas (IBGE, 2010), and in the U.S., 19% (BUREAU, 2010). The change in relation to the proportion of people living in rural and urban areas happened in the U.S. around the 1920's: in the 1910 more than half of the total population (54%) lived in rural areas, while in the 2010 this number decreased for 19% of people living in rural areas (BUREAU, 2016a). In Brazil this change happened much later, around the 1960-70's, with a strong rural exodus and the number of population living in rural areas stills decreasing (IBGE, 2010). Figure 2 represents these changes in U.S. and Brazil.
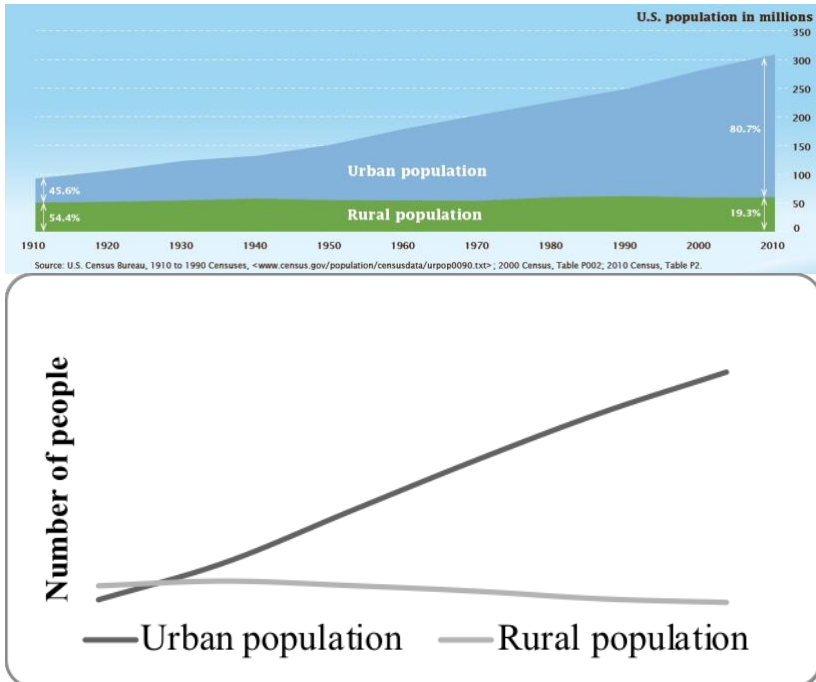
Figure 2. Change in rural and urban population in U.S. and Brazil over the years. Sources: U.S. Census Bureau (2016) and Brazil data from Demographic Census (2010) elaborated by the author.

Overall, in 2016 Brazil had 1,350,809 dairy farms, with a total of 19,678,817 milked cows that produced 33,624,653 tons of milk (FAOSTAT, 2016; IBGE-SIDRA, 2016), resulting in a productivity of ~1,300L/cow/year (~4L/cow/day). In the same year, the U.S. had 41,809 licensed dairy farms and 9,330,000 milked cows (USDA-NASS, 2017) that produced 96,359,376 (FAOSTAT, 2016) tons of milk, with a productivity of ~7,800L/cow/year (~25L/cow/day). In the next sections we will present some individual characteristics of dairy production in both countries.

2.1 MILK PRODUCTION IN BRAZIL

Brazil has two main producers regions: south, with 35% of total milk produced in the country and southeast with 34% of total milk produced; three states produce more than half of the milk in the country: Minas Gerais (26%), Paraná (13%) and Rio Grande do Sul (13%)

(ICEPA, 2016) – the last two states are part of the southern region and Minas Gerais is part of the southeastern region. Historically milk production in Brazil is growing, especially in the 2000's. The historically growth in milk production was due to two factors: the increase number of animals and their individual productivity (Figure 3) (MAIA et al., 2013). Also, according to the same authors, at the same time there was a reduction in the number of farmers, especially in the south region where increased production, with a reduction of 32% in dairy farms.

Produção de leite e efetivo de animais ordenhados
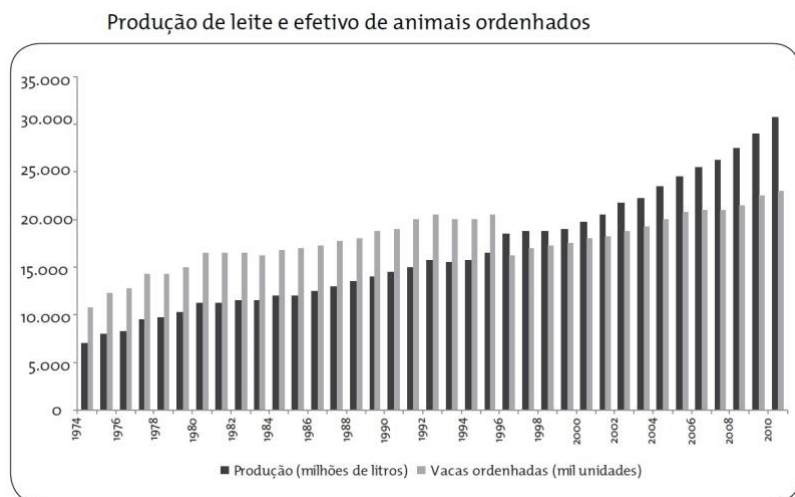
Figure 3. Milk production (dark gray) and amount of cows milked (light gray) over the years in Brazil (1974-2010). Source: MAIA et al. (2013).

In Brazil there is heterogeneity in dairy farms, ranging from less than 10L of milk/day to more than 500L of milk/day. A substantial part is produced in small farms, with almost half producing less than 10L of milk/day – although many of these farmers produce milk for self-consumption (MAIA et al., 2013). Farms that produce between 50 and 200L of milk/day contribute with around 40% of total production and larger farms (around 3% of total) contribute with 35% (see Figure 4) (MAIA et al., 2013). However, in Brazil family farmers produce 60% of the milk in the country according to IBGE (2009) and almost 80% of the milk is produced by small farmers (until 200ha) according to the analysis by Mitidiero Junior et al. (2017), which highlights the

importance of this activity for this category of farmers, and specially small farmers.

Distribuição percentual do número de estabelecimentos e da produção de leite, por estrato de produção
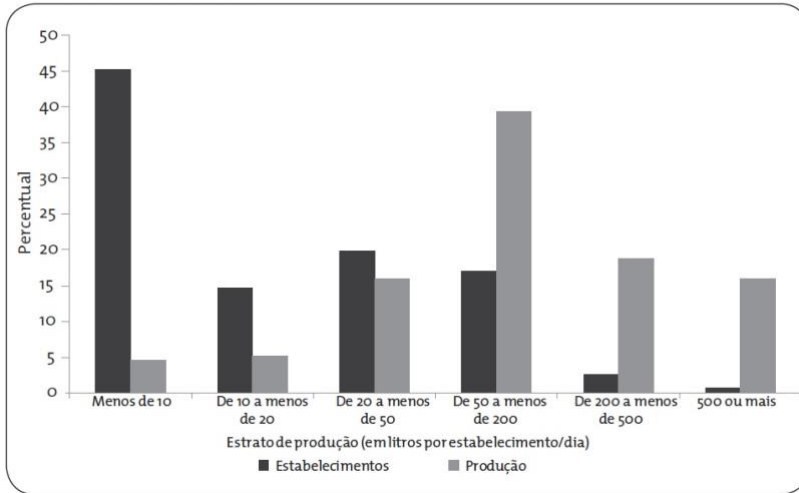
Figure 4. Number of dairy farms (dark gray) and contribution in total milk production (light gray) (in percentage, by amount of milk produced in the farm) in 2006. Source: MAIA et al. (2013).

In northern of Brazil (Pará State) cows produce around 4L of milk/cow/day (DANTAS et al., 2016) whereas in Rio Grande do Sul cows produce around 7L/cow/day (PICOLI et al., 2015), in Paraná 13L/cow/day (LANGE et al., 2016) and in more technified systems in Minas Gerais (total confinement and semi-confinement) milk production is around 15L/cow/day (LOPES; SANTOS; CARVALHO, 2012). This means that in some regions the production is lower than the nationally average (4L/cow/day). The most commonly used breeds are *Bos taurus* like Holstein, Jersey and Swiss brown; and *Bos indicus* breeds, mainly Gir and Guzerá or a crosses between *Bos taurus* and *Bos indicus* (DE ASSIS et al., 2005). For example, *Girolando* is a cross breeding between Gir and Holstein developed in Brazil in 1996 with the aim to increase milk production/animal and to have animals more adapted to the tropical clime (EMBRAPA, 2002). In south of Brazil the majority of farmers use Holstein and Jersey (COSTA et al., 2013), whereas farmers in other regions prefer *Bos indicus* breeds.

Gender is a relevant issue in dairy production in Brazil. In family farms, women have an important historic role. The activity switched to be men controlled by with modernization of milk production, when it became economically important; in general, family farms activities related to self-consumption are more female and activities destined for the market are more controlled by men (DE GRANDI, 1999; MAGALHÃES, 2009). Magalhães (2009) explains that dairy production has a gender division: men participate of meetings, courses and workshops and the bills are in their name; women are responsible of milking and selling cheese when they produce it themselves. This division is not different than what happened in the past; the biggest challenge is that now the money generated by milk is for the "business" and before it used to be managed by the women (DE GRANDI, 1999; PAULILO; DE GRANDI; SILVA, 2003). The role of women and men in milk production is an important issue of gender on family farming and contributes to other contemporary problem, the rural succession. Women have less voice on the family and the daughters have the least significant role in it, which contributes to their desire to leave the farm and go to study and work in bigger cities (MAGALHÃES, 2009). Today the countryside is male and old and the continuity of the milk activity is one of the main concerns for family farmers in south of Brazil (STROPASOLAS, 2011).

In Brazil the dairy processors need to follow governmental regulations with the aim to meet milk quality standards (MAIA et al., 2013). The Inspection Service can be at a federal (SIF), state (SIE) or municipal (SIM) level, and the federal regulations are the most strict. According to IBGE (2017) the larger processors (those that process more than 50,000 L milk/day), are responsible for more than 80% of the raw milk collected in the farms, but represent only 13% of all milk processors in the country; also, 90% of processors sampled by IBGE in 2017 followed the federal regulation (SIF). The 2006 census reported that only 11% of farms had cooling tanks needed to guarantee better quality of milk, although this number is higher in southern region; 13% had mechanic milking, although this number is higher in the southeastern region (20%) and southern region (38%) (MAIA et al., 2013). To improve milk quality, in 2011 the government altered the Normative Instruction (the IN62) making it more strict regarding limits for *somatic cell count* (CCS) and *standard plate count* (CPP, referred to amount of bacteria) than before in the IN52 (BRASIL, 2011b), that had limits are similar to standards of New Zealand, U.S. and E.U.

2.2 MILK PRODUCTION IN THE UNITED STATES

In the U.S., almost 50% of the total milk is historically produced in two regions with one main producer State in each region: the Lake States region with 24%, where Wisconsin State contributed with 14% of the total cow milk produced in the country; and the Pacific region, where California, the major producer, contributed with 19% of the total milk in the country in 2016 (USDA-ERS, 2018b; USDA-NASS, 2014). Milk production contributed with 9% of total U.S. agriculture sales in 2012, making it an important industry for the country. Dairy products include fluid beverage milk, cheese, butter, ice cream, yogurt, dry milk products, condensed milk, and whey products (USDA-ERS, 2018a).

The U.S. became the third largest dairy products' exporter between 2004 and 2014, behind New Zealand and European Union, exporting for many countries, e.g., Mexico, Canada, China, South Korea, Japan and Philippines (CESSNA et al., 2016). Because of the exportations and growing variability in the milk prices and feed costs, which increased the financial risk for dairy farmers, the U.S. government created a voluntary risk-management program called Dairy Margin Protection Program with the aim to provide farmers with financial protection. Basically, this program works offering protection for the farmers when the difference between the U.S. all-milk price and the estimated average feed cost fall below an elected level (for more details, see MACDONALD; CESSNA; MOSHEIM, 2016; and CESSNA et al., 2016).

The U.S. Department of Agriculture (USDA) classifies the farm operations according to herd size: herds with less than 30 cows are considered very small; between 30 and 99 cows, are considered small; 100 to 499 cows are considered medium; and 500 or more cows, are considered large. In U.S. the number of farms is declining but number of cows is increasing; until 1990 most milk came from farms with around 150 cows, whereas today milk comes from farms with around 900 cows; earlier, the farms were managed by family farmers who controlled all production process, and today despite many farms being family operated, they contract workers and buy feed for the cows (MACDONALD; CESSNA; MOSHEIM, 2016). In the following figure (Figure 5) we can note in the first part the number of each category of farm (in heads per farm) and the decrease in the number of small farms (<50-99) over the years. In the second part in the same figure we can note the contribution of milk (in percentage) to the industry by each category of farm: in 1992 farms with up to 99 heads contributed with

approximately half of the milk for the industry and in 2010 large farms (<999) contributed with approximately half of the milk.

According to the Census of Agriculture of 2012, family or individual farmers are 77% of the total dairy farmers and contribute with 45% of milk sales in the country (USDA-NASS, 2014). So, family farms still are the majority of dairy producers in number of farms, but they are fewer in numbers than in the past and they have less cows, so their contribution with total milk commercialized is less than larger farms (MACDONALD; CESSNA; MOSHEIM, 2016). There also larger family farmers: the Economic Research Services (ERS-USDA) defines family farms as those operated by a family in more than 50% of all operations in the farm and controls the enterprise but sometimes they are organized in partnerships (MACDONALD; CESSNA; MOSHEIM, 2016).

Changing size structure of U.S. dairy production, 1992-2012

Head per farm	1992	1997	2002	2007	2012
			Number of farms with dairy cows		
<50	93,118	63,657	48,260	34,338	34,332
50-99	41,813	33,477	25,465	18,986	15,351
100-199	14,062	12,602	10,816	8,975	7,359
200-499	4,652	4,881	4,546	4,307	3,712
500-999	1,130	1,379	1,646	1,702	1,537
>999	564	878	1,256	1,582	1,807
Total	155,339	116,874	91,989	69,890	64,098
			Share (%) of inventory		
<50	20.4	14.5	9.8	7.2	6.3
50-99	29.0	24.5	19.1	13.8	11.1
100-199	19.0	18.0	15.4	12.8	10.6
200-499	13.7	15.3	14.7	13.8	12.0
500-999	8.0	10.2	12.2	12.5	11.3
>999	9.9	17.5	28.8	39.9	48.7
Total	100.0	100.0	100.0	100.0	100.0

Source: USDA, National Agricultural Statistics Service, Census of Agriculture.

Figure 5. Structure changes of U.S. dairy production between 1992 and 2010. Source: MACDONALD; CESSNA; MOSHEIM, 2016.

The majority of cows in U.S. have outdoor access (~60%), but 40% of cows are indoor housed in tie stalls systems – this means that cows are kept tied by a neck chain in a stall (USDA, 2014). Also 20% of

cows are housed in free-stalls with no outdoor access. Almost 60% of milk is considered conventional, which means that forage is harvest and then delivered for the cows; but also the U.S. have grazing and organic production (around 7% each system), and 26.5% are a combination of conventional and grazing systems (USDA, 2014). In the U.S., 86% of cows are Holstein and only 8% are Jersey, and milking is twice per day in 88% of farms (10% perform three milking/day, usually in large farms) (USDA, 2014).

3 POTENTIAL ANIMAL WELFARE PROBLEMS ON MILK PRODUCTION SYSTEMS

This section intends to introduce the main animal welfare problems in commercial dairy farms, i.e., potential management practices that could negatively affect dairy cattle welfare in terms of biological functioning (when the management affects animal's health), naturalness (when animals are unable to express their natural behavior) and affective states (when animals are suffering from pain, hunger or frustration).

The daily routine in a commercial dairy farm is very intense. The cows are milked twice or three times per day, usually with the same interval of time. Thus, if is performed twice/day, the milking is early in the morning or very late in the evening. To be milked, the cows need to be taken to the milking parlor, both in pasture-based or indoor housed systems.

Indoor housing can restrict the movement of the animals because they can be tied, as in almost 40% of operations in the U.S., or free stall where they are kept inside a barn where they can move but in a restricted space. Indoor housing affects animal welfare mainly because it restricts natural behavior and health (CHARLTON; RUTTER, 2017). Lameness cause pain and is the main health problem reported by dairy farms in North America; indoor housing conditions contribute with important risk factors, such as concrete floors, zero grazing, and uncomfortable stalls (VON KEYSERLINGK et al., 2009). The diets based on grains can also causes ruminal acidosis, a metabolic disease related to zero-grazing systems and with low fiber ruminal pH decreases and it stops to work causing discomfort and can lead to death.

Although pasture-based systems could be "animal friendly" because animals could express natural behavior, there are many potential welfare problems, such as pasture seasonality causing hunger and loss of body weight; ectoparasites like flies making the cattle uncomfortable, loss of body weight and milk; and provision of water and shelter for cold, rain and sun, which can affect the animals' thermo-regulation causing stress, dehydration, skin problems and reduce milk production (PINHEIRO MACHADO FILHO et al., 2015). Also several management practices are that used in both systems can affect animal welfare, such as human-animal relationship, or the quality of treatment given to the animal. All of these issues negatively affect animal welfare as a whole – health, natural behavior and pain, hunger, thirsty, and other negative states. In Brazil, in a survey of family farms comparing three

management systems, identified problems related specially to subclinical mastitis, tick infestations, deficiencies in the provision of drinking water and shade, and poor hygiene practices during milking (COSTA et al., 2013). The same study also reported low body condition scores on extensive and pasture-based farms.

Restricted or insufficient drinking water reduces food intake, which affects body weight and milk production, and increases urea in milk and blood (STEIGER BURGOS et al., 2001) that is related to metabolism and could compromise the animal's biological functioning. Drinking water and provision of shade are also related to thermo-regulation, reducing heat stress. Heat stress affects physiology and behavior, changing for example respiration rates, body temperature and negative social interactions (SCHÜTZ et al., 2010). Provision of water *ad libitum* and unrestricted shade are important elements to minimize heat stress and then improve cattle welfare, specially on pasture-based systems.

Other managements are not necessarily linked to any system. Cow-calf separation is a common practice used on dairy farms around the world. Except for some *Bos indicus* breeds like Gir that need their calf to be milked, usually the calves are removed from the cows and housed separated in the first days after birth. This is a contentious practice because there are positive and negative effects on calf welfare. As discussed by Vasseur et al. (2010), early cow-calf separation would be positive to decrease exposure to pathogens, to control feeding including colostrum management and less stressful to break the bond between cow and calf, but would be negative to the lack of maternal care, better weight gain and health, and development of social behavior. Also, a study using a cognitive bias test paradigm showed that calves separated from their dams were more pessimists (DAROS et al., 2014). In southern Brazil 70% of farms separate the calves from the dam until 12h after birth (HÖTZEL et al., 2014) and in U.S. half of farms separate them until 6h after birth (USDA, 2014, p.104).

Feed intake is also other potential problem for calf welfare. Although the general recommendation is to feed 10% of body weight in milk divided in two portions twice per day, studies suggest that calves when fed *ad libitum* can drink twice of this recommendation (20% the body weight) (reviewed by KHAN; WEARY; VON KEYSERLINGK, 2011) and that this recommendation can be causing hunger (DE PAULA VIEIRA et al., 2008). Greater milk consumption reduces age at first breeding (SOBERON; VAN AMBURGH, 2013), improves health, body weight gains, reduces hunger and the ability of calves to express their

natural behavior, thus improving their welfare (KHAN; WEARY; VON KEYSERLINGK, 2011; VON KEYSERLINGK et al., 2009). Calves fed on a bucket instead artificial teats do not satisfy the high motivation to suckle, which causes frustration and increases the occurrence of diarrhea and the possibility of non-nutritive sucking (DE PASSILLÉ, 2001).

Indoor housing provides shelter and protection from climatic conditions, but when it is not appropriated cleaned, it can promote transmission of infectious diseases and diarrhea. Group housing can also increase disease transmission when not properly managed, but promotes play behavior and social interactions, which is important for species that live in groups like cattle. In an interesting approach, it was suggested that social isolation can cause learning deficits on calves (MEAGHER et al., 2015). In south Brazil 40% of calves are fed on the bucket and 70% are single housed (HÖTZEL et al., 2014); in Canada almost 90% of calves are individually housed (VASSEUR et al., 2010), and in the U.S. this is the standard practice (USDA, 2014, p.116).

Dehorning is another management practice that negative affects animal welfare. It refers to the elimination the horns, causes pain at the moment and for up to 48 hours after the proceeding. The practice is broadly used around the world mainly to avoid/minimize injuries for the stockpersons and other cattle of the same herd. Pain can be mitigated with a combination of pharmacological tools (STOCK et al., 2013; WINDER et al., 2018), which are not widely adopted in dairy farms.

The last practice associated to calves and not broadly discussed by animal welfare researchers is the culling of the newborn male calf. As only females produce milk, the male calves are eliminated from the farm, which is an ethical issue involving the production systems and in particular because of the way the calves are culled. In south Brazil where dairy production is mostly conducted by small family farmers, half rear or give away the male calves, but the other half apply different methods to eliminate the calf, including exsanguination, asphyxiation and mainly (80% of farms) blunt force trauma to the head (HÖTZEL et al., 2014). All of these methods cause pain before death, but the main issues that have to be discussed are the ethical implications and possible practical solutions for that.

Finally, one issue broadly investigated and well know by researchers on animal welfare are human-animal relationships. In summary, the quality of treatment that the stockperson give to the animals affects the responses of the animals to the stockperson, in a reinforcing loop, affecting negatively the welfare of both and animal

production when the quality of treatment is negative (i.e., HEMSWORTH, 2003). Much effort is made by training stockpersons to improve the quality of treatment and reduce stress at the farm. On milk production, this is particularly important on the milking parlor. Negative interactions between the stockpeople are negatively correlated with milk yield and quality (HEMSWORTH et al., 2000).

However, changing some management practices could improve dairy cattle welfare, for example the amount and the way of milk is offered for calves. Understanding factors that affect the decision-making of farmers is also interesting and helpful to improve animal welfare. In this sense, production goals, views regarding different type of animals, and culture are some aspects that influence the decision-making of farmers in a dairy farm (CARDOSO; ULLER-GÓMEZ; HÖTZEL, 2012; DRIESSEN, 2012). Also, lack of knowledge and technical assistance are determinants in the management of disbudding/dehorning (CARDOSO; VON KEYSERLINGK; HÖTZEL, 2016) as are the attitudes of extensionists regarding the farmers (HÖTZEL; SNEDDON, 2013).

Moreover, technical recommendations for dairy production often times does not include the studies and recommendations for changing managements to improve animal welfare. This is clear for example on books about dairy production in Brazil that recommend disbudding without any recommendation for pain relief (CARDOSO, 2014). These factors determine the current practices on dairy farms that negatively affect dairy cattle welfare. Studies regarding social aspects that involve farmers, extensionists, professionals, academics and also lay citizens are important to understand the contexts and the reason for current management practices and possible ways to change realities.

4 THE IDEAL DAIRY FARM AND ANIMAL WELFARE ON DAIRY PRODUCTION: RELEVANT ASPECTS FOR STAKEHOLDERS INVOLVED AND NOT INVOLVED WITH AGRICULTURE

In this chapter three studies carried out separately on the topic of the *ideal dairy farm* will be presented. The question "What do you consider to be an ideal dairy farm and why are these characteristics important to you?" was asked to different groups of people in three studies:
• A survey composed by two studies, with Brazilians involved and not involved in the dairy chain: dairy farmers, agricultural advisors and lay citizens;
• Personal interviews involving Brazilians not involved in milk production, complemented with a short questionnaire about animal welfare in the ideal dairy farm;
• An online survey of U.S. lay citizens[1] about the ideal dairy farm.

4.1 THE IDEAL DAIRY FARM IN BRAZIL: RELEVANT ASPECTS FOR DAIRY FARMERS, AGRICULTURAL ADVISORS AND LAY CITIZENS[2]

4.1.1 Introduction

Differences in concerns and opinions about similar issues on the topic of food animal production practices exist between different stakeholders, likely driven by diverging self-interests and values (DOCKÈS; KLING-EVEILLARD, 2006; TE VELDE; AARTS; VAN WOERKUM, 2002; VAN ASSELT et al., 2017; VANHONACKER et al., 2008). Several studies have investigated the views and opinions of lay citizens and consumers (often referred to as the lay public) on the topic. For example, lay citizens frequently associate high standards of animal welfare with higher quality animal products and reject the use of chemicals, including antibiotics and hormones, for purposes of increasing production (BARLOW, 2011; BOOGAARD et al., 2011; CLARK et al., 2016; PIEPER; DOHERR; HEUWIESER, 2016). Also,

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[1] The study with the US citizens was carried out in the context of an exchange in the first six months of the PhD at the University of British Columbia, Canada.

[2] This study was recently submitted in a very similar version and is under review.

there is considerable evidence indicating that lay citizens expect farm animals to be well treated and to live a more natural life (LASSEN; SANDØE; FORKMAN, 2006; PRICKETT; NORWOOD; LUSK, 2010). There are also some accounts indicating that at least some lay citizens perceive farm animals living in conditions that are far from optimal (CLARK et al., 2016; TE VELDE; AARTS; VAN WOERKUM, 2002).

European (EUROBAROMETER, 2007) and U.S. (WOLF et al., 2016) lay citizens believe that farmers have the most influence on determining the welfare of dairy cattle. Farmers have complex views about issues related to animal welfare; for example, they are concerned with production but also recognize animals as sentient beings (CARDOSO; VON KEYSERLINGK; HÖTZEL, 2016; DOCKÈS; KLING-EVEILLARD, 2006; WIKMAN et al., 2013). Furthermore, mixed motives appear to influence their decision-making regarding farm animal management (DRIESSEN, 2012) and their representations of animals and animal welfare (DOCKÈS; KLING-EVEILLARD, 2006). Not surprisingly, compared to lay citizens, farmers express less concern over some aspects of animal welfare, for example the ability to engage in natural behaviors, aspects related to pain, stress and the availability of space (VANHONACKER et al., 2008). Given these differences it is not surprising that lay citizens and farmers tend to rate dimensions of animal welfare differently (LASSEN; SANDØE; FORKMAN, 2006; TE VELDE; AARTS; VAN WOERKUM, 2002; VANHONACKER et al., 2008).

Others that potentially impact the management of dairy farms are their advisors, such as the agriculture extension agents, nutrition consultants, herd veterinarians, animal scientists, and hoof trimmers, who may or may not have a direct financial interest in the farm. Given their important advisory role it is surprising that there are only a few studies summarizing the views of this important stakeholder group (e.g., reviewed by CORNISH; RAUBENHEIMER; MCGREEVY, 2016; and SUMNER; VON KEYSERLINGK; WEARY, in press). The limited work to date indicates that agricultural extension agents prioritize animal health and production over other aspects of animal welfare goals (CANTRELL; LUBBEN; REESE, 2013; HÖTZEL; SNEDDON, 2013). Veterinarians working in Europe indicate that regulations or voluntary incentives are important to motivate adherence to animal welfare standards by farmers, but also that improved communication between farmers and veterinarians is needed (VENTURA et al., 2016b).

Encouraging engagement among different stakeholders to identify similarities (and differences) in views and opinions is a viable vehicle to identify sustainable practices in animal production (DRIESSEN, 2012; HÖTZEL, 2016). Considering the different perspectives that permeate the discussions about dairy farming and the scarce knowledge of the attitudes and views of stakeholders that work directly with the dairy chain, as well as lay citizens in Brazil (RUCINQUE; SOUZA; MOLENTO, 2017; VARGAS-BELLO-PÉREZ et al., 2017; YUNES; VON KEYSERLINGK; HÖTZEL, 2017), we set out to investigate the views of these three different stakeholders. The aim of this study was to explore the shared and divergent views amongst Brazilian dairy farmers, agricultural advisors and lay citizens on what characteristics they viewed were most important on an ideal dairy farm, and their associated reasons.

4.1.2 Material and methods

This study was exploratory in nature and was based on a qualitative methods that assumes that a convenience sample provides a rich and diverse set of responses when saturation on the proposed topic is achieved (ROBSON; MCCARTAN, 2016). To understand the views of Brazilians involved and not involved in animal production we surveyed: 1) dairy farmers, 2) agricultural advisors, and 3) lay citizens. Surveys participants were 18 years or older, participated voluntarily and remained anonymous. Each participant received a consent form that they were asked to read and, if they agreed to participate, were required to sign before they began the survey. The research protocols used herein were approved by the Ethics Committee of Research with Human Beings of Federal University of Santa Catarina, Brazil (1539053 and 1248867).

We invited participants to respond to a single open-ended question: "How do you imagine an ideal dairy farm and why are these characteristics important to you?". This was followed by multiple-choice demographic questions (age, sex, education, area of residence and involvement in animal production). Our intention was to reach a diverse group of respondents, so we recruited participants through different channels.

Dairy farmer's and agricultural advisor's recruitment
Given their close working relationship dairy farmers and agricultural advisors were recruited using the same vehicles. Some

participants within these two groups (n=112) were recruited through two dairy production portals that have national coverage, Milk Point (milkpoint.com.br) and Revista Leite Integral (revistaleiteintegral.com.br); both of these were linked to the online questionnaire via their Facebook page. Some participants (n=148) were recruited via social media, through links obtained via the PhD student, who sent the online questionnaire invitation via social media links such as Facebook and WhatsApp and e-mail groups with interests in veterinary, agronomy or animal science. Finally, an additional 17 dairy farmers were recruited at a dairy cattle conference held in the city of Castro. All participants included as either farmers (n=107) or advisors (n=170) had self-identified as having some involvement in animal production. Participants that self-identified as being both farmer and advisor (n=46) were considered as farmers.

Lay citizens' recruitment

Lay citizens (n=280; people who self-identified as having no involvement in animal production) were recruited at the Hercílio Luz International Airport (Florianópolis, Brazil). The airport location was chosen due to the intense movement of middle class people (ANAC, 2014) of both sexes and different ages. People in the airport hall that were waiting for flights or for arriving passengers were approached and invited to participate in the study by asking if they were interested in voluntarily answering a short questionnaire covering the general theme "animal production". The responses were transcribed into a digital document.

Thematic analyses

The responses of the 3 groups of stakeholders were analyzed separately. We used the NVivo Qualitative Data Management Program (version 11, 2015; QSR International Pty Ltd., Doncaster, VIC, Australia) to organize the data and code the answers. Characteristics and reasons given for what constitutes an ideal dairy farm were analyzed together to contextualize the presented characteristics. We performed a thematic analyses, the most commonly used method in qualitative research, as it is useful to capture complexities of meanings in text data (GUEST et al., 2012). This method consists of describing ideas arising from the transcriptions that arose through the data collection period, identifying themes using a codifying process and involves careful reading and rereading of the transcriptions, identification of key words, phrases, trends and themes (GUEST et al., 2012). The specific steps for

this type of analysis are: data reduction (information is coded finding themes); data display (organization of the information allowing for conclusions to be drawn); and conclusion drawing and verification (noting of patterns and themes and using confirmatory tactics such as triangulation between three readers) (HUBERMAN AND MILES, 1994). The PhD student plus two trained researchers independently examined 30 randomly selected responses from each stakeholder group with the aim to improve reliability in the analysis. The individual responses were broken down into phrases, which were then codified into themes. The three readers compared results and reconciled any discrepancies and the PhD student then undertook the remaining analyses. Many responses bridged more than one theme and were thus coded into multiple themes. Quotes that were representative of specific themes that appear in the paper were translated to English.

4.1.3 Results

The demographic profile within each group of participants is presented in Table 1. The majority of dairy farmers lived in rural areas, whereas the majority of agricultural advisors and lay citizens lived in urban areas. In general, lay citizens' age and sex were well distributed according to the latest Brazilian census (IBGE, 2012). In contrast, the majority of farmers and advisors were male. The high proportion of male farmers is in accordance with the last Brazilian agricultural census that reported that 87% of people primarily responsible for the farm unit are men (IBGE, 2009). Most participants in all 3 groups were highly educated, with at least a bachelor's degree.

We identified five common themes in the responses of all stakeholders: milk quality; animal welfare; economics; societal; and environmental issues (Figure 6).

Table 1. Participants' demographics (values in percentage).

Demographics	Variable	Farmers (n=107)	Advisors (n=170)	Lay citizens (n=280)
Age (year)	18-24	7	14	16
	25-34	33	37	24
	35-44	28	25	25
	45 or above	32	25	35
Sex	Male	85	60	48
	Female	15	40	52
Education	Elementary school	17	2	18
	Technical degree	9	7	9
	Bachelor's degree	47	39	45
	Graduate degree	27	52	28
Area of residence	Rural	67	31	12
	Urban	33	69	88
Involvement in animal production	Dairy farmers	100	0	0
	Veterinary, agronomist, animal scientist or technician	0	70	0
	Student or professor in agriculture sciences	0	23	0
	Professional of the dairy chain	0	7	0
	Not involved	0	0	100
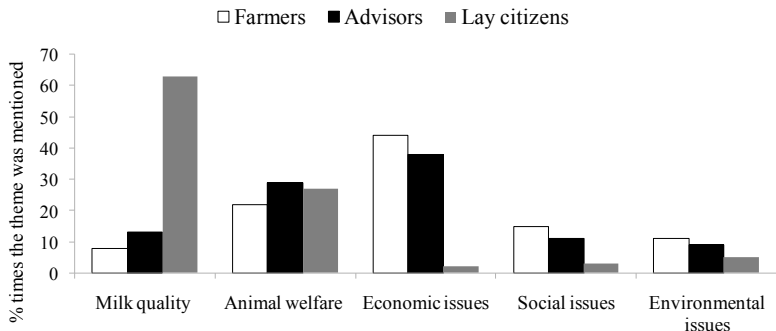
Figure 6. The percentage of times a particular theme was mentioned by either the dairy farmers (n=107, white bars), dairy advisors (n=170, black bars) or the lay citizens (n=280, gray bars) in response to being asked to the single open ended question.

The main characteristic of an ideal dairy farm, according to farmers and advisors, were related to factors that they perceived to affect profitability, such as production, productivity (Figure 7A and 7B) and "economic viability" (Farmer 12), e.g., "[A farm with] good profitability, good productivity, lots of efficiency" (Farmer 31); "[An ideal dairy farm is one where] increases in productivity lead to more profit to farmers" (Advisor 15). Farmers producing all the necessary

resources needed on the farm was often mentioned, "[A farm] should be self-sustaining, and produce manure, pasture, cereals, electricity (…)" (Farmer 38); "Ideally a self-sustaining system, that is, one that produces absolutely no impact and can rely exclusively on resources generated by the farm" (Advisor 24). Efficiency was used in terms of use of resources, [A farm that has] high efficiency in the use of available resources, like land, water, labor, etc." (Farmer 3); "I imagine an ideal farm producing milk at low costs, which means pasture based, but with technology, to be an efficient system" (Farmer 93).

Farmers and advisors often cited elements that in their understanding increase productivity, such as genetics, reproduction, feeding (nutrition), farm management, good workers, facility cleanliness, and type of housing.

Milk quality was mentioned as a key characteristic of an ideal dairy farm, e.g., "To me the ideal dairy farm should primarily be dedicated to produce high quality milk..." (Farmer 10); "[An ideal dairy farm is one that] produces high quality milk for human consumption" (Advisor 12). Four advisors were concerned about the overuse of chemicals by farmers: "Agroecological production because it does not contaminate the milk with insecticides and other chemicals" (Advisor 80); "...without hormones, just homeopathy (or antibiotics in case an animal's life is on risk, for example)" (Advisor 115).

Farmers and advisors also cited the term animal welfare many times (e.g., "Milk quality and animal welfare should be priorities…" (Farmer 85). The term was often associated with facilities and management: "[The farm] needs to provide welfare to the animals, but not just the climate comfort aspect that significantly affects production, also with rational management, without any violence with the cows." (Farmer 41); "...animal welfare, in terms of facilities as well as management..." (Advisor 46). Animal comfort was related to animal housing and productivity, "[an ideal dairy farm] ...respects housing conditions and comfort to the animals" (Advisor 136); "Where the animal has maximum comfort to produce its maximum..." (Farmer 106). Only a few demonstrated concern about the affective states of animals, for example, "An adequate environment for the animals and for the workers. It does not matter if it is pasture or confinement, the cow should have high quality food, water, a place with shade to rest, good milking management and, when necessary, fast and efficient interventions to avoid animal suffering" (Farmer 126); "Where animals are respected, not just used..." (Advisor 61).

Some participants of these groups showed awareness that animal welfare and environmental concerns are characteristics demanded by the lay citizens, e.g., "An ideal dairy farm should have specialized workers and management based on animal welfare (...) I believe that this is a great basis for dairy production because it will meet, in the future, the expectations of consumers, besides being ethically coherent with the modern concepts of animal production (Advisor 3). Environmental issues were discussed broadly in terms of the farm practices adhering to legislation, avoiding harm and preserving the environment, "…ecologically correct. With the best possible use of energy and natural resources" (Farmer 54).

Pasture based systems were cited by both advisors and farmers, who listed a range of benefits in terms of production, profitability, animal welfare and environmental sustainability: "Shade, water and pasture during the day and night. This is the only way the animals can be free to express their natural behavior" (Farmer 127); "I imagine an ideal farm producing milk with low costs of production, which means, pasture based..." (Farmer 93); "...an ideal dairy farm has pasture based production, because it has less workload..." (Farmer 92); "Pasture based milk production because I believe that this model could generate the best result for the farmer" (Advisor 121); "Pasture based - it is important to ensure environmental sustainability, soil fertility, quality of pasture and year-round production" (Advisor 57).

Farmers and advisors placed great emphasis on the quality of life of farmers and workers. They cited characteristics like wellbeing of people, quality of life, comfort, happiness, social responsibility, dignity, and the need for rest on weekends and vacations, e.g., "The family or people involved on that work must have vacations and guarantee for salary so they can they live well, with health insurance, good housing and leisure" (Farmer 96); "[A dairy farm that] can warrant dignified conditions and less workload for the workers" (Advisor 73). Also, advisors expressed a specific concern about rural succession, e.g., "An essential issue is to support youth, they will ensure continuity of the work; they should be supported to continue in the business and ensured that is life quality in the countryside" (Advisor 48). Some justified profitability as a desired feature due to social concerns; "[With] profitability the producer can invest in the activity and provide higher quality of life for himself and his family" (Farmer 36); "Good productivity and profit to provide comfort and quality of life" (Advisor 10). One advisor commented about gender differences in leadership

roles on dairy farms, "I would like that women had power of decision in this activity [dairy] and not just the 'family men'" (Advisor 63).

Technology was discussed as an important tool to reduce workloads and ease management, and participants often mentioned it in reference to employees or family workers: "Farm routines with as much automation as possible throughout the entire production process will improve work efficiency, thus allowing time for the small producers to rest" (Farmer 32); "Tools, technologies and equipment better adjusted to the economic reality of rural properties, to reduce excessive workload, often hard work, and to improve the quality of life of the producer" (Advisor 33).

Lay citizens' aspirations regarding the ideal dairy farm

Lay citizens focused their comments mainly on milk quality and concern for the animals (Figure 7C), e.g. "The ideal would be one [farm] concerned with milk quality and with the animals" (Citizen 108), and frequently linking both, e.g. "A farm that allows good animal welfare (...) because I believe that milk quality has a direct association with animal welfare" (Citizen 63); "[An ideal dairy farm] with healthy cows because their quality of life impacts the production of healthy milk" (Citizen 117).

More than half of the lay citizens cited milk quality, many of them justifying as important for people's health, e.g., "[A farm] ...that produces milk with good quality for my health" (Citizen 213). Additionally, overall hygiene and cleanliness of facilities, stockmen, cows and tools/instruments used during milking were relayed numerous times, particularly in relation to cleanliness being important for milk quality, e.g., "[An ideal dairy farm] should take care with hygiene to not contaminate the milk" (Citizen 2). Assurance of high milk quality also came with an expectation that the farm was automated and that workers were well trained in how to maintain food safety, e.g., "[A farm that is] clean, with trained workers using individual protection equipment, without human hands in contact with milk..." (Citizen 55); "I believe that the farm would have to be all automated to avoid risks of contamination" (Citizen 211), and that there was oversight providing assurance on this issue, e.g. "[A farm] with better supervision of milk quality and hygiene" (Citizen 57). Some people commented that the ideal dairy farm should be organic, "[A farm] with fully organic inputs and oversight is important given the current reality of milk adulteration, and mainly to ensure healthier products" (Citizen 256). Abstaining from using chemicals in dairy production was often mentioned by the lay

citizens; milk should be produced using less or no hormones, antibiotics, preservatives, pesticides on the pasture, or other additives or chemical products, e.g., "[A farm] without hormones; other medicines like antibiotics should only be used if there is a bacterial infection; pesticides should be avoided and just used if there are no other treatment options" (Citizen 200). These factors were important for milk quality and food safety, e.g. "It is important that high quality milk be produced, without pesticides and other elements that are found illegally in the milk today" (Citizen 25) and "Free of pesticides that are harmful to human's health" (Citizen 197).

Lay citizens that answered our question also made frequent mention of terms or phrases associated with naturalness, e.g., "[A farm] ...without many antibiotics, hormones (…). As natural as possible" (Citizen 234); "...I believe the more natural, the better the final product" (Citizen 180). Others associated naturalness with a process that resulted in milk from cows that were not forced in any way; "...ideally, natural animal production should be maintained, without any ways that force it and impair its' essence" (Citizen 142); a more natural management, "Less stressful and anti-natural management as possible" (Citizen 197); a natural environment for the cows, "...more natural pasture" (Citizen 275); "...dairy cattle reared in their natural environment because to me it is important to know that the milk that I consume has a good origin" (Citizen 216); and not from an industrialized farm, "I imagine that an ideal farm seeks to keep the place as natural as possible. (...) There is so much industrialization in milk production and this is bad" (Citizen 118). Cows' should be able to feed naturally, e.g. "[An ideal dairy farm is one that has] adequate pasture and feeding, as natural as possible" (Citizen 78). The preference for pasture was often coupled with providing a better life for the cows; "Where the cows stay untied, on pasture, able to feed and walk naturally. Because I think that freedom should not be denied to any animal" (Citizen 54); "[A farm with] extensive rearing, natural pasture, so that animals are not stressed" (Citizen 115).

Lay citizens were concerned about the quality of treatment given to animals, often citing ethical arguments specific to ensuring that animals were free from mistreatment, stress, pain and suffering: "Where the animal is not mistreated..." (Citizen 18); "Is important to me because I want pure milk for consumption, without animal mistreatment" (Citizen 91); "...Animals without stress or trauma; because the animals' welfare comes first, before human needs" (Citizen 93). For lay citizens animals should be treated with respect, care, and affection, e.g., "...treating the animals well, with music…" (Citizen 60); "I would

expect respect for the animals" (Citizen 161); "...special care and affection for animals" (Citizen 56). Participants also spoke about animals having a good life and being able to live in a comfortable environment, with enough space, without machines, with their calves, and with freedom; "I believe that an ideal farm should have enough space for the animals to have some life quality" (Citizen 11); "I imagine a big farm where the animals can graze and walk, not where they are confined, and where they are taken (by someone that likes animals) for milking by hand or by machines and equipment that doesn't hurt them" (Citizen 166); "I've seen media reports and it scares me the amount of machinery that is used. It should be something more humane for the cows" (Citizen 34); "[A farm with] animals free on pasture, confined just for a brief period, calves with their mothers as long as possible. Animals have feelings just like us and therefore I believe it is important that they live as happy and healthy as possible" (Citizen 130).

For a few lay citizens, the ideal dairy farm was one that had practices that were environmentally friendly. Phrases such as concern, respect and protection of the environment were used; "...the environment is essential for our future and of other beings" (Citizen 223) and "A farm that is innovative and is paying attention to preserving the environment in a sustainable way" (Citizen 17). In essence, many of the citizens wanted it all: "An ideal dairy farm should be concerned not just with the final product that is marketed, but also with the welfare of the animals, the environment, and the producer" (Citizen 162).

Figure 7. Word clouds generated using the 25 most frequent words generated by each of the stakeholders in response to the main question. The words appearing in larger bolder type were used most frequently.

4.1.4 Discussion

Although all 3 stakeholder groups cited milk quality; animal welfare; economics, societal and environmental issues as important, they placed different emphasis on each of the themes. Whereas the lay citizens highlighted milk quality, both the farmers and advisors spoke mostly about economics. When considering only animal welfare, we also noted differences in terms of the weighing of the different constructs of animal welfare (see FRASER et al., 1997): the farmers and advisors primarily referred to aspects related to biological functioning while the lay citizens emphasized affective states, good treatment of animals, and naturalness.

When asked their views on what constitutes an ideal dairy farm the responses from the farmers and advisors were very similar, but different from the lay citizens. Van Asselt et al. (2017), who surveyed Dutch citizens, poultry farmers and poultry veterinarians about health and food safety comparing indoor and outdoor systems, reached the same conclusion. Differences in perceptions between farmers and citizens have been reported previously (e.g., BENARD; DE COCK BUNING, 2013; TE VELDE; AARTS; VAN WOERKUM, 2002). According to van Asselt (2017) affect, stigma and underlying values influenced the different perceptions of farmers, veterinarians and citizens.

All 3 groups made reference to animal welfare but placed different emphasis on the three constructs – biological functioning, affective states and animals' ability to live a natural life (FRASER et al., 1997). Farmers and advisors clearly assessed the use of animals from an utilitarian approach, whereas the lay citizens took on a deontological approach. The lay citizens were most concerned with the quality of treatment given to the animals and naturalness, only referring to biological functioning as it related to milk quality. This is in line with previous reports indicating that citizens are primarily concerned with farming practices that they perceive to influence affective states of the farm animals (VANHONACKER et al., 2008), the way animals are treated (TE VELDE; AARTS; VAN WOERKUM, 2002), and with naturalness (LASSEN; SANDØE; FORKMAN, 2006; PRICKETT; NORWOOD; LUSK, 2010). Although the developing countries have been slower to document these types of concerns (VARGAS-BELLO-PÉREZ et al., 2017; VON KEYSERLINGK; HÖTZEL, 2015), recent studies (RUCINQUE; SOUZA; MOLENTO, 2017; YUNES; VON

KEYSERLINGK; HÖTZEL, 2017) suggest that animal welfare is becoming an increasingly important topic in Brazil.

Most farmers and advisors participating in our study limited their discussion to issues related to the biological functioning construct of animal welfare, frequently referring to basic health and good facilities, without any explanation of why these characteristics would be important for the farm; only a few farmers and advisors demonstrated concern about the affective states of the animals. Others have also reported that farmers and extension agents place greater emphasis on biological functioning (e.g., CANTRELL; LUBBEN; REESE, 2013; TE VELDE; AARTS; VAN WOERKUM, 2002; VANHONACKER et al., 2008). Farmers and advisors often related animal welfare to the available physical environment, such as providing a comfortable place for the animals. This arguably narrow view of animal welfare focusing on health and biological functioning is commensurate with the traditional focus of teaching of traditional animal science programs that have a disciplinary focus, i.e. nutrition, genetics, and economics.

Agricultural advisors play an important technical support role in farmers' activities, which places them in potentially influential positions to help guide the dairy chain. However, our study suggests that they will likely have little influence in aiding farmers when external social demands are placed upon them by changing societal values. Given that many advisors have an inherent conflict of interest it is not surprising that they portray very similar views to that of their primary client – the farmer. This is one of three scenarios presented by Meijboom (2017), who argue that veterinarians working on food production have to be independent from the concerns and interests of other stakeholders (e.g., the farmers and lay citizens), to deal with ethical challenges such as animal welfare; they should be capable to deal with different and divergent values of those stakeholders and advise governments to make regulations (see more on MEIJBOOM, 2017). For advisors to help drive change, particularly in regard to those practices that have an ethical component, such as sustainability or animal welfare, we suggest that they will need to internalize a broader concept of these issues that takes into consideration the expectations of the broader society.

Although milk quality was the primary concern raised by the lay citizens, farmers or the advisors rarely mentioned it. When referring to milk quality the lay citizens also clearly articulated that to achieve high standards of milk quality other features such as hygiene, cleanliness, animal welfare, animal health, legislation, and trained workers were important. Again, the farmers and advisors failed to link these

characteristics with milk quality, and only a few farmers linked them with productivity. Growing public demand for healthy food (ARVOLA et al., 2008; DEAN et al., 2012; GUIVANT; MACNAGHTEN, 2015; O'BRIEN et al., 2014) and global concerns for farm animal welfare have received much attention (see also CLARK et al., 2016). Lay citizens' emphasis on milk quality and the need for strict sanitary conditions and government regulations, may reflect in part the reporting of milk adulteration scandals that occurred in Brazil in recent years (DEBONA, 2014; FOLHA, 2007; LEHMEN, 2017), a topic that was specifically referred to by some of our lay citizens. That the farmers and advisors failed to show similar concerns may be explained to some degree by the milk alteration events being viewed as issues that are post farm gate. It is also concerning that milk quality measures taken on a large proportion of farms in Brazil are below government quality standards (BALCÃO et al., 2017; BRUZAROSKI et al., 2017; OLIVEIRA et al., 2011; PAIXÃO et al., 2017).

Naturalness, cited by the lay citizens as an important characteristic of dairy farming, is a highly praised topic by the lay public around the world (LASSEN; SANDØE; FORKMAN, 2006; PRICKETT; NORWOOD; LUSK, 2010). Normally citizens associate a preference for access to pasture for cattle with naturalness (BOOGAARD; OOSTING; BOCK, 2008; ELLIS et al., 2009; HÖTZEL et al., 2017; MIELE et al., 2011). Most interesting in our study was that all 3 stakeholders considered pasture based systems as the ideal rearing system for dairy cattle but they differed in why they viewed it to be important. Lay citizens cited naturalness, whereas both advisors and farmers emphasized potential benefits for milk production, the animals, the farmers, and the workers. This support for pasture by all stakeholders is promising when considering that more than 80% of cattle production in Brazil currently takes place on pasture (IBGE, 2009).

Another key aspect associated with naturalness by the lay citizens was the rejection of the use of antibiotics and hormones, and pesticides, an issue considered important by lay citizens in other studies (CLARK et al., 2016; HÖTZEL et al., 2017; PIEPER; DOHERR; HEUWIESER, 2016). Consumers' rejection of antibiotics and hormones is often associated with preference for naturalness of the system and product quality (CLARK et al., 2016), and a criticism to modernity (BOOGAARD et al., 2011). Although the farmers and the advisors demonstrated that they are paying attention to public and market demands, by recognizing that animal welfare and product quality are

important on an ideal dairy farm, they rarely made reference to the use of antibiotics and hormones. The fact that neither the advisors nor the farmers appeared to be concerned about antibiotics is worrisome when one considers the concern shown by international organizations on the need to reduce the use of antibiotics in livestock (FAO, 2018a; VAN BOECKEL et al., 2017). Advisors are in a unique position to contribute to this effort and, according to Magouras et al. (2017), understanding their attitudes on this topic is a major step towards reducing antibiotic resistance. Clearly, different stakeholders assess the use of antibiotics and hormones as tools for animal production from different perspectives and with a different knowledge base (BARLOW, 2011; PIEPER; DOHERR; HEUWIESER, 2016). In view of the growing international interest in this issue, it is likely that changes will be required; thus, both the farmers' and their advisors' attitudes should be explored as to prevent them from being barriers for change.

The lay citizens associated modern farm equipment and technologies with high milk quality. In contrast the farmers and the advisors both associated the implementation of technology with social issues from a worker perspective, namely that technology decreases their workload making the work easier, which in turn improves the quality of life of both farmers and workers. The debate regarding modernity in agriculture (BOOGAARD et al., 2011; FRASER, 2008; THOMPSON, 2012) is worthy of further discussion. According to Boogaard et al. (2011), society shows ambivalence towards modernity in farming systems, criticizing the loss of naturalness, traditions and values in food production and the perceived negative effects on nature and animals, while appreciating the improvements in food quality and food safety. It is interesting that lay citizens participating in our survey showed this same complexity and ambivalence. Thompson (2012) argues that different people have different points of view about agriculture, ranging from an industrial view to an agrarian view. In our study lay citizens took on a more agrarian view when citing characteristics related with naturalness and concern regarding animals, but not exclusively, as they also took on an industrial view when citing that the implementation of technology assures milk quality. Not surprisingly, the farmers and advisors praised characteristics of a dairy farm that reflected an industrial view of agriculture – using words such as efficiency, profit, and technology – but their associated reasons clearly reflected their interests in reducing work loads and ensuring a better quality of life for rural people living and working on farms, aspects that arguably also reflect an agrarian view of agriculture.

The farmers and the advisors showed considerable concern for the quality of life of the people who are directly involved in the daily running of the dairy farm. Some of them discussed family succession, likely reflecting their concerns about securing a future for agriculture (in this case, dairy production). Productive, economic and social conditions determine the willingness of the next generation to stay at the farm (SPANEVELLO, 2008). Internal family conflicts and the hard work – which includes working on weekends and holidays but does not result in extra income – act as deterrents for the young preventing them from remaining on the family farm (STROPASOLAS, 2011). The creation of a special policy referred to as the National Plan of Youth and Rural Succession (MDA, 2015) shows the dimension and contemporaneity of this issue in Brazil. Succession within family farming is particularly important in the dairy chain given that family farms produce 60% of the milk in Brazil (IBGE, 2009).

All 3 groups of stakeholders commented that the ideal dairy farm should take into account aspects related to the environment. The debate regarding the negative environmental impacts of livestock production is complex, with no clear and easy solution. For instance some solutions could result in social problems, for example loss of livelihood for people that depend of livestock (STEINFELD, 2006), but resonate with consumers and environmental advocates. Considering the complexity of these issues (VAN CALKER et al., 2005) it follows that solutions must consider all three aspects for sustainability (i.e., economic, social and ecological).

We surveyed 3 separated groups of people with the aim to identify topics that were of interest to them when asked about an ideal dairy farm and their subjacent reasons. This type of work does not make statistical inferences regarding differences among these groups but does play a key role in generating data for other researchers to help guide future investigations (GUEST; MACQUEEN; NAMEY, 2012). In this way, we suggest that complementary studies could include investigating the views of specific types of farmers and their associated stakeholders (i.e. corporate agriculture businesses or small family farmers, organic producers, etc.), but also quantitative approaches using representative samples, or qualitative methodologies that allow different stakeholders to present and discuss their views.

Additionally, we must consider that 85% of our farmers were men, while the groups of advisors (40% women) and lay citizens (52% women) were more balanced by sex. Just one participant, from the advisor group, mentioned the issue of gender in dairy farming; a factor

that is known to influence the attitudes of people, especially regarding animal welfare. Clark et al. (2016) in their review of 80 studies indicated that women generally are more concerned about animal welfare than men, and will have more negative attitudes towards modern farming. In Brazil, particularly in the case of family farms, women have long played an important role in dairy production (MAGALHÃES, 2009). Readers should therefore consider this aspect of gender when interpreting our results. We also encourage future work on the issue of gender, particularly among family run dairy farms and the potential role that this factor may play when advocating for change.

4.1.5 Conclusions

Our findings suggest that the aspirations regarding an ideal farm of dairy farmers and agricultural advisors are very similar with both groups placing great emphasis on economics. In contrast the lay citizens reported milk quality as their primary concern, an issue rarely mentioned by the other 2 stakeholders. All stakeholder groups mentioned animal welfare as a major concern, although they differed in the emphasis placed on the different constructs of animal welfare. Overall our findings highlight a number of disconnects between the expectations of the lay public, dairy farmers and agricultural advisors. We suggest that dairy farmers and agricultural advisors should both reflect on the desires of the lay public in what they view to be an ideal dairy farm, as this may help bridge some current disconnects.

4.2 BRAZILIAN CITIZENS' EXPECTATIONS REGARDING ANIMAL WELFARE ON DAIRY PRODUCTION AND OPINIONS REGARDING CONTENTIOUS HUSBANDRY PRACTICES[3]

4.2.1 Introduction

Over the past 50 years, animal advocacy groups and concerned citizens have increasingly questioned intensive animal production practices (VON KEYSERLINGK; HÖTZEL, 2015). In some countries this has led to regulations governing how animals must be cared for on farms (e.g. New Zealand, the E.U.), while in other countries, particularly the U.S., corporations have exerted pressure for improved changes (CENTNER, 2010; FRASER, 2006; TOMASELLI, 2003). For example, U.S. retailers such as McDonald's and Walmart announced that after 2015 they will no longer source eggs from farms that use cages (HSI, 2016; LYMBERY, 2016). The United Egg Producers in the US also recently announced that they would eliminate the practice of euthanizing male chicks (UEP, 2016). A similar agreement The German Parliament has also stated that they will no longer euthanize male chick immediately following hatch (OSTERATH, 2016). The European Union has also announced that surgical castration of pigs without anaesthesia will be phased out by 2018 (E.U., 2017). Similar changes have been seen in other parts of the world, for example, in Brazil, where existing regulations do not specify mandatory standards of care for specific farm management practices (CASSUTO; ECKHARDT, 2016). Large processors in Brazil including Aurora, BRF and JBS have announced that they are phasing out sow' gestation crates (AURORA, 2015; BRF, 2017; JBS, 2016). This demand for change has resulted in Brazilian animal agricultural industries having to rethink their practices.

Given that these changes can also create upheaval for the farmers it is important that we continue to try to understand how the public views farming practices. Clearly, if we are able to anticipate practices

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[3] Two versions of this study were published at proceedings: 1) in the Proceeding of XXIV Congress of Latin-America Association of Animal Production (ALPA) at Chile, November of 2015: *Brazilian citizens' views on dairy production* and 2) in the Proceedings of the 7th International Conference on the Assessment of Animal Welfare at Farm and Group level (WAFL) at Netherlands, September of 2017: *Brazilian citizens: Expectations for dairy cattle welfare and awareness of contentious practices*. A similar version was published in Animals: *Brazilian citizens: Expectations regarding dairy cattle welfare and awareness of contentious practices* 7(12), 89, 2017.

that may be potentially contentious then we can arguably pursue sustainable options that work for the farmers, the animals and resonate with societal values (WEARY; VENTURA; VON KEYSERLINGK, 2016). Failure to do so can result in situations where the public may boycott products or support legislation that sets out to ban certain practices but that may not necessarily work for the farmers or the animals under their care. Public acceptance is an essential component of the sustainability of the food animal industries (BROOM, 2010; TUCKER; MENCH; VON KEYSERLINGK, 2013; VON KEYSERLINGK et al., 2013).

Little is known about the views of citizens from developing countries, such as Brazil, regarding animal production systems (CLARK et al., 2016), specifically if animal welfare is an important issue for them when considering specific animal production systems. Bonamigo et al. (2012) showed that despite Brazilian consumers initially not being concerned about the welfare of broilers, they reversed their position once they were informed about how chickens are raised for meat. Similarly, Souza et al. (2013) reported that participants changed their perception about meat consumption after seeing images regarding mistreatment of farm animals. Brazilian citizens were also shown to prefer free-range, cage-free, and more natural production systems when asked their views about different production practices used to raise laying hens, beef cattle, pregnant and lactating sows, and poultry meat (YUNES; VON KEYSERLINGK; HÖTZEL, 2017). Finally, the majority of Brazilian citizens surveyed by Hötzel et al. (2017) rejected two common practices used in the dairy production, zero-grazing and cow-calf separation for animal welfare reasons. Indeed if animal agriculture industries are to remain sustainable in the long run, they must work towards implementing practices that resonate with societal values.

Our overall aim was to explore attitudes of Brazilian urban citizens about dairy farming. Using a convenience sample we performed two studies, both designed to gain insights into what Brazilians viewed to be an ideal dairy farm and the second, to assess awareness and acceptability of four potentially contentious husbandry practices routinely used in dairy production.

4.2.2 Material and methods

This study used a mixed-methods approach, which combines collection and analysis of quantitative and qualitative data, as explained

in the appropriated section of this thesis. The first part of this work involved in-depth interviews that made use of open-ended semi-structured questions designed to elicit the participants' views and attitudes about dairy production in Brazil. The second part made use of a questionnaire that had an open-ended question that allowed the participant to convey their views on dairy cattle welfare. This was followed by multiple quantitative questions designed to determine the participant's awareness about specific dairy production practices.

We used a convenience sample of Brazilian urban citizens that were 18 years or older, self-identified as not being involved in dairy production, and balanced for gender. The number of participants interviewed (n=40) and for the questionnaire our goal was to collect information from a sufficiently diverse group of participants, so our sample size of 300 for the questionnaire was based in part on previous work (HÖTZEL et al., 2017) that collectively mirrored a representative sample of the population living in the south region of Brazil (IBGE, 2012).

The Ethics Committee of Research on Humans of the Federal University of Santa Catarina, Brazil – protocol number 1.195.546 and 1.538.926 – approved both studies. All research participants were recruited at the Hercílio Luz International Airport, in Florianópolis, Brazil, given that this location facilitates an intense movement of people. People waiting for flights or passengers in the public area before security in the airport lounge were invited to voluntarily participate in the study. People who self reported as not being involved in dairy production, and who agreed to participate after they had been told that we would need about 15 minutes of their time, were invited to participate in the study.

Study 1: in-depth interviews

Immediately after approaching a potential participant the researcher asked whether they were interested in participating in a research study. If a positive answer was obtained the researcher went through the consent form with the participant and asked for signed consent before the interview was initiated. With the exception of four of the 40 interviewees all interviews were audio recorded. In the case of the four participants consent was not given to be audio recorded but they did consent to the interviewer taking detailed notes about the conversation. The interview started with a single open question: "How do you imagine an ideal dairy farm?" The participants typically started by simply describing what they viewed to be the characteristics of an

ideal dairy farm but then the researcher used open-ended questions to elicit the reasons why the respondent considered these characteristics important. At the end of the interview the researcher asked the following demographic questions: age, sex, education, area of residence and region of Brazil. This frequently stimulated further conversation that was then used to explore specific issues that the researcher felt needed clarification. The interview ended with a final question where the interviewer asked the participant if they had any further comments. The interviews were transcribed for use in the subsequent thematic analyses.

Study 2: Questionnaire

Participants (n=300) were informed of the purpose of the research, and presented with a printed consent form. Upon signing the consent form, and after participants were assured that their participation would remain anonymous, they were given the questionnaire. The same demographic questions as outlined above for the in-person interviews were also asked in the questionnaire, followed by an open-ended question: "In previous research done by our team, some people have told us that an ideal dairy farm should pay attention, among other things, to the welfare of their animals. If you agree with that statement, can you tell us what you would expect of a dairy farm that takes care of the welfare of their animals? Consider, please, the cows and their calves". On a separate page, and after answering the open-ended question, participants were invited to answer closed questions structured to determine whether they were aware of (yes/no) and position, using a five point Likert scale (support to oppose), regarding four routine management practices used on dairy farms. The specific practices were presented in simple, short sentences, as follows: cow-calf separation, "The newborn dairy calf is separated from its mother shortly after birth"; zero-grazing, "On some dairy farms cows are reared inside barns, without access to pasture at anytime when lactating"; culling the newborn male calf, "Some male calves are killed immediately after birth because they are not used to produce milk"; dehorning/disbudding, "The horns of young calves are removed without use of any medication to control the pain". The order of the practices was randomized among participants. Open-ended responses were transcribed into a digital document at the end of data collection.

Analyses

To address our first objective, the interviews and responses to the open ended question in the questionnaire were analyzed according to the

methodology outlined by Huberman and Miles (1994), which consists of coding the information, identifying themes, and organizing the information to allow for the drawing of conclusions. For the responses of the open-ended questionnaire question we used 228 responses, having excluded those where the responses were illegible. The first and last authors coded all of the qualitative data, and an invited third expert in qualitative analyses independently examined 10 and 30 of the interviews and questionnaires, respectively. These three readers compared results and reconciled any discrepancies. Quotes presented in this document were translated to English by the first and last authors and back translated to Portuguese by an invited researcher to verify that the original meaning was preserved.

To address our second objective quantitative data were analyzed descriptively through basic statistics, using means and percentages. From an initial sample of 300 respondents, four were excluded from the analysis because they declared some involvement with dairy production, leaving 296 usable responses. The five point Likert scale question about the position of participants regarding the four practices was reclassified into three points (support/indifferent/oppose).

4.2.3 Results

By design we did not include any participants in both studies that self identified as having some involvement in dairy production. We also intentionally targeted individuals such that our group of participants in both studies were balanced for gender, and were similar in terms of representing the age classes in the latest Brazilian census (IBGE, 2010). The majority was urban, from the south and southeast regions, and were highly educated, with nearly 90% holding a bachelor degree (Table 2).

Although we did not ask participants specifically about their income, a recent report released by the Brazilian Civil Aviation Office (ANAC, 2014) based on a representative sample of Brazilians indicates that the majority of domestic air travelers within Brazil are middle class, and approximately 20% of the upper class.

Table 2. Demographics of participants separated by interviews and questionnaires.

Demographics	Variable	% Participants interview (n=40)	% Participants questionnaire (n=296)
Age (years)	18-24	7	26
	25-34	42	35
	35-44	18	17
	45-54	10	11
	55 or above	23	11
Sex	Male	48	44
	Female	52	56
Level of education	High school	10	22
	Some college	2	7
	Bachelor's degree	81	48
	Graduate degree	7	23
Area of residence	Urban	98	98
	Rural	0	1
	Suburban	2	1
Region of Brazil	North	2.5	6
	Northeast	7.5	4
	Centre-West	17.5	11
	Southeast	32.5	33
	South	40	46

Qualitative findings

Study 1: Interviews – Features of an ideal dairy farm and their associated reasons

Interviewees' main concerns revolved around assurances of high milk quality and absence of chemical additives to the milk, both justified as important considerations for people's health. Interviewees also said that on an ideal farm, animals should not suffer, and that the environment and the employees should be respected. The ideal dairy farm should also be profitable, the main reasons being farmers' quality of life and the country's economy.

Regarding milk quality, interviewees described the ideal farm as a place that must respect hygiene and be clean. There was an expectation that the milk be produced without the use of added hormones and antibiotics: "as few chemicals as possible" (S1-32); "Antibiotics are always harmful to health, not only for the people but also for the animal (…)" (S1-11). Interviewees also talked about the role of animal feed in the context of milk quality. Most interviewees mentioned feed quality, considered pasture or natural feed as the ideal, e.g., "I believe that ideally cows should eat natural things - that would be pasture. Natural would be better because I believe that the cow would not necessarily produce more milk, but would produce better milk" (S1-7). However, one interviewee associated concentrate with better milk

quality, i.e., "Confinement, concentrate, are good for milk quality" (S1-5). Some also related animal health to milk quality, e.g., "Because if the animals are not well the product won't be as good as it could be" (S1-17). Absence of agrochemicals and transgenic components in the pasture was also mentioned in relation to milk quality, e.g., "Agrochemicals are used to produce pasture and this goes into the meat and milk. They should be used in a way that doesn't harm humans" (S1-18).

There was a high expectation by the interviewees that there be an absence of animal suffering, i.e., "No suffering for the animals at milking" (S1-9); "With animal welfare, animal comfort; let's say a happier animal, something like that" (S1-26), and that animals should be well cared or well reared, which could mean "well fed, good space, freedom" (S1-6). Individuals also expressed their desire that animals be provided enough space: "Animals with adequate space, because I saw that some of them are tied and I think this is outrageous because nobody likes to be confined (...). Nobody was made to be confined, not a bird, not a cow, not anybody, not us, nobody likes it. And I think a cow mustn't be happy there..." (S1-11); "It is shocking that cows are not on pasture... they must be free, because like it or not, it is an aggression towards the animal; she works the whole day, no time off, this is an aggression towards the animal, I think" (S1-6). For some interviewees, the way animals are treated results in better milk quality, e.g., "If the animal has a good quality of life, the product will be better" (S1-20). In this context it was mentioned that employees should be trained, and family farms were identified as the best option, because the farmers are in the best position to care for the animals: "...because the [family] farmers live closest to the animals and provide them with humane treatment, like giving them a name; this treatment, I think, also influences the product" (S1-2). The use of hormones was also related to the animal's health, "Because I think they harm the animal's health... I think they cause tumors or something. I do not see them as a good thing" (S1-40).

Naturalness was also an important characteristic raised by the interviewees; many were concerned with the animals' feed, and pasture-based systems were considered ideal because of their naturalness, e.g., "many cows on pasture (...) because its natural (...) its closer to nature, they can feel better" (S1-10); "...natural food as it was at the beginning of Creation, green pasture" (S1-29). Some showed negative attitudes towards modernity and technology in terms of equipment, and related these features to loss of naturalness: "Something more manual and not so much machinery [about milking]" (S1-2); "I don't think it's

necessary [machinery], it's not good because it's not natural" (S1-10); "I think anything that is too industrialized brings some harm to our health. I think this kind of milk is too pasteurized... I think the best is natural milk, as more natural is better. More natural milk, even if it lasts less, it is better" (S1-26). A few interviewees associated the lack of naturalness, the use or presence of chemicals, and recent diseases to milk consumption: "I remember when I was a kid, my mother used to say that milk was a very healthy food. And today it isn't anymore. So what happened between then compared to today for milk not be healthy anymore? Because you see information that milk has fat, this and that and that today everyone is allergic to lactose... So, I've been wondering what has happened. Could it be that in our time the way milk was produced was healthier than it is today?" (S1-31); when reflecting to the importance of chemicals added in the milk, the same interviewee concluded: "Why not using the most natural way possible? We know that's good, because it's natural" (S1-31).

Profit was another major concern raised by the interviewees. They discussed the importance of profit for farmers' livelihoods and way of life, the country's economy, and the economic sustainability of the chain: "Ideally, a farm should not need subsidies" (S1-3). Some mentioned that if a farm is profitable farmers might generate employment. The export of milk products and production of special products, for example without lactose was also discussed. Aspects of animal management, including cows' access to water, good feeding, health and housing, genetics, and even music in the milking parlor, were discussed in the context of increased production and profit.

Some interviewees commented that they would like to have more knowledge about how animals are reared, and a few of them commented on their sources of information, e.g., "These days I have read that animals suffer a lot" (S1-40) and cited sources where they gathered information such as television and the Internet. Many started the interview saying they did not know anything about dairy farming, and for this reason they had no idea how an ideal farm should be, but as the interview progressed they did convey, to some degree, what they expected in a dairy farm. For example, one individual began by asking a question and then immediately went on to answer: "The animals are confined, right? I think I agree more or less with this way... I don't know if it could be much better. It could be... but I can't imagine how. Maybe with animals not confined in such small spaces... something like that" (S1-25). Others revealed that they did not like what they imagined a dairy farm to be: "Everyone knows it's a real production line" (S1-2);

"Back in the day the cows produced milk without concentrates, today there are concentrates, but we don't know what they are made of. Some say that they have chemical additives, others say they don't, I don't know to what extent this is true because we are in an environment with lots of information and we don't know what information is correct" (S1-31).

Many interviewees declared some discontent towards the dairy chain, saying that they did not know whether people still drank milk or what the industry added to the milk, i.e., "I don't know which sorts of preservatives are put into the milk to allow it to stay in contact with aluminum. Lots of studies say that aluminum is not ideal for food preservation. Because aluminum is carcinogenic" (S1-7); or that the industry is not truthful in its presentation of the image of dairy farming: "Confined, I suppose that's how it is. I think it is a utopian, naive thing to think that cows are kept as you see in the ads or on the box of milk, a cow's picture on pasture, free and happy... I don't think so" (S1-40). One interviewee said that because of this, "consumers prefer not to think about the origin of the product that they consume" (S1-2). Many interviewees talked about government inspection of commercialized products, e.g., "I think there should be more government oversight of the milk trade. The milk leaves the farm and we don't known how it is preserved, how the storage places are..." (S1-7), usually recalling recent cases of milk adulteration in Brazil: "Some of my friends do not drink milk from some companies, and others do not drink milk at all, because of the [cases of milk] adulteration that have been reported a lot lately" (S1-14).

Study 2: Questionnaire – Important aspects related to animal welfare on a dairy farm

The 228 responses collectively resulted in 4,994 words (which means that on average the responses had 22 words each) that were then coded into four themes (Table 3). Many responses bridged more than one theme and were thus coded into multiple themes. This means the examples given below, many times bridge more than one theme.

Questionnaire participants were primarily concerned about the feed given to the cows, e.g., "Adequate feeding for the cows" (S2-88); "Healthy feeding for the animals" (S2-103); "Nutritious pastures for milking cows" (S2-191). Some participants provided more general responses calling for adequate animal facilities, while others were more specific, citing hygiene and cleanness of facilities: "Adequate housing" (S2-182); "(...) with excellent hygiene conditions" (S2-19). Good health

and veterinary care were also cited, e.g., "Animal health care" (S2-158). Participants also mentioned access to drinking water and shade, thermal comfort, and access to shelter: "Natural shade, if possible, and high quality water available" (S2-1); "[The farm] must have a place for animals to protect themselves from the sun and rain, where they can sleep and eat, and provided adequate veterinary care" (S2-7); "Adequate thermal conditions" (S2-31).

Table 3. Emerging themes in response to the main question (n=228 participants).

Theme	n[1]	(%)[2]
Biological functioning	108	47
Quality of animal treatment	86	36
Naturalness	50	22
Affective states	44	19
Total[3]	288	124

[1] Number of references codified into each theme.
[2] Percent relative to number of references in relation to total arising from all participants.
[3] Total exceeds 228 participants and 100% as some responses were sometimes coded into multiple themes.

Most participants associated animal welfare with the quality of treatment given to animals or, in their words, "ethical management" (S2-75). Participants expressed concern regarding mistreatment and, in their opinion, animals should receive adequate management, should be treated well, and mentioned "quality of life, being careful with the animals, avoiding aggression and mistreatment" (S2-18); "Adequate and decent dairy cows' management" (S2-14); "I'd hope all animals are cared for with the same level of care as humans" (S2-22). Some expected audits to ensure that handlers treated animals well, e.g., "In my opinion there should be a more rigorous oversight and animals should be treated the best possible way" (S2-2).

For many participants, good quality treatment results in more production, e.g., "Adequate treatment to animals, without mistreatment, which also results in better product quality and productivity" (S2-30); "All animals must be respected and loved, so their production increases" (S2-28), and in better product quality: "I hope animals are well cared for, so the products have better quality" (S2-167) and consumers' health: "Cows' welfare is reflected in product quality, with evident consequences for our health" (S2-23).

Additionally, some participants related the ability of animals to express natural behaviors, e.g., "With animals free within nature" (S2-

47); "Animals that live with freedom" (S2-122); "Not limiting animals' freedom... allowing a normal life cycle..." (S2-213); "Pastures free of pesticides, as natural as possible" (S2-183); "That cows were not forced to give birth constantly to sustain milk production" (S2-47). Other respondents commented about the way animals are reared; that cows should graze in large, open spaces, or should be fed pasture and more natural, less industrialized, or organic feed, e.g., "I hope animals to be grass-fed, not grain-fed" (S2-157); "Cows reared on pasture (S2-200)". Some participants specifically rejected indoor housing, e.g., "Animals should not be confined" (S2-32); "Not under radical confinement; some freedom to move and the possibility to graze" (S2-109).

Concerns about natural production were associated with criticisms regarding excessive or inadequate use of chemical products, e.g., "Pasture without pesticides, as natural as possible" (S2-183); "Without artificial stimuli to increase production" (S2-19); "Without products to accelerate growth" (S2-201); "I'd expect them feed the animals without pesticides and hormones" (S2-151); "A farm that offers organic feed to its animals" (S2-114); "To avoid too many medicaments" (S2-170). One reason for this rejection was the perception that some of these substances could affect the health of animals, e.g., "The use of veterinary phytotherapic drugs, to avoid contaminating the animals" (S2-14), but also the consumers: "The volume of chemicals present in the milk cause health problems to consumers" (S2-185).

Some participants also mentioned the emotional lives of the animals, stating that they should live without stress, frustration, suffering, or pain, e.g., "Never inflicting pain to animals" (S2-27); "There should be at least anesthesia to remove the horns" (S2-149); "I'm not in favor of any kind of mistreatment and managements that cause pain or suffering" (S2-50). Also animals should be happy and comfortable, e.g., "A well cared for animal is a happy animal" (S2-46), including playing music for the cows, e.g., "Using classic music during milking" (S2-6). A few participants (5% of total of participants) mentioned early cow-calf separation, e.g., "That cows and calves be allowed to live together" (S2-51). Some argued that the cow and calf should spend at least some time together, or that farmers should be more careful with calves because the cows are supposed to produce milk for the calves.

Study 2: Questionnaire – Knowledge of specific dairy farming practices
Regarding how informed the questionnaire participants considered themselves to be about dairy production, 2% said very

informed, 24% somewhat informed, 13% intermediate, 27% somewhat uninformed, and 34% totally uninformed. In the open responses 10% of the participants addressed their own lack of knowledge on the proposed topic. For example, some said they had never thought about a dairy farm or the welfare of the animals or had no idea how a dairy farm works but nonetheless most expressed several opinions, e.g., "I totally ignore how a dairy farm works, but I believe that it should be designed to benefit all animals, environment and humans" (S2-13); "As I'm not expert in the subject, I don't know what resources are needed... but as for my concern, it is with the volume of chemicals inside milk that cause health problems to the population" (S2-185); "I don't know how a dairy farm works, but I believe that all efforts must be made so that the animals don't suffer or feel pain; there must be quality of life" (S2-221).

Quantitative findings

Study 2: Questionnaire – Awareness and support (or not) for contentious practices

Most participants answered that they were not aware of the four described practices commonly used on dairy farms. However, once they were made aware of the practices, most rejected them (Table 4). Awareness of the specific practices was also low: early cow-calf separation (45%), zero-grazing (32%), culling the newborn male calf (21%), and dehorning/disbudding without pain control (15%). Those that were aware cited the following sources as vehicles of information: Internet (26%); TV (21%); friends or family (16%); printed material like newspapers, magazines or books (11%); a visit to a farm (9%); rural upbringing or having lived in a rural area (7%); animal protection societies (5%); personal experience (5%); and school (1%).

Table 4. Percentage of participants (n=296) and their position about early cow-calf separation, zero-grazing systems, culling the newborn male calf or disbudding/dehorning calves without pain control once they were informed about the practice.

Topic	Unaware (%)	Reject (%)	Indifferent (%)	Support (%)
Early cow-calf separation	65	84	14	2
Zero-grazing	68	85	13	2
Culling the newborn male calf	79	90	9	1
Dehorning without pain control	85	89	10	1

4.2.4 Discussion

This study provides insights about the knowledge and expectations of Brazilian lay citizens regarding what an ideal dairy farm is and the welfare of dairy cattle living on Brazilian dairy farms. Most participants were unaware of the four specific practices that are commonly done on dairy farms; more importantly, once they became aware they overwhelmingly rejected these practices. Although interviewees described an ideal dairy farm and were in many cases not knowledgeable about dairy farming, they did cite characteristics related to a farm as a whole such as milk quality. Many also discussed animal welfare as an ethical requirement, and that profitability of the dairy farm was essential for social reasons.

Not surprising given the knowledge base that the participants had about dairy farming, they frequently mentioned animal welfare as a broad concept but rarely explored specific aspects about dairy farming that they thought influenced animal welfare. However, when probed specifically about animal welfare the participants in our study brought up similar issues and concerns as other citizens from other countries (CLARK et al., 2016; MIELE et al., 2011), with the majority of their comments focusing on at least one of the three common constructs of animal welfare, affective states, biological functioning and naturalness (FRASER et al., 1997).

Concerns relating to biological functioning and health are frequently raised as the most important aspect of animal welfare by farmers and veterinarians (BENARD; DE COCK BUNING, 2013; TE VELDE; AARTS; VAN WOERKUM, 2002; TUYTTENS et al., 2010) but, interestingly, our participants in both studies expressed similar concerns, desiring that the animals' basic needs such as feeding and health, clean, comfortable and appropriate animal facilities were part of an ideal dairy farm. The participants related these concerns as important given their perceived effects on milk quality, also shown by others (BOOGAARD et al., 2011; HÖTZEL et al., 2017). Other aspects of herd management that our participants perceived would influence milk quality and consequently people's health, such as the type of feed, medicines and chemical additives used for milk production, were also mentioned. These concerns are supported by many reports on the potential down stream effects on human health from residues found in food and water, including agrochemicals (e.g., CARVALHO, 2006), hormones (e.g., ANDERSSON; SKAKKEBAEK, 1999; MALEKINEJAD; REZABAKHSH, 2015) and antibiotics (e.g.,

reviewed by LANDERS et al., 2012). Given the discussion in the public domain in many countries about the misuse of antibiotics in human and animal health and in agriculture and its relation to antibiotic resistance (WHO, 2015), it is not surprising that our participants raised this topic. The search for healthy food to prevent diseases in humans is a contemporary concern around the world that is endorsed by the scientific community (e.g., HU; WILLETT, 2002; WILLETT, 1994). Concerns about the impact of additives to animal feed or antibiotics have been reported as one of the motivations driving people to buy organic food (ZANOLI; NASPETTI, 2002). Despite the interest in organic production systems and products shown by our participants and in other studies (BOOGAARD et al., 2011; O'BRIEN et al., 2014; PRICKETT; NORWOOD; LUSK, 2010; VANHONACKER et al., 2008; ZANOLI; NASPETTI, 2002), access to organic animal agriculture products may be limited in some emerging countries (FRISON; ROVER, 2014), given challenges associated with both technical support, and sourcing animal feed that is free of transgenic components (HONORATO et al., 2014).

Naturalness, another concern expressed by many participants as they discussed animal welfare, was expressed in terms of preference for production systems that allow for natural behaviors like grazing, as well as access to space. This may be driven in part by the on-going discussion regarding restriction of movement in the pig and egg industries, which have both received considerable attention in the public domain in Brazil (YUNES; VON KEYSERLINGK; HÖTZEL, 2017). The desire for more naturalness has been reported to be rooted in beliefs and values held by lay citizens of different countries (BOOGAARD; OOSTING; BOCK, 2008; ELLIS et al., 2009; HÖTZEL et al., 2017; PRICKETT; NORWOOD; LUSK, 2010). For consumers, naturalness in terms of food likely has a variety of meanings, including tasty, fresh and healthy food, food containing no chemical residues, food containing natural ingredients, and food that has been minimally processed or processed under homemade, organic, local, eco-friendly systems (ROMÁN; SÁNCHEZ-SILES; SIEGRIST, 2017).

Some participants expressed a desire for traditional, less industrialized farms. This rejection of technology in dairy production systems may be explained by an association with problems identified concerning the welfare of other domesticated animals such as pigs and chickens, rural communities and the environment brought by industrialization of animal production and confinement systems (FRASER, 2008). Indeed, lay citizens often reject aspects of these so

called industrialized systems, such as fertilization treatments (PIEPER; DOHERR; HEUWIESER, 2016) and zero-grazing (PRICKETT; NORWOOD; LUSK, 2010). The desire for a return to the past suggested by some participants of this study has been discussed by Fraser (2008) as a romantic view of agriculture, an expectation that a return to models of agriculture used before industrialization, would solve the ethical problems of modern animal production. There is also a growing body of evidence that there is a strong desire by the public that farming embrace sustainability (BOOGAARD; OOSTING; BOCK, 2008; THOMPSON, 2012), and thus technologies that are socially acceptable may be play a role in the future (HÖTZEL, 2014; VON KEYSERLINGK et al., 2013).

Many participants in both studies discussed the ethical treatment of animals as good quality of treatment, absence of pain, suffering and stress. This was somewhat surprising given that most identified themselves as being largely uninformed about dairy farming. However, this may be explained at least in part by the growing presence of animal advocacy campaigns exposing contentious practices in farm animal production systems, including dairy production, and the repeated replication of the issues raised in these campaigns in television programs and social media in Brazil (CHAVES, 2012; G1, 2013; NOGUEIRA, 2016; SPITZCOVSKY, 2016). Respondents listed the Internet, TV, friends and family as main sources of information, giving some support to this conclusion.

Across both studies more than half of the participants self identified as having little or no knowledge about dairy farming, an issue also raised by many of the participants in their responses. Their lack of knowledge was also apparent in the words they used to describe their ideal dairy farm, with descriptors such as properly or adequate frequently used, rather than specific terms or references to specific practices and their outcomes. Not surprisingly given their background, most participants had low awareness of the four practices described in the questionnaire, which are commonly used in dairy farms in Brazil (COSTA et al., 2013; FRUSCALSO; ANTILLÓN; HÖTZEL, 2017; HÖTZEL et al., 2014; SANTOS; BITTAR, 2015). Despite the low awareness of the existence and prevalence of these practices on dairy farms, participants overwhelmingly opposed them, a phenomenon also shown in other surveys (HÖTZEL et al., 2017; ROBBINS et al., 2015; SCHUPPLI; VON KEYSERLINGK; WEARY, 2014; VENTURA et al., 2013). Others have also shown that citizens have little or no knowledge of how farm animals are reared but, when asked, consider animal

welfare highly important and show interest in knowing more about the issue (EUROBAROMETER, 2016; VARGAS-BELLO-PÉREZ et al., 2016).

Some have argued that the agricultural industries must place greater efforts in educating citizens about farming practices as a means to improve understanding and acceptance of some contentious practices (BENARD; DE COCK BUNING, 2013; HOLLOWAY, 2004; PIEPER; DOHERR; HEUWIESER, 2016; YOU et al., 2014). However, there is a growing body of work indicating that when people gain knowledge about the practices, it does not lead to increased acceptance but rather decreased confidence about whether farmers are able to provide their animals a reasonably good life (HÖTZEL et al., 2017; ROBBINS et al., 2015; VENTURA et al., 2013; WEIBLE et al., 2016). These findings reiterate that lack of knowledge of livestock farming does not explain the low support for practices perceived to reduce animal welfare. Engagement of the public in the development of new technologies, in contrast, may be one way to make the dairy chain more socially sustainable (HÖTZEL, 2016; WEARY; VENTURA; VON KEYSERLINGK, 2016).

The ideal type of production system was also discussed by many participants, with some rejecting indoor housing and concentrate feeding while others describing an ideal farm as one with open spaces and animals grazing on pasture. Most interesting is that in both of these later arguments participants cited naturalness and animal welfare when justifying these characteristics. Some have argued that pasture access for dairy cattle provides benefits for animal health and welfare, while others have argued that indoor housing reduces dairy cattle health and the ability of the animals to express natural behaviors (reviewed by CHARLTON; RUTTER, 2017).

There is tremendous potential within Brazil to produce pasture-based milk given the favorable climatic conditions throughout much of the country (VON KEYSERLINGK; HÖTZEL, 2015). Interestingly, a study discussing possible future scenarios for the milk supply chain in Brazil by 2020 identified animal health, food safety and environmental issues as the major challenges facing the dairy chain (SPERS; WRIGHT; AMEDOMAR, 2013). These challenges, along with animal welfare, should be taken into consideration throughout the milk supply chain as failure to do so may result in risks given the lack of trust expressed by many of our interviewees.

Small producers, that are largely family run, have an important role in the Brazilian milk supply chain because they produce a

substantial amount of the total milk produced in the country (IBGE, 2009). If the dairy chain is negatively affected due to the existence of animal welfare concerns, thousands of family farmers that make their livelihoods from dairy and milk production could potentially be affected (IBGE, 2009). When well managed, pasture-based systems are profitable (BALCÃO et al., 2017; MACHADO FILHO et al., 2014) and may help social sustainability of dairy farming.

The convenience sample used in this study should not be considered representative of the Brazilian population, given that the higher level of education of the respondents and the distribution within regions of Brazil was not representative. However, the findings herein do represent the ideas of a group of mixed sex, urban, well-educated middle class Brazilian citizens that spanned a variety of ages. Although, having a higher socio-economic status can result in greater emphasis being placed on animal welfare regulations by citizens it was not an aim of the present study. The methods used in the current study assumed that citizens drive changes on food production, not consumers (see AERTS, 2013; and JOHNSTON, 2008). Moreover, more educated people, not necessarily with high incomes, tend to be more concerned about animal welfare than those that are not aware of the issue (CLARK et al., 2016). Over the last decades the socio-economic status of the Brazilian population has improved and animal welfare, as well other contemporary issues, has increasingly played a greater part of citizens' daily life.

4.2.5 Conclusions

When the participants were invited to imagine a dairy farm they showed a special concern for milk quality, but also mentioned the social importance of dairy farming and animal welfare. The participants that were prompted to give their opinions about animal welfare made associations with the quality of cows' treatment (avoidance of pain, frustration and suffering), good animal health, feeding and hygiene, the ability of the animals to perform natural behaviors, and the need to avoid or reduce the use of drugs, hormones and pesticides. The majority of participants in this study were unaware of farming practices of early cow-calf separation, zero-grazing system, the culling of newborn male calf and dehorning/disbudding without pain mitigation, but when made aware overwhelmingly rejected these practices. These findings suggest that participants of this study are mostly unaware about common animal production practices but are highly concerned about milk quality and

animal welfare. These studies provide insight that animal welfare is indeed important to some members of the public, as was the case for our group of highly educated urban middle class Brazilians, and there is risk that certain routine dairy production practices may not be socially sustainable once the public becomes aware of them.

4.3 THE IDEAL DAIRY FARM IN THE UNITED STATES: RELEVANT ASPECTS FOR LAY CITIZENS[4]

4.3.1 Introduction

The way animals are raised on farms has changed greatly over the past century, including a growth in farm size and increased technology (FRASER, 2008). Critics argue that more intensive farming practices can harm the environment, rural communities, worker safety, food quality, food safety and animal welfare (BOOGAARD et al., 2010; GARNETT et al., 2013; GODFRAY et al., 2010).

Concerns regarding dairy production include painful procedures, like tail docking and calf dehorning (ROBBINS et al., 2015; WEARY; SCHUPPLI; VON KEYSERLINGK, 2011), and practices that are perceived to interfere with important natural behaviour, like cow-calf separation (VENTURA et al., 2013) and zero-grazing (SCHUPPLI; VON KEYSERLINGK; WEARY, 2014). These studies provide some evidence that although different stakeholders may share similar concerns in other instances they have opposing views. This disconnect was also observed in a recent study where farmers strongly believed that urban citizens are ignorant about agricultural practices, and thus public knowledge of agriculture should be considered irrelevant (BENARD; DE COCK BUNING, 2013). Although there can be disagreements about the issues and potential solutions (HÖTZEL, 2014; VANHONACKER et al., 2008), it is widely recognized that public input is needed when developing policy on farm animal welfare standards (e.g., GROOT KOERKAMP; BOS, 2008; O'CONNOR; BAYVEL, 2012).

More broadly, understanding the values of the general public may be important in the development of sustainable food animal agriculture, as the adoption of animal husbandry practices inconsistent with public

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expectations may undermine social sustainability (e.g., VON KEYSERLINGK et al., 2013; VON KEYSERLINGK; HÖTZEL, 2015; WEARY; VENTURA; VON KEYSERLINGK, 2016). To our knowledge there have been few attempts to solicit the views of the general public about their aspirations for specific agriculture practices (e.g., GAYMARD; BORDARIE, 2015). This type of research may provide valuable insights into which factors are important to the general public as well as identify potential areas of concern that, if not addressed, may hinder the sustainability of the dairy chain.

The aim of this study was to assess the views of people not affiliated with the dairy chain on what they perceived to be the ideal dairy farm and their associated reasons.

4.3.2 Material and methods

Participants were invited to respond to a single open-ended question: "What do you consider to be an ideal dairy farm and why are these characteristics important to you?" They were free to express any aspects they felt were important. Data were collected via an online platform (Fluid Surveys, www.fluidsurveys.com). In order to better characterize the participants, they were first asked several multiple-choice demographic questions before answering the study question. The survey was completely anonymously and was approved by the UBC Behavioural Research Ethics Board (H13-01466).

Survey methodology

Participants were recruited online from the U.S. via Mechanical Turk (MTurk, www.mturk.com). Several studies have assessed this tool and concluded that this approach results in high-quality and reliable data (BUHRMESTER; KWANG; GOSLING, 2011; ROUSE, 2015; SAUNDERS; BEX; WOODS, 2013) that is more representative than many other samples (MASON; SURI, 2012; ROUSE, 2015). Participants were given the following information before taking the survey: "Take a short survey asking your opinion of dairy farms. We want to know what characteristics you think make the 'ideal dairy farm." Upon completion participants were paid (US$0.50). This convenience sample was intended to provide a rich and diverse set of responses achieving saturation on the topic of what characteristics make up an ideal dairy farm. These results should not be considered representative of the U.S. population.

The survey was launched twice, six months apart, once on June 10, 2014 and again January 29, 2015. The consent form for the first cohort contained the term Animal Welfare Program as part of authors' affiliation and we were concerned that this phrase may have framed some responses. Thus for the second cohort this phrase was not included. The MTurk platform was set to recruit 250 U.S. respondents in each cohort (e.g. June 2014 and January 2015).

Survey analysis

Demographic data, separated by cohort, are presented on Table 1. Open-ended responses were analysed using the NVivo Qualitative Data Management Program (QSR International Pty Ltd. Version 10, 2014). The analysis was based on the qualitative method described by Huberman and Miles (1994): *data reduction* (information is coded finding themes), *data display* (organization of the information allowing for conclusions to be drawn) and *conclusion drawing and verification* (noting of patterns and themes and using confirmatory tactics such as triangulation between three readers). Three trained evaluators blind to demographic information, independently examined 30 randomly selected responses, breaking them down into phrases, which were then used to identify the primary themes. The three readers compared results and reconciled any discrepancies. The lead author then undertook the final analyses.

The thematic analyses of the responses identified four primary features of an ideal dairy farm, which participants justified using reasons that were coded into two distinct themes (Table 6). The main themes therefore arose from the responses rather than being determined a priori. Many sentences bridged more than one theme and were thus coded into multiple themes.

4.3.3 Results

Given that we were primarily interested in the views of respondents not directly associated with dairy chain, responses from participants that identified themselves as *farmers* (n=7) were eliminated. In addition, responses that were so inarticulate that they could not be coded (n=25) were deleted. The remaining 468 usable responses (234 from the June 2014 cohort and 234 from the January 2015 cohort) were from 46 U.S. States and the District of Columbia (no responses were obtained from Montana, Wyoming, Nebraska and South Dakota).

The frequencies of themes obtained from the two cohorts were similar, with *cows* arising as the primary theme accompanied by the main reason *animal welfare and ethics* (Table 6). Given that the prevalence of these themes did not vary between the two cohorts we conclude that including the term *Animal Welfare* in the ethics consent form for Cohort 1 did not bias in these results. Therefore, data from the two cohorts were pooled for the qualitative analysis. Results are described according to theme, with sub-themes for the reasons. Themes are listed per order of prevalence.

Table 5. Participant demographics of the cohorts that participated in an online survey where they were asked to respond to the question "What do you consider to be an ideal dairy farm and why are these characteristics important to you?"

Demographics	Variable	Cohort 1 (%) n = 246	Cohort 2 (%) n = 247
Age	18-24	24.0	19.4
	25-34	44.7	50.2
	35-44	16.7	17.8
	45-65 or above	14.6	12.5
Sex	Male	53.3	58.3
	Female	46.7	41.7
Level of education	Some high school	0.8	1.2
	High school graduate	13.0	10.9
	Trade or vocational degree	1.6	4.1
	Some college	28.5	25.1
	Associate degree	9.8	10.5
	Bachelor's degree	38.6	39.3
	Graduate	7.7	8.9
Area of residence	Urban	29.7	21.5
	Rural	19.5	25.9
	Suburban	50.8	52.6
Familiarity with dairy	Very familiar	10.6	6.1
	Somewhat familiar	53.7	64.4
	Not familiar	35.8	29.6
Involvement in dairy [a]	Professional or student	3.6	2.4
	Animal advocate	6.1	4.5
	Not involved	91.5	92.3
	Other	1.6	2.0

[a] Participants were allowed to self-identify in multiple roles, so the sum of percentages exceeds 100.

Features related to the cow

The most commented characteristic of the ideal farm was 'cow' - reflecting concerns about cow treatment; specifically that the farmer or the workers should treat cows "well", "humanely", or with "kindness". For example, one respondent stated that: "An ideal dairy farm would be one that has no mistreatment of their livestock" (RC1-113).

Secondly, respondents mentioned that cows should be allowed space to roam. This was reflected by terms such as "open space", "outside", "on pasture where the cow could be free", "I think a dairy farm that tries to use all natural feed and allows the cattle plenty of open space to roam and graze" (RC1-13). Reference to pasture was cited mainly in the context of space allotments, though some respondents did not specify if they considered pasture important just to roam outside, or to graze; "To let the cows free range on pasture" (RC1-23); "The cows are all out in the pasture most of the day and then brought in to be milked and sent back to the pasture" (RC2-30). Others were specific in their responses that cows should be fed grass: "Cows have plenty of grass to eat" (RC1-20); "An ideal dairy farm would feed the cows only grass" (RC1-36); "Ideally, all dairy farms should feed their cows grass" (RC2-237).

Within the theme 'cow', respondents also made frequent reference to desiring 'naturalness' in dairy production, often referred to when speaking of space and pasture, but sometimes also referring to natural diets. For example two responses were: "A farm where the animals are raised humanely, outside of cages, in a natural environment. Also a farm that doesn't mass produce unnatural animals using steroids and antibiotics" (RC2-59); "One where the animals are allowed to roam freely, not confined to pens or cages, are feed an organic or natural diet" (RC1-4).

Respondents did not approve of cows being injected with hormones to produce more milk, or antibiotics, unless necessary: "They would not be fed any grain or given any drugs unless absolutely necessary. No hormones" (RC1-228); "Also, the cows wouldn't be given lots of antibiotics or other medicines to make them produce more milk" (RC1-14); "(...) not treated with synthetic hormones or antibiotics - unless absolutely necessary" (RC2-231).

A few comments were specific to the cow-calf bond, including, "Mothers and calves should have large stalls with fresh bedding each day" (RC1-53); "The ideal dairy farm puts the well-being of the animals above other considerations. This means, for example, not separating a new-born from the mother" (RC2-54).

Lastly, participants showed concern for the health of cows, stating that cows must be healthy, without disease, and must receive veterinarian care; "Clean, free of disease, (...), good medical care" (RC2-169); "An ideal dairy farm is clean (...) and are also treated medically when they have problems" (RC1-25). This concept was expanded by some participants to include comments on the facilities

specifying that they should be good, safe and clean for the cows; "I think an ideal dairy farm would be a safe and clean environment for cows to live" (RC1-91); "The dens or housing for the cows should be well kept and clean so the cows are healthier" (RC2-190).

Table 6. Emerging themes in response to the question: "What do you consider to be an ideal dairy farm and why are these characteristics important to you?"

Encoding	Main themes	Cohort 1		Cohort 2	
		n [a]	% [b]	n [a]	% [b]
Characteristics	Cow	208	62	211	57
	Business operation	61	18	99	27
	Dairy products	59	17	43	12
	Environment	11	3	15	4
	Total [c]	339	100	368	100
Reasons	Animal welfare and ethics	91	53	98	58
	Milk quality	81	47	71	42
	Total [c]	172	100	169	100

[a] Number of references codified into each theme.
[b] Percent relative to number of references in relation to total of sentences codified.
[c] Total number references codified.

Reasons related to animal welfare and ethics

Reasons presented that were ethical in nature included the quality of treatment workers or farmers should give to animals. Respondents expressed concerns that animals should be treated with "respect", "humanely" or "fairly", "kindly", "with love", and with "dignity", because it is moral or ethical; "They [the cows] should be treated humanely because it's the right and moral thing to do" (RC1-218); "This is a humane issue and people should treat animals with respect. It is just common decency" (RC2-38).

An ethical perspective was also present in the arguments that animals deserve respect. Some commented that the animals were not here only for the benefit of humans: "I do not believe that we should mistreat animals even though we are the dominant species on the planet, all life still deserves respect" (RC1-13) and "The animals that provide the milk are not just a tool but living beings that give us our milk, so they deserve respect" (RC2-66).

Referring to the quality of life of the animals was frequently used to justify the characteristics of the ideal farm; namely, the characteristics presented were important for participants because they were equated with a better life for the animals; "I feel that this would allow the cows to have the best life" (RC2-118); "This is important to me both for my own health and the health and quality of life of the cows" (RC1-44).

Finally, a few participants suggested that the quality of treatment given to animals at the farm could affect their consumption of dairy products; "This is important to me because I am deeply troubled and affected by cruel treatment to animals and would not want to purchase any products derived from such treatment" (RC2-34) and "I don't want milk from mistreated animals" (RC2-170).

Features related to the business operation

The second most frequent characteristic identified by participants was associated with the business operation. This theme included characteristics about the farm as a whole, with most references indicating that the ideal farm should be profitable, productive and efficient. Some respondents also stated that the ideal farm should be organic, small, operated by family farmers, and committed to contributing to their community (e.g. offering tours or selling their milk products locally), e.g.;

"The ideal dairy farm is similar to the one local to me. It is small to medium sized and has a lot of local interest and local interaction. They mostly sell milk and cheese to local stores but sell ice cream made on site and sell it locally. (...) They also put on a lot of community events on the weekends and are always extremely busy during them. It feels like part of the community" (RC1-207).

"An ideal dairy farm would be locally owned and privately managed organically. These are important characteristics that show character and inspire confidence in a business" (RC1-117)

"The ideal farmer works hard to produce organic products. This is important to me because its shows that we are getting our dairy products from a reliable place" (RC2-94).

Some respondents connected the cows' mistreatment with the term "factory farm", and disapproved of this kind of treatment in an ideal dairy farm, e.g.; "No factory farming. A more organic approach" (RC1-122); "It is important to me because having seen dairy Factory Farms my heart breaks for the animals who must endure awful conditions. My hope is for the animals to be treated humanely" (RC2-169).

Respondents expressed some concern about the owners (farmer), stating that they should be "efficient", "educated", "loving" and "competent"; "The owner cares about his animals and takes great pride in ensuring a great life for them" (RC2-171). Others stated that the farmer should be "honest" and "responsible"; "Lastly, a dairy farmer has to be honest. Honesty is important with everyone, especially farmers"

(RC1-193). Other respondents referred to social aspects, about work conditions and involvement with the community, e.g., "(...) a clean safe environment for everyone involved" (RC1-44); "Paying their employees a good wage also is important" (RC1-151); "The staff should be friendly and machines should work nicely" (RC1-244); "I think an ideal farm would be where the milking is done by machines" (RC1-157); "A farm that respects the community it is in as well as the environment in the surrounding area" (RC2-23).

Features related to dairy products

Respondents expressed expectations relative to the quality of milk, stating that the ideal dairy farm produces high quality milk and other products; "The farm would also uphold standards of health for their products" (RC1-16); "I consider a dairy farm ideal when they care about the quality of products that they sell" (RC1-61).

Many respondents provided qualifiers when referring to quality, stating that this referred to absence of antibiotics, hormones or other chemicals in the milk, and a clean environment to produce a safe and healthy product, e.g., "They should be as natural as possible, don't use chemicals on their products" (RC1-69). Some referred to the need to follow laws and regulations, as well as good equipment, for farms to keep the consumers safe and healthy; "The collection of the milk must be handled with health regulations" (RC2-243); "All equipment would be clean and in perfect working order to ensure the milk doesn't get contaminated or that the equipment doesn't injure a cow (RC1-169).

Reasons related to milk quality

The other main aspect that was identified by respondents involved concerns for themselves, especially their own health; simply put, they want healthy milk. Moreover, participants made explicit in their responses that they want milk and other dairy products that are high quality, clean and safe to consume. These respondents suggested that the quality of life of a cow influences the quality of the milk she produces, which in turn influences human health: "These [low use of antibiotics, no sacrifice of animals, good quality of products, hygienic practices and attention to detail] are important to me because it ensures that what I'm eating will be of the highest standard and acceptable in both flavor and nutritional content" (RC2-73); " I think that the better the cows are taken care of, and the healthier they are, the healthier the milk will be" (RC1-96); "One where cows aren't given hormones

because I don't like the idea of taking drugs in my food and drink" (RC1-28).

Finally, a number of people linked the food that cows consume with milk quality, mentioning that the cow's feed should be organic, grass-based, and without hormones or antibiotics. Others associated the quality of the milk with the quality of life of the cows, and concluded that for this reason cows should be treated well: "Grass fed cows produce, I think, better tasting products" (RC1-111); "The less drugs given to them the better, so they don't pass them along to humans in their milk" (RC2-222); "The cows have to be treated properly, free range not locked in pens their whole lives. Good milk comes from happy cows" (RC2-3).

Features related to the environment

Although only a few respondents (11 in the first cohort and 15 in the second cohort) made references that reflected concerns with environmental issues, those that did comment clearly indicated their desire that some care and responsibility about pollution and environmental impact should be part of an ideal dairy farm. Terms like "green", "eco-friendly" and "sustainable" were used to designate the ideal dairy farm: "A dairy farmer that gets their milk responsibly for the environment" (RC2-66); "I would say ideal would be a farm which gives back as much as it takes from the earth and strives to be a 'green' farm" (RC1-52); "The farm is being run in an eco-friendly way" (RC1-234); "The farm is sustainable, because it is important to respect the environment" (RC2-111)

Other relevant results

Respondents expressed characteristics related to several aspects of a dairy farm within the same response; individual participant responses referenced on average 1.5 features. The ideal farm often included characteristics relating to the cows, milk products, environment, consumers, farmers, workers, and the community: "Sustainable. Does not waste a lot of natural resources. Humane, not torturous for the animals. It's important for me because these things are ethical considerations for production of food" (RC1-221); "A farm that has the latest equipment and produces the best product. Where the animals are cared for and given enough room. The food fed to the animals should be high quality and not filled with chemicals or hormones" (RC2-164); Well cared for cows, top of the line pasteurization equipment. Caring for your animals is very important,

don't hurt them! Providing top quality and safe products for your consumers is also extremely important" (RC2-214); "One that produces quality milk for reasonable costs and treats animals and workers well. That is important to me because I enjoy quality milk and low prices" (RC2-247); "Fresh, green grass, happy cows, good milk. The happier the cows, the better tasting the milk, the more money can be made" (RC2-225).

In a few responses participants made reference to previous information or experiences that informed their views of the ideal dairy farm. For instance, a few individuals referred to visiting their local dairy farm. However, the majority of the comments that made reference to previous information and the resulting perception were negative. For example, "I think the animals should be treated well. We hear too many horror stories" (RC2-215); "It is important to me to preserve animal welfare, because I think it is disturbing and horrifying how animals are treated in some dairy farms" (RC1-15); "This is important to me because I have seen first hand some dairy farms where the cows are kept in their stalls all day hooked up to the pump machines and it is pretty horrid" (RC1-76).

4.3.4 Discussion

To our knowledge this is the first study that described characteristics of an ideal dairy farm by people not associated with the dairy chain. Participants referred to the social, economic and ecological perspectives generally discussed in the definition of sustainability (ALLEN et al., 1991; CAPORAL; COSTABEBER, 2002; VON KEYSERLINGK et al., 2013). The majority of respondents (90% - 419 of total) referred to the animal in some capacity when referring to an ideal dairy farm. These concerns focused largely on animal welfare and argued that cows inherently deserve to be provided a good quality of life, and that providing a good life would have the instrumental benefit of improving milk quality for consumers.

Our research differs from previous studies in that it solicited general public views on specific issues of livestock systems associated with animal welfare (e.g., BOOGAARD; OOSTING; BOCK, 2006; ELLIS et al., 2009; MIELE et al., 2011; VANHONACKER et al., 2008). Instead of asking participants about experimenter-generated characteristics, we invited participants to freely express their views of an ideal farm. That animal welfare was the most cited theme, regardless of whether the term Animal Welfare was present in the Ethics Consent

Form, indicates that the quality of treatment given to animals is a priority concern for participants. A Dutch study reported similar findings when the general public were asked their views on factors deemed most valuable to ensure the dairy farm's future, all respondents made mention of the animal (BOOGAARD; OOSTING; BOCK, 2008).

The majority of reasons provided by participants referred to ethical arguments about the treatment of animals. In this context, respondents argued that milk production is ethically acceptable only if animals are well treated. This utilitarian view is frequently mentioned in the ethical debate about the use of animals in agriculture. Sandøe et al. (1997) stated that utilitarians believe that it is acceptable to kill animals for consumption, as long as it is predicated on the animals having a good life and that they are killed without pain. However these authors also argue that to achieve these conditions radical changes must be implemented on farms to ensure that animals are being treated in this regard. Indeed it is the moral aspect behind animal production that has emerged from interested people that has guided much of the debate about farm animal welfare (FRASER et al., 1997). We suggest that these insights provided by the respondents in this study indicate that providing assurance that animals are well cared for will improve acceptability of dairy farming to people who are not routinely affiliated with the dairy chain.

Respondents focused largely on two aspects of animal welfare (as defined by FRASER et al., 1997): firstly, comments linked to the concept of natural living, including that the animals be provided access to space and pasture. Participants also made reference to the animal's health, central to the concept of biological functioning. Concerns about natural living have been reported in many other studies on public perceptions about farm animal welfare (e.g., PRICKETT; NORWOOD; LUSK, 2010). Lassen et al. (2006) reported that living a natural life was an important part of animal welfare for the general public. Vanhonacker et al. (2008) reported that general public are concerned with an animals' ability to engage in natural behaviors. A number of European studies showed that citizens valued space and pasture, and outdoor grazing as important components of animal welfare (BOOGAARD et al., 2010; BOOGAARD; OOSTING; BOCK, 2008; ELLIS et al., 2009; MIELE et al., 2011). One recent North American study reported that the general public demonstrated preference for systems that provide some pasture access to cows (SCHUPPLI; VON KEYSERLINGK; WEARY, 2014), a point also raised by many of the participants in our study. Dairy farms that incorporate some form of pasture (e.g. diversified or mixed

systems) could contribute to sustainability of dairy chain in two ways: environmentally, given that they have reduced water requirements (MEKONNEN; HOEKSTRA, 2012) compared to zero grazing or pasture based systems; and socially, given that they resonate with public values (see also SCHUPPLI; VON KEYSERLINGK; WEARY, 2014). Thus we suggest that some form of access to pasture should be part of any future discussions regarding the sustainability of the dairy chain, despite conflicting evidence from different studies on the effects of pasture access on milk production (CHAPINAL et al., 2010; FONTANELI et al., 3; WHITE et al., 2002). Interestingly, although the participants in the current study mentioned productivity and profitability as desired characteristics of the ideal farm, they did not question the potential economic implications of including other desired characteristics of what makes up an ideal dairy farm.

For 22% of respondents the most important characteristic was related to dairy products, which was sometimes related to human health. Interestingly, milk quality was associated with qualifiers such as organic, green, local, small scale and family run operations. Others that referred to concerns about milk quality focused on the ideal dairy farm having cows that did not receive any hormones or unnecessary antibiotics. Desiring practices that do not rely on hormones highlights the disconnect between standard production practices and what participants view as ideal; exogenous hormones are frequently used on many farms to address challenges associated with low fertility (MOORE; THATCHER, 2006) and to increase milk production (BAUMAN, 1992). Given that respondents clearly rejected the use of these technologies, our results suggest that continued reliance on them may undermine the sustainability of the dairy chain (VON KEYSERLINGK et al., 2013). Although 22% of respondents rejected the use of antibiotics and exogenous hormones as means to increase milk production, some did specifically endorse the use of antibiotics when cows were ill (by stating that cows should be treated when necessary), suggesting a desire for naturalness but not at the expense of animal welfare.

Most of our participants made reference to aspects associated specifically with dairy farming and thus were not completely naïve of farm practices. Many volunteered information referring to the use of hormones or antibiotics and the associated effects on milk quality and human health, as well as animal rearing practices such as early cow-calf separation, and the environmental impact of dairy farming. Several studies have reported differences in the assessment of animal welfare

between farmers and people not associated with animal production (MIELE et al., 2011; TE VELDE; AARTS; VAN WOERKUM, 2002; VANHONACKER et al., 2008). This has prompted some to suggest the need to facilitate consensus building between stakeholders, including farmers and general public, on animal welfare issues (POLETTO; HÖTZEL, 2012; VON KEYSERLINGK; HÖTZEL, 2015).

Some respondents also referred to modernity as important for the ideal dairy system. In general, respondents desired a mix between an industrial and agrarian view of agriculture. Thompson (2012) points out the presence of 2 types of public philosophies of agriculture: the industrial philosophy that sees agriculture as a business, and just one of many sectors in the industrial economy, which should be efficient and not cause risks to third parties; and the agrarian philosophy, which is more concerned with other issues of agriculture, such as ecosystem services, good nutrition, and food security. Participants of our survey showed interest in having access to high-quality food, which they equated with a more natural production system [e.g., with no (or limited) antibiotics and cows grazing], which was also linked, often simultaneously, with the animal's quality of life, and with human health. However, many participants were clear that this does not mean that they expect that farmers should produce in the same way as when the production was less technological and less profitable. As Boogaard et al. (2010) concluded, the general public want it all: they prefer naturalness and tradition, but also value modernity in dairy production.

A variety of reasons may explain why animal welfare concerns were emphasized in the comments in this survey. First, it seems reasonable that after six decades of public debate and the presence of organized animal protection groups (VON KEYSERLINGK; HÖTZEL, 2015), society may have internalized animal welfare as a critical issue of food animal production. Moreover, access to information, and formation of social values can contribute to general public demonstrating concern about animal welfare in animal agriculture (ROLLIN, 2004). In fact, media coverage of cases involving the use and mistreatment of farm animals has been particularly intense in recent years, and in many U.S. states the public have been exposed to an increase in legislative initiatives aimed at addressing farm animal welfare (CENTNER, 2010). Additionally, food safety crises commonly attributed to industrial animal production systems (e.g. Bovine Spongiform Encephalopathy and Salmonella outbreaks) are frequently highlighted by the media (e.g., NUNEZ, 2015). It is clear that at least in developed countries the general public has become more interested in farm animal production

(CLARK et al., 2016; ELLIS et al., 2009; EUROBAROMETER, 2007), and a few studies in developing nations suggest a similar trend (BONAMIGO; BONAMIGO; MOLENTO, 2012; SCHNETTLER et al., 2008; VARGAS-BELLO-PÉREZ et al., 2016; YUNES; VON KEYSERLINGK; HÖTZEL, 2017). This increased interest is also reflected by an increased media attention, the primary source of information on farming practices for the public (EUROBAROMETER, 2007; MIELE et al., 2011; TONSOR; WOLF, 2010), which likely influences urban citizens' perceptions of the animal industries (VERBEKE; WARD, 2001). Also, animal activism sometimes promotes a negative image of animal industries (for an example see KANSO, 2015), which may contribute to some practices (for example, cow-calf separation, VENTURA et al., 2013) being rejected by the general public (e.g., RODAN; MUMMERY, 2014; TIPLADY; WALSH; PHILLIPS, 2013). This link may explain why some of our respondents voiced concerns regarding the treatment received by animals, suggesting that the quality of treatment does not fully match their aspirations. For example, 5.5% of participants explicitly reported that many cows are currently mistreated on dairy farms, or argued that there is need to improve the quality of treatment, or labeled the systems as unethical.

4.3.5 Conclusions

The main characteristics of an ideal dairy system identified by the respondents were related to animal welfare from two perspectives: consideration for the quality of life of the animals, based on ethical arguments, and the consequences of animal care on the quality of milk. We noted preferences for organic systems, smaller family size operations, and rejection of the use of antibiotics and hormones for purposes of increasing production. Respondents also made mention that the farm enterprise should remain productive and profitable. Overall, we conclude that participants of this study expressed an ethic for dairy farming that includes concerns for the animal, social, and environmental aspects of the dairy system. Our study suggests that by providing assurances that animals are well treated, developing methods to incorporate pasture access and assurance of healthy products without relying on antibiotics or hormones, will improve the social sustainability of the dairy chain.

5 THE IMPORTANCE OF SHADE ON PASTURE BASED SYSTEMS ON DAIRY PRODUCTION FOR U.S. LAY CITIZENS AND DAIRY HEIFERS

This section is about two studies that aimed to access the importance of shade for different stakeholders, lay citizens and animals. The first study was carried out with U.S. lay citizens through an online survey about their attitude regarding different scenarios combining the way where cows were reared, if on pasture or indoor housing, experiencing or not experiencing heat stress in these environments. The second study was an experiment that we measured the relative motivation of dairy heifers to access shade in summer comparing to autumn.

5.1 PASTURE WITHOUT SHADE OR A BARN WITH FANS? OPINIONS OF U.S. LAY CITIZENS ABOUT HEAT STRESS AND DAIRY CATTLE WELFARE[5]

5.1.1 Introduction

Previous research has shown that survey participants typically express a preference for systems where cows are able to graze (SCHUPPLI; VON KEYSERLINGK; WEARY, 2014), and cite access to pasture as an important characteristic of the production systems (BOOGAARD et al., 2010; BOOGAARD; OOSTING; BOCK, 2008). One reason why pasture is thought to be better for animals is because it allows animals to better express their natural behavior (BOOGAARD et al., 2010). However, pasture also may have disadvantages related to animal welfare (reviewed by CHARLTON; RUTTER, 2017). For example, outdoor rearing systems often do not have any shelter (e.g., COSTA et al., 2013), exposing animals to unpleasant climatic conditions including excess heat. Cows can suffer from heat stress when exposed to solar radiation, with consequences for physiology and behavior (SCHÜTZ et al., 2010; STEIGER BURGOS et al., 2001).

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[5] The study with the U.S. citizens was carried out in the context of the "sandwich" that the doctorate student did in the last five months of the course, at the University of British Columbia, Canada.

Fraser et al. (1997) proposed three types of concerns that should be considered when discussing animal welfare: 1) *natural living* – the ability of animals to have natural lives, expressing their natural behavior; 2) *affective states* – related to the capacity of animals to feel well; and 3) *biological functioning* – related to the health of animals. However, it is not clear how people respond when production systems place one type of concern in conflict with another. For example, a cow reared on pasture (arguably good from a natural living perspective) but without adequate shade may feel uncomfortably hot (poor from an affective state perspective) and experience the effects of heat stress (poor from a biological functioning perspective). One survey indicated that U.S. consumers consider that allowing animals to express their natural behavior outdoors is more important than being at a comfortable temperature (PRICKETT; NORWOOD; LUSK, 2010). Expression of natural behavior was also considered important by Flemish citizens, although not more so than the absence of disease (TUYTTENS et al., 2010). One recent study used an experimental design to put naturalness and affective state concerns into conflict (ROBBINS; FRANKS; KEYSERLINGK, 2018). Participants were randomly assigned different scenarios describing "Sally" (a chimpanzee) as feeling either very good or very bad, and as living in either a naturalistic or a confined environment. The responses showed that participants were especially affected by the naturalistic environment, rating Sally as happier in this setting even when the scenario specified that she was feeling very bad. To our knowledge, no study to date has experimentally contrasted conflicting welfare concerns for farm animals, or indeed examined how people view conflicts between natural living and biological functioning concerns.

The aim of this study was to test how public attitudes to cattle rearing vary when experimentally assigned to scenarios that manipulate natural living, affective state and biological functioning concerns, using a 2 x 2 design varying natural living (pasture versus indoor housing) and affective state/biological functioning (experiencing or not experiencing heat stress). Based upon the results of Robbins et al. (2018), we predicted that participants would express more positive attitudes towards pasture-based rearing even if this was associated with heat stress.

5.1.2 Material and methods

We used an online questionnaire developed in Qualtrics (www.qualtrics.com) with Likert scale, open-ended and multiple-choice questions. A convenience sample of 601 participants from the U.S. was recruited via Mechanical Turk (MTurk, www.mturk.com), thought to provide high-quality and reliable data (BUHRMESTER; KWANG; GOSLING, 2011; SAUNDERS; BEX; WOODS, 2013). The MTurk population of respondents is replaced by fresh people at approximately 7-month intervals. Respondents are somewhat more likely to be young, liberal, urban and single relative to the U.S. population (BOHANNON, 2016), although some studies have shown that MTurk provides a more representative sample than other types of recruitment (MASON; SURI, 2012; ROUSE, 2015). The study was approved by the University of British Columbia Behavioral Research Ethics Board (H15-03053).

The questionnaire

Each participant was randomly assigned to one of four hypothetical scenarios using a 2 x 2 experimental design. The two factors were cow housing (pasture vs. indoors) and heat mitigation (presence vs. absence of shade or fans). The four scenarios were presented as: 1 – "A herd of dairy cows is kept on pasture where they can graze. The pasture has a shaded area; on warm days the cows are unlikely to suffer from heat stress"; 2 – "A herd of dairy cows is kept on pasture where they can graze. The pasture has no shaded area; on warm days the cows are likely to suffer from heat stress"; 3 – "A herd of dairy cows is kept in a barn where they have free access to food. The barn has fans; on warm days the cows are unlikely to suffer from heat stress"; 4 – "A herd of dairy cows is kept in a barn where they have free access to food. The barn has no fans; on warm days the cows are likely to suffer from heat stress".

After reading the scenario participants were invited to respond to three questions (all on five-point Likert scale) designed to assess their attitude to the scenario: 1) "How much do you disagree/agree with the way these cows are being raised?"; 2) "How inappropriate/appropriate do you consider the cow's living conditions to be?"; and 3) "Do you consider the way these cows are living to be unacceptable/acceptable?". Participants were then invited to respond two open-ended questions: 1) "Please explain your general opinion about the scenario you read"; and 2) "If there was one thing you could change about this farm what would that be?"

Additional questions (also using a Likert five-point scale) assessed potential reasons for the attitude based on an animal welfare

construct of affective states (two questions: "How unlikely/likely do you think it is that the cows described in the scenario are suffering?" and "In your point of view how are these cows feeling?"), biological functioning (one question: "How healthy would you say these cows are?") and naturalness (one question: "How natural do you consider the environment where these cows are kept?"). Also we asked about animal welfare per se in two questions: welfare ("How do you describe the welfare of the cows you read about it?") and quality of life ("How would you describe the cow's quality of life?").

Participants were then asked a series of socio-demographic questions (age, sex, level of educational attainment, place of residence – urban, suburban, or rural – and income). The survey ended with four multiple choice questions (true or false) to test participant knowledge about dairy production (all answers were in fact true): 1) The majority of dairy cows in U.S. are housed indoors; 2) A dairy cow needs to have a calf to keep producing milk; 3) The majority of cows and calves are separated from each other within the first few hours of birth; 4) Most dairy calves have their horns removed when their are born, either with a hot iron or with caustic paste. Responses to these four questions were summed, creating a score that varied from 0 (low knowledge) to 4 (high knowledge).

Data analysis
Quantitative data

For the quantitative analysis we excluded 20 participants who provided invariant responses (i.e. marked the same response on all Likert scale questions) leaving 581 responses for the final analysis (136 in Scenario 1, 148 in Scenario 2, 145 in Scenario 3, and 152 in Scenario 4).

A weighted kappa was used to assess concordance between the three first attitude questions (i.e. how much they agreed with the scenario, how appropriate they considered it, and how much they considered the scenario acceptable); the weighted kappa coefficient was 0.84, indicating very good agreement, so these responses were averaged to create a score for participant *attitude* towards to scenario.

The effects of each the socio-demographic (*age*, *sex*, *education*, and *income*; 1 df each), *knowledge* of the dairy system (1 df), and the two treatments and their interaction (i.e. *pasture*, *heat mitigation* and *pasture x mitigation*; 1 df each) on attitude were tested using ANOVA.

To assess how *attitude* related to different components of welfare, we asked respondents questions intended to evaluate their views of the

scenario in terms of the cows' *biological functioning*, *naturalness* of the system, and two questions designed to assess the *affective state* component of welfare. For the latter two questions (*suffering* and *feeling*), the weighted kappa coefficient was 0.66 (indicating good agreement), so these two responses were averaged to create a composite score for *affective state*. Similarly, we asked two questions regarding animal well-being (*animal welfare* and *quality of life*); the weighted kappa coefficient was 0.79 (indicating good agreement), so these two responses were averaged to create a score for *well being*. The degree to which *biological functioning*, *naturalness*, *affective state* and *well being* were associated with participant *attitude* towards the scenarios was tested using Spearman rank correlations.

Least-square means and standard errors are presented below. Significant was declared for $P < 0.05$ and a tendency at $P < 0.1$.

Qualitative data

We received a total of 546 qualitative responses to the first open-ended question and 564 qualitative responses to the second open-ended question. These responses were analyzed with the aim of better understanding attitudes towards the scenarios. Responses were analyzed by treatment. Our analysis was based on Minayo (2012), using a hermeneutic-dialectic approach that involves exhaustive reading of responses and coding these into themes, giving meaning to the content based on understanding, interpretation and dialectic. To understand the meaning of the content, the PhD stuedent organized the material into topics, with the aim of better understanding responses. The interpretation phase involved re-reading the responses to make sure that the ascribed meanings made sense. The dialectic phase involved re-reading and questioning the interpretations and editing, as needed to improve reliability. For this analysis we focused our approach initially using the theoretical framework of Fraser et al. (1997) that reflects three types of concerns: 1) biological functioning and health; 2) affective states, including pain; and 3) naturalness, including the ability of animals to express natural behavior. We were also open to any other themes that arose following the thematic analyses.

5.1.3 Results

Profile of participants

Participant characteristics are summarized in Table 7. By design all participants were U.S. citizens. Participants were more likely to be

younger, male, have higher levels of educational attainment, and somewhat higher income relative to U.S. census averages. Scores for knowledge were higher than chance, with more than half the participants scoring 3 or 4 out of 4 on the knowledge questions.

Table 7. Responses of 581 participants to the socio-demographics questions asked in the survey, presented in relation to U.S. Census Bureau (BUREAU, 2010a, 2010b, 2016b, 2017) averages for the population.

Demographics	Variable	n	%	U.S. Census Bureau (%)
Age (years) [a]	19-29	220	38	14
	30-39	188	32	13
	40-49	82	14	14
	50 or older	91	16	32
Sex [a]	Male	324	56	49
	Female	257	44	51
Level of education [b]	Less than high school degree	5	1	10
	High school graduate	76	13	29
	Some college but no degree	125	22	16
	Associate degree	95	16	10
	Bachelor's degree	203	35	21
	Master's degree	63	11	9
	Doctoral degree	8	1	2
	Professional degree	6	1	1
Area of residence [c]	Urban	475	82	81
	Rural	106	18	19
Income previous year (US$ - households) [d]	Less than 35,000	203	34	32
	35,000-74,999	238	41	31
	75,000-149,999	122	21	26
	150,000 or more	18	3	11
Knowledge about dairy	Four of four questions correct	113	19	
	Three of four questions correct	191	33	
	Two of four questions correct	158	27	
	One of four questions correct	84	14	
	Zero of four questions correct	35	6	

[a] (Bureau, 2010a), [b] (Bureau, 2017), [c] (Bureau, 2010b), [d] (Bureau, 2016)

Quantitative results

Participants responded most positively to the scenarios that provided protection from heat stress: pasture access (Likert 4.1±0.08) and indoor housing with fans (Likert 3.5±0.08); and responded less positively to the scenarios that do not protected cows from heat stress: pasture rearing system that exposed cows to heat stress (Likert 2.4±0.08), and least positively to scenario with indoor housing and heat stress (Likert 2.2±0.08) (Figure 8). So attitudes were more positive to the scenarios with heat mitigation relative to those without ($F_{1,570}=382.8$, $P<0.0001$), and more positive to the scenarios with pasture versus

indoor housing ($F_{1,570}$=18.4, P<0.0001). We also found evidence of a weak interaction between these two effects ($F_{1,570}$=5.1, P<0.0237), driven by more favorable attitudes to indoor housing with fans than to pasture without shade. Of the socio-demographic factors only sex was significant ($F_{1,535}$=12.8, P<0.0004), with females having a less favorable attitude than males (attitude scores averaging 2.9 ± 0.06 vs. 3.2 ± 0.05, respectively).

The three constructs of animal welfare (naturalness, affective states and biological functioning), and the overall construct of well being, were all positively correlated with attitude (Spearman r=0.55, 0.84, 0.77, 0.87 respectively, all Ps<0.0001).

Figure 8. Mean ± SE attitude of participants (n=581) to scenarios that described dairy cows either having access to pasture or indoor housing, experiencing or not experiencing heat stress (i.e. shade on pasture and fans indoors). Attitude was a construct consisting of the average of Likert (1 to 5) responses to three questions, where higher numbers indicate a more positive attitude.

Qualitative results

Participants justified their attitude towards the scenarios using arguments related to the cows' affective state, biological function, and natural living, as well as in relation to a duty of farmers to care for the cow and a lack of information in the scenario. These arguments are discussed in turn below.

Arguments based on affective states

Participants assigned to the scenario describing cows on pasture with access to shade justified their mostly positive attitudes by arguing that the cows were outdoors, able to graze, with space and shade for warm conditions, such that basic needs were met. For example one

participant explained: "I like that the cows have an open pasture to live in and access to enough shade to keep cool on hot days" (P430). Another wrote "The pasture has a shady area where the cows can go when it's hot. Adequate conditions" (P189).

In response to the scenario describing pasture without access to shade, participants described the suffering from heat stress as "inhumane", and "unacceptable". For example, one participant explained that "They are living beings and they need shade too.... It'd be nice if they had a shelter" (P98).

In response to the scenario describing indoor housing with fans, positive attitudes regarding were justified on the basis that "[Cows] are being treated in a very humane way" (P78), that "The cows are kept comfortable with fans" (P166). Some specifically stated that some level of confinement was acceptable if this was accompanied with good conditions, "As long as the cows aren't in pain or very confined, I'm okay with it" (P61), and "If the cows are being treated humanely, I don't have any issues with them being kept in a barn" (P270). Other participants simply felt that there was no obvious problem with the scenario, stating that "There is nothing negative in the cows' situation" (P138).

Participants who received the least positive scenario (indoor housing without fans) justified their more negative attitudes on the basis that cows may be suffering from heat stress and were not able to go outside, i.e., "This seems to be animal cruelty" (P234); "The cows don't have freedom to roam and are trapped in a room. They are subject to uncomfortable heat... that is animal abuse" (P294).

Arguments based on biological functioning (health)

Many participants were concerned about cows' health in scenarios associated with heat stress: "I believe it should be made sure that the cows are as healthy as can be" (P37); "Cows that can find comfortable places to rest are raised as healthier than cows than farm that do not provide such places" (P302); "They are in an unhealthy environment" (P39). Several participants expressed concern that cows might be physically harmed from heat stress, i.e., "The conditions in which the cows are raised are not good at all for the health and performance of the cows" (P123); "I believe the cows should not [have] their health jeopardized due to heat stress" (P492).

For the scenario in which fans were provided, people related this to good health. For example, one participant stated "I appreciate that you've added fans in the barns for the cow's comfort/health" (P102).

Participants also felt that heat stress could affect milk quality, e.g. "If they are in too much heat they will be stressed out and it will affect the quality of their milk" (P128), to milk production, e.g. "I suspect the fans ensure the cows are comfortable enough to produce more milk" (P102), and to reproduction, e.g. "If the cows are experiencing heatstroke, that means they're not healthy. If they're not healthy, they're probably going to have problems reproducing" (P569).

A few participants believed that cows could died from the heat stress, for example, one claimed that "The cows are certain to die under these conditions" (P328) and another stated "Dying of heat exhaustion would be a cruel and painful way to die" (P451).

Arguments based on naturalness

Some participants expressed positive attitudes to the scenario describing pasture access without shade, often basing their arguments on naturalness. For example, one participant stated that "They are cows, being outside is their natural environment" (P134), and another argued that "I think that it would be preferable if the cows had shade. However, it's much better that they are on pasture versus living in a barn or in confined corrals between milkings" (P464). A few seemed to implicitly agree with the welfare trade off, stating "I think it is perfectly fine given the information" (P361). Others were more explicit about the acceptability of the trade off, arguing "I don't like the fact that the animals can suffer from heat exposure. However, I believe it is better than suffering by being constantly locked up" (P459)

Similarly, negative attitudes of some participants to the scenario describing indoor housing with fans were sometimes based upon concerns about naturalness. One participant wrote "I think that cows should be able to be outside and not stuck in a barn" (P70). Another claimed "Cows are animals and shouldn't be caged, even in a barn. They should be allowed to free roam and enjoy the sunshine and grass!" (P306). Several explicitly argued that having fans within the barn was not enough to justify the lack of pasture access. For example, one stated "So, because a dairy cow has access to food and gets a fan to circulate the air this is supposed to be considered humane? (…) These cows are not properly cared for" (P256). Yet another argued "It's nice that the cows are being kept in a comfortable living area, but it's only natural and fair for them to be allowed to go outside sometimes" (P332). A third argued "[Although] conditions are relatively comfortable, it's not the natural way of things in my opinion" (P572).

Some participants responding to the pasture without shade scenario justified their attitudes using comparisons to cattle living in the wild. For example "Cows are made to graze in the sun. They are animals" (P396), and "That is probably how many cows go through life. The fact is that most cows probably experience much, much, worse circumstances. In the 'wild' they would probably also experience heat stress without man made shelters and assistance" (P285). Others using comparisons to cattle living in what they considered to be standard conditions on farms, stating "It is not ideal but better than most commercial operations" (P341), and "Cattle don't have shelters while roaming on large pastures that cover thousands of acres. They have survived for years without shelter" (P584). Similarly, participants responding to the scenario describing indoor housing without fans often justified their attitudes using comparisons to natural conditions, stating "Cows in the wild wouldn't have fans either so these cows don't necessarily need fans either" (P174), "I don't think that in nature animals get fans" (P321), and "Cows in nature don't have air conditioning" (P350).

Arguments based on a duty of care

Some participants argued that it was a moral responsibility to provide protection to the cows, stating "The cows are providing [the farmers] with an income, the least they could do is give them a shaded area" (P221). Participants often expressed some moral judgment about the way farmers were rearing their cows. For example, participants commented that they could not understand why farmers would not plant trees, a solution that they believed was obvious and easy to apply. For example, "I don't really see any excuse for them to be in the sun all day long with no shade" (P183), "There's no excuse not to provide any type of shade under these conditions" (P473), and "Shelter would not be that hard or expensive to construct" (P496). Similarly, they felt that fans (for indoor housing) were easy and inexpensive to install, stating "Since it is easily fixable, it is cruel and inhumane to make them suffer now" (P54), "I'm not sure why cows can't get fans installed...? It doesn't make any sense" (P191), and "The cows are suffering needlessly from a problem that seems to have an inexpensive solution (fan blowing)" (P429).

Some participants also made a comparison of the scenario presented with situations they considered typical on commercial farms and that were either similar or worse for the cows. This rationale was often applied to the scenarios in which participants had to deal with the trade off. For example, "It is not unusual to see cows in pastures that

have little or no shade" (P593), and "…[It] doesn't seem that bad compared to other animal situations" (P171).

Arguments based on a lack of information

Several participants expressed a more neutral attitude towards the scenarios, often stating that this was due to a lack of information. For example, in response to the pasture with shade scenario participants stated "I need more details. It does sound like a nicer condition than most cows are raised in, but I only see the positives here. What other conditions like how they're fed/etc. are in play?" (P284), and "I didn't receive enough information to be able to make an informed judgment about the cows' living conditions" (P413). For the pasture without shade scenario one participant said "I would need to see the environment first to understand what is really happening" (P487). Similarly, participants assigned to the indoor housing with fans scenario argued "My answers were neutral because I felt I wasn't given enough information about the cows' conditions within the space, other than temperature" (P525), and "I felt there wasn't enough information to form an opinion on how the cows were being raised/treated. How much space do they have to walk around? Are they allowed to go outside?" (P91). Some participants in the most negative scenario (indoors without fans) made similar arguments, stating "I don't have enough affirmation on this matter I don't know if they must be kept this way for the better of the dairy" (P305), and "I don't have a strong opinion about this. I'm not sure how much animals feel pain and suffer, so I don't have a strong answer" (P472).

Improving the environment – changing scenarios

To better identify what participants considered problematic, they were asked to suggest changes to the scenario. People assigned to the scenario with pasture and shade suggested improvements in the amount of resources available to the animals (e.g. shade, water, and space) and stated that is was important that cows were healthy in that environment. For the scenario with pasture but without shade, participant comments focused on planting trees for shade constructing some shelter to protect the cows (Figure 9).

Participants assigned to the indoor scenarios often suggested allowing the animals to go outside, including providing cows access to pasture with trees for shade. This hybrid solution was considered to provide conditions described as "pretty much ideal", a "good place to live", and a "very humane situation". One quote summarized this

desired scenario: "The best scenario would be to let the cows freely graze on pasture which is shaded with trees, and when they are in the barn to be fed or milked, have an evaporative cooling system in operation" (P148).
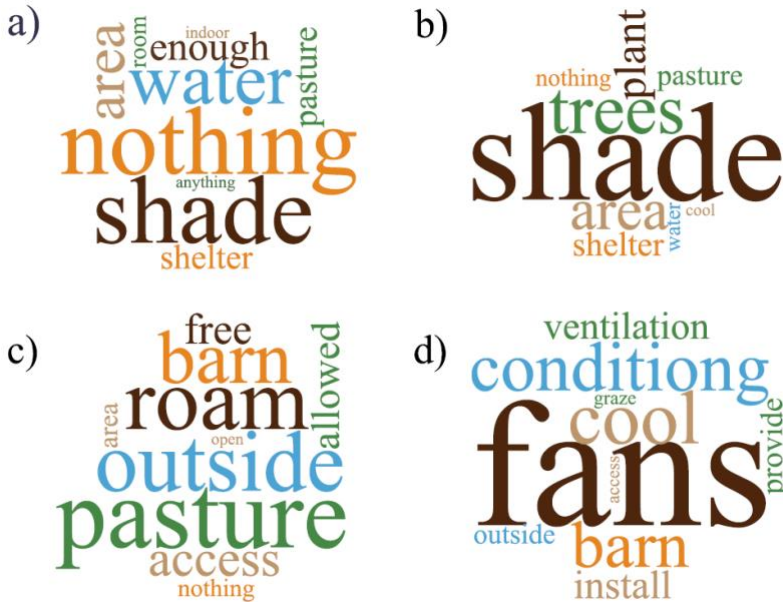
Figure 9. Word clouds generated using the 10 most frequent words in response to the question "If there were one thing you could change about this farm what would that be?" The words appearing in larger bolder type were used most frequently. Responses of participants assigned to the four scenarios are shown separately: a) pasture with shade, b) pasture without shade, c) indoor housing with fans, and d) indoor housing without fans.

5.1.4 Discussion

The results of this study indicate that participants valued both access to pasture and protection from heat stress when assessing rearing conditions for dairy cattle. In addition, when participants encountered scenarios that placed welfare concerns in conflict, they showed a more positive attitude to a scenario that kept cows indoors but provided fans to mitigate heat stress, versus a scenario in which cows were kept on pasture without access to shade. In this situation at least, it seems that

participants prioritized welfare concerns about heat stress (associated with poor affective states and biological functioning) over concerns about access to the outdoors (associated with naturalness). Thus the most favorable attitudes were to the option of pasture with shade, followed by indoor housing with fans, and the latter two options (outdoors with no shade and indoors with no fans) were perceived much less favorably. In our survey we included quantitative assessments of the scenarios in terms of different welfare components (naturalness, affective state and biological function), as well as for a concept of well being that is arguably synonymous with welfare. We found that affective state, biological functioning and well being were all highly correlated with the participants' attitude towards the scenario, but that naturalness was somewhat less associated with attitude. These results may explain why participants favored the scenarios without heat stress versus those without pasture access when these features were in conflict.

Some previous work has suggested that affective states are the most important aspect of animal welfare construct. For example, Pettersson et al. (2016) asked why UK consumers bought free-range eggs, and found that participants ranked promoting the animals' happiness (affective states) as the first reason, followed by health (biological states) and then naturalness. Our data suggests that failure to provide protection from heat stress is considered unacceptable. Participants judged scenarios without heat mitigation as "inhumane". Some participants specifically commented on the obligation of farmers to protect their cows, and viewed the lack of heat mitigation as an unacceptable breach of this obligation. Our study suggests that although U.S. citizens prefer that cows have access to the outdoors, they would not support pasture-based systems without shade.

Arguments based on naturalness were cited in the open-ended responses to justify attitudes. People often associate naturalness with organic production, health and the environment (ROZIN; FISCHLER; SHIELDS-ARGELÈS, 2009, 2012). Previous work in different cultural and geographic contexts has shown that naturalness is often perceived as important (reviewed by Clark et al., 2016), perhaps especially in the context of food (ROMÁN; SÁNCHEZ-SILES; SIEGRIST, 2017). A series of studies in the U.S. and Europe have illustrated some of the meanings of naturalness and reasons for the people's positive attitudes towards this characteristic. Rozin et al. (2004) argued that people's preference for natural is explained because "natural is inherently better, in moral and/or aesthetic senses", which they called *ideational* aspect of naturalness. In a recent review about the importance of naturalness in

food, Román et al. (2017) categorized three attributes for naturalness that are important for people: 1) organic or local; 2) regarding ingredients (e.g. preservatives, chemicals, hormones, pesticides and GMOs), and processes (e.g. traditional or homemade); and 3) healthy, eco-friendly, tasty and fresh. Rozin et al. (2012) found that people relate natural much more with plants than with animals, but citizens often cite characteristics related to naturalness in farm animal contexts (e.g., BOOGAARD; OOSTING; BOCK, 2008; BOOGAARD et al., 2010). We argue that naturalness may be more important when considered in relation to animal products (i.e., milk), and less important when the animals are the center of the discussion (like in our study). We encourage research to investigate the reason for the importance of naturalness in farm animal contexts.

The qualitative responses also pointed to concerns related to naturalness, affective states and biological functioning, although participants dealt differently with the trade offs presented in our scenarios. It is likely that some participants felt uncomfortable with the situations where animals were likely to suffer from heat stress. Festinger's (1957) work on cognitive dissonance suggests that when presented with an internal conflict people attempt to minimize the problem (and thus alleviate the conflict). This may explain why participants 1) made comparisons between the scenarios and either natural or farming examples that they perceived to be worse (thus arguing that the situation was not that bad), 2) suggested that installing shade and cooling systems was cheap and straightforward (thus suggesting that the solutions to the dilemma were easy), and 3) argued that we did not provide enough information (thus allowing them to abstain from judgment). The emergence of these strategies also suggests that, as intended, the scenarios presented uncomfortable trade offs for the participants.

Although some participants believed that planting trees for shade is straightforward, research suggests that farmer' attitudes to trees on pasture can be complex (MEIJER et al., 2015). Also, access to high quality planting material, management skill, information, technical advice and damage by cattle, leaf-cutting ants, wind or competition by grasses can be barriers for farmers (CALLE; MONTAGNINI; ZULUAGA, 2009; VAN NOORDWIJK et al., 2008). We suggest that a failure to plant trees should not be viewed as a simple case of neglect, and encourage new research examining the perceived social, economic and technical barriers faced by farmers. This issue highlights the distance between rural and urban/suburban citizens (see SCHNEIDER,

2009). For this issue it may be helpful to create forums for conversation about contentious issues, allowing a better understanding of citizens' views and farmers' constraints (BERGSTRA; HOGEVEEN; STASSEN, 2017).

Other than sex, socio-demographic characteristics did not relate to participant attitude towards the scenarios. Gender effects are commonly reported in studies on attitudes towards farm animal welfare (CLARK et al., 2016). The lack of other demographic effects suggests that the concerns we have identified are broadly held across a range of demographic categories. This generality may be associated with familiarity of the issue, and that our participants had high scores in knowledge about dairy production. Mistreatment has been broadly reported on U.S. dairy farms in recent years (ANDREWS, 2017; GIBSON, 2015; KOWALSKI, 2014), so this issue is likely familiar to the public. Interestingly, some participants mentioned that cows could die from heat stress, likely increasing the concern around heat mitigation. Indeed, many cases of cattle death are associated to heat stress in North America as reported in the news (CARTER, 2014; MOELLER JR, 2011; OSGOOD, 2017) and in the scientific literature (BUSBY; LOY, 1996; BISHOP-WILLIAMS et al., 2015).

Previous studies have reported that MTurk participants tend to be younger and more urban than expected in a representative sample of U.S. participants (BOHANNON, 2016). Participants in the current study were younger, but not more urban when compared to census averages. Our study had more male participants, with higher levels of education and income than the general population. Despite these differences from census averages we remind readers that we found no relation between socio-demographic characteristics and attitudes regarding the scenarios.

Most dairy farms in the US use indoor housing (~80%); only 7.5% of farms are pasture-based (USDA, 2014, p. 163). Participants seem willing to accept housing systems when it provides comfort for the animals. This may be because participants realized that this was the normal form of housing; most respondents correctly responded that most dairy cows in U.S. were kept indoors. Knowledge about farming can ameliorate some attitudes regarding aspects related to dairy systems (VENTURA et al., 2016a) and can contribute to forming more complex opinions about farming (BOOGAARD et al., 2010). The results might differ for participants from countries where most of cows are pasture reared (e.g., Brazil and New Zealand). We encourage other studies to investigate these questions in places with different dairy production systems to investigate which system would be more socially acceptable.

When asked what changes participants would like in the scenario, participants often called for mixed systems (providing access to well managed indoor and outdoor spaces). Other studies have found that these systems can work well for cows, allowing them to choose to enter the barn or to visit pasture depending upon the time of day, season, where feed is provided and previous experience on pasture (CHARLTON; RUTTER, 2017). Unfortunately we did not provide a scenario describing this option; we predict that attitudes would be more favorable to this hybrid option than to any of the scenarios described in the current study.

5.1.5 Conclusions

Participant attitudes were most favorable to dairy cattle rearing systems that included pasture and shade, and least positive to indoor systems without fans, but attitudes were more favorable to indoor housing with fans than to pasture without shade. These results, and those of our qualitative analysis, suggest that participants were concerned about all three components typically considered inherent to animal welfare: the naturalness of the system (e.g. the cows' ability to express natural grazing behavior), cows' affect state (e.g. feeling uncomfortably hot), and biological functioning (e.g. health risks associated with heat stress). In addition, qualitative responses indicated that participants believed that farmers have a duty of care that includes protecting their animals for excess heat.

5.2 MEASURING MOTIVATION TO ASSESS THE IMPORTANCE OF SHADE FOR DAIRY HEIFERS PASTURE BASED REARED

5.2.1 Introduction

Over 80% of all cattle are kept in pasture based systems in the country (IBGE, 2009), which aligns with citizens' preferences around the world (BOOGAARD et al., 2010; BOOGAARD; OOSTING; BOCK, 2008; HÖTZEL et al., 2017; SCHUPPLI; VON KEYSERLINGK; WEARY, 2014). However, in many parts of the world (e.g., Brazil or parts of U.S.) animals may suffer from heat stress following exposure to solar radiation (reviewed by POLSKY; VON KEYSERLINGK, 2017). Excessive heat load negatively impacts both physiology (STEIGER BURGOS et al., 2001) and behaviour (SCHÜTZ

et al., 2010) of cattle. Allowing access to shade may mitigate the negative effects of heat stress (KAMAL et al., 2018) whereas depriving animals the opportunity to seek shade may affect their ability to perform natural behaviours, as well compromise their affective states and their biological functioning (VON KEYSERLINGK et al., 2009). However, little is known about the motivation expressed by cattle to access shade.

Preference and motivational tests for animals are broadly used in research to investigate the importance of resources to animals (KIRKDEN; PAJOR, 2006); thus, the motivation of cattle to access shade can be experimental tested to measure its importance. Motivation is defined as "the process within the brain controlling which behaviours and physiological changes occur and when they occur" (BROOM; FRASER, 2007, p. 40). Operant conditioning, where animals are required to perform some behaviour to receive a reward (SØRENSEN et al., 2001), is a common experimental paradigm used to assess motivation (DAWKINS, 1988; JENSEN; PEDERSEN, 2008). Briefly the animals learn to associate the reward with the need to perform a specific behaviour; a measurable cost can then be quantified following the performance of the behaviour, often referred to as the price paid (RUSHEN et al., 2008, p. 89). The underlying assumption is that the more the animals pay to access the reward, the stronger the motivation (JENSEN; PEDERSEN, 2008). In other words, animals pay more for resources they consider to be valuable (inelastic demand) and less for valuable resources that they consider less important (elastic demand) (DAWKINS, 1983). This, in summary, allows us to compare "how important different options are to animals" (FRASER; NICOL, 2011, p. 191).

Using this approach, Schütz et al. (2008) showed that lactating dairy cows preferred to stand in the shade rather than lie down in the sun, even after 12 hours of lying deprivation; indicating that shade is a highly valued resource. In another study, Legrand et al. (2009) showed that provision of shade could influences cows' motivation to access pasture or barn.

In this study we employed operant conditioning methods to assess non-pregnant dairy heifers' motivation strength to access shade in summer in the south of Brazil. Using weight as a barrier to restrict access to a resource was used to measure motivation in other species (DUNCAN; KITE, 1987 with hens; MANSER et al., 1996 with rats; MASON; COOPER; CLAREBROUGH, 2001 with minks) including cattle (VAN OS et al., 2017; VON KEYSERLINGK et al., 2017). Using a gate with increasing weights, we compared the heifers' motivation to

access an experimental area with shade in summer, the same area with reduced space and no shade, and the same area in autumn. We predicted that heifers would push more weight during the summer months to access shade than during the autumn months.

5.2.2 Material and methods

A wooden gate that was 0.8 m wide and 1.6 m high and a fixed pulley system that allowed for 5 kg weights to be attached such that when the force (F) used to push the gate (in newtons) was equivalent to the weight (in kilos). The weights were 5 kg washers held together by a fence post (Figura 10A). The weight on the gate was increased gradually over time (5 kg every 2 days of test), meaning that the animals had to increasingly pay a higher price to access the reward. The motivation tests were performed in three phases: 1) shade in summer, 2) empty space (summer control), and 3) shade in autumn. Before the tests, the heifers were habituated to the area and other experimental conditions and trained to push the gate.
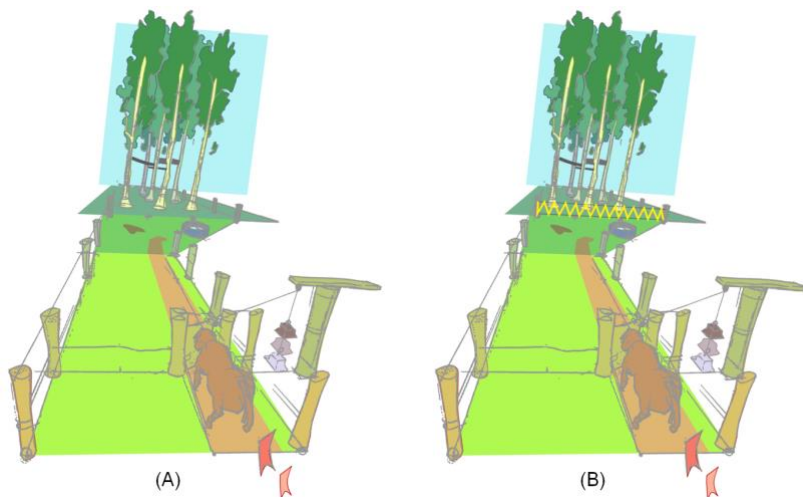
Figure 10. Gate functioning: the fixed pulley system fitted with a series of 5kg weights. (A) General view of the experimental area; (B) View of experimental area after closing the shade with the yellow band.

Animals and housing

The study was approved by Ethics Committee on Animal Use of Federal University of Santa Catarina, protocol 8610011215. The experiment was conducted from Month-Month (summer through autumn) of 2017 at the experimental farm of the Federal University of Santa Catarina (Florianópolis, Santa Catarina, Brazil; 17°40'25''S and 48°32'30''W). The region's climate is Cfa - a humid subtropical climate, according to the Köppen climate classification (revised by ALVARES; STAPE; SPAROVEK, 2013).

Eighteen 42 month old non-pregnant dairy heifers (Jersey x Holstein cros-bred) with an average body weight of 300 kg were used in the experiment. The heifers were managed on a rotational pasture system, Voisin grazing (explained by BALCÃO et al., 2017), that required them to be moved to a new paddock every day at 8:00 h (referred to as the home paddock). Each paddock was 50 x 50 m2 and enclosed using electric fencing. There was no shade available in any of the paddocks.

Experimental areas

The experimental area (Figure 10) had little pasture available for grazing and was 500m2: by 360 m2 (40 m x 9 m) consisted of natural tree shade, Eucalyptus sp. (or approximately 20 m2 of shade/animal) and 140 m2 was a space between the gate and the shade, without any trees, artificial shade, or pasture available for grazing. The former area will be referred to as the shaded area and the latter will be referred to as empty space. The entire area was enclosed using electric fencing. The artificial shade (80% of protection against solar radiation) measuring 75 m2 (25 m x 3 m) was placed at a height of 3 m, between the trees in the shaded area providing an additional 4 m2 of shade/animal (referred to as composite shade). This was done because the natural tree shade was sparse, so the artificial shade provided the environment with greater shade coverage, as well as of higher density where there was also natural shade.

Water was available at all times in 500 L water troughs placed in the all paddocks as well in the experimental area. Mineral saltboxes were also provided *ad libitum* in the home paddock. On each experimental day at 12:00 h the group was gently moved from the home paddock to the holding area, immediately adjacent to the test arena (Figure 11).
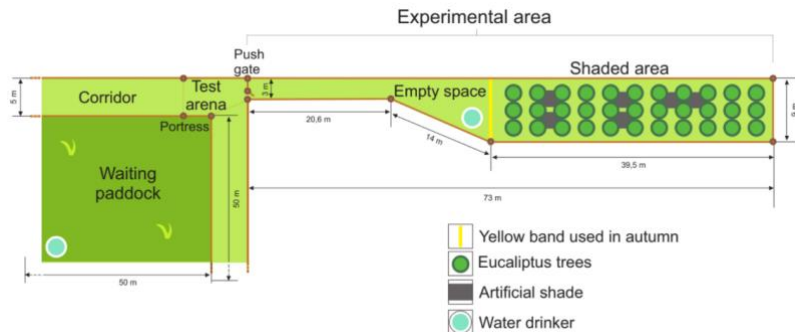
Figure 11. A view of the holding area, the test arena, the push gate and the experimental area (the empty space and the shaded area). The yellow band was used during the 'empty space' phase to restrict the space to the empty space. Surrounding this area, there were no buildings for at least 350 m.

Experimental set up

The heifers were conditioned to the start the trial at the sound of a bell that was rung when the researchers entered the home paddock to move them the holding area. The heifers entered the test arena individually. To control for order of training and testing, the order of the heifers was changed daily. Before the training to push the weighted gate (habituation period) took place over 3 days beginning with the gate being open, allowing the heifers to pass freely into the experimental area. The heifers stayed in the experimental area until some heifers started to leave voluntarily or the weather turned cloudy, or it was 16:00 h. After that, the group was returned to the home paddock. After the gate was opened around 30° and during the tests, the heifers needed to push the gate to enter in the experimental area.

Experimental days had to meet one of the following criteria: weather was sunny and/or partially cloudy (to create shade) or warm days in summer treatments (above 30°C under shade). For the other two phases of the experiment (see below) the experimental days were not limited by weather.

Habituation to the shaded area and training period

The experimental area was outside of the pasture area, and was thus novel to the heifers. In the habituation period the aim was for the heifers to become familiar with the area and learn that the shade provided a fresher area than non-shaded areas. In the first days of the habituation period, the heifers were moved from the home paddock

directly to the shaded area. After three days, they were moved to the waiting paddock to become familiar with the routine; essentially, they needed to learn to stay in the waiting paddock for around 10 min to get calm after the walking before the training or tests started, and to be tested individually. The habituation period was finished when the heifers learned to move to the waiting paddock as a group, and from there to the shaded area individually.

After the habituation period, the training started. The heifers were led from their home paddock to the waiting paddock at the same time of the day as they were during the habituation period (around noon). All the heifers were trained individually to push the gate, with access to shade as the reward reinforcing this behaviour. The goal of the training was for the heifers to recognize the gate and learn that they could pass it by pushing it with their body. The method of bringing the cows from the waiting paddock to the experimental area was the same as the one used for habituation, adding that we rung the same bell used in the home paddock as a signal to bring them close to the test arena.

The training consisted in the heifer pushing the gate and entering the experimental area within two minutes. The gate was closed 15° every two or three days, depending on each heifer's response, until they pushed the gate completely (i.e., 90°; 75°; 60°; 45°; 30°; 15°; closed). The heifers were trained one step by day. If a heifer did not perform the daily task of passing the gate within 2 min, she had the opportunity to try again later during the same training session. Near the end of the 2 min, the heifers were encouraged to pass through the gate with vocal encouragement and/or rump nudges. If a heifer did not perform the daily task on her second chance, she was provided with an opportunity to pass through the same gate opening as in the previous day. If she did not perform the task, she remained on the step of training for up to three days, after which it was considered that she did not learn and she was removed from the experiment. The tests began immediately after the training period ended.

Testing period
Phase 1: Motivation to access shade in summer

All the heifers that pushed the gate when it was completely closed but without any weight during the training phase were tested. The sequence of events during the testing period mirrored that of the training phase: namely, a bell was rung while the heifers were in the home paddock to signal that testing was about to begin. After being moved to the holding paddock each heifer was tested individually; heifers were

required to initially push 5 kg to access the shaded area and this weight was increased by 5 kg following entry into the experimental area. If a heifer failed to push the gate within the 2 minutes of entering the test arena she was returned to the holding paddock and retested at the end of the day's test session. If the heifer failed to push the weighted gait during the 2 min of this second attempt, the gate was opened and she was allowed to enter the shaded area. Heifers were allowed to get the reward to avoid frustrating them if they did not pass the test on a given day, which could form a negative association with the area. An additional 5 kg was added after 2 successful days of pushing a given weight until each heifer failed to push the weighted gait. The last weight successfully pushed by each heifer was considered to be the maximum weight pushed.

Phase 2: Motivation to access the empty space

All heifers were then tested to access the empty space. An electric fence was separated the shaded area from the remainder of the experimental area when the heifers were tested to assess their motivation to access the empty space. To ensure that the heifers were aware that the shaded area was not available yellow fencing material was added near to the gate and in the electric fence as a cue to the heifers that the shaded area was closed (Figure 10B). The heifers were habituated to recognize the visual cue (the yellow band) indicating that shaded area was not accessible.

After 11 days of habituation to the empty space as the heifers did not want to enter to the empty space, the gate was left open while the heifers were in the holding area, followed by a re-training period, consisting of 3 days. On day 1 the gate was opened at 90° to allow all heifers to enter the empty space without having to push the weighted gate; on day 2 the angle of the gate was reduced to 30° and on day 3 the gate was closed thereby requiring the heifers to push the gate in order to enter access the empty space. Heifers that chose to enter the empty space stayed in small groups and remain there for a maximum of 5 min.

Phase 3: Motivation to access shade in autumn

Initially, the same 18 heifers were habituated during 4 days in the same area to recognize that the shade was accessible again. After this period a re-training session was run for 3 days, with the gate open 90°, 30° and closed but without weight. Only the heifers that pushed the gate when it was closed were tested for shade in autumn (n = 15), while the others were allowed to enter the shade with the gate open during all this

phase. After the re-training period was completed, the same methodology described above for testing during summer was employed.

Ethogram and social hierarchy

Heifer behavior while in the shaded area was recorded using 10 min scan sampling every 3 days, resulting in 12 days of observation during the summer and 3 days during the autumn phase. Specific behaviors and location (no shade, composite or simple shade) that were recorded were standing or lying, ruminating or movement in the environment. Agonistic interactions (including the instigator and the victim) and grooming (autogrooming, allogrooming and grooming on the trees - scratching) were recorded. In summer there were 12 days of observation, with a total of 99 scans. In autumn there were 3 days of observation with 18 scans.

The social hierarchy of the group of heifers was estimated from data collected for another experiment six months before this experiment. The methodology had been previously described by Coimbra et al. (2012) and was used to calculate a social matrix that took into consideration the agonistic interactions observed in the experimental area.

Other data

The following information about the heifers was collected during the training and all testing phases: the order that heifers left the holding area, the latency of each heifer in each trial to push the gate (the time, in seconds, from when the body of the heifer was completely outside of the holding area until it was completely inside the experimental area), if the heifer pushed the gate in two minutes (yes/no), and which heifer pushed in one trial vs. two.

Climatic data

Temperature and humidity measures were collected during the habituation, training and test periods, both in the shaded area and under the sun (except in phase 2). Two digital thermo-hygrometers (Incoterm 7664.01.0.00, China) were placed, one under the sun and other under the single (tree) shade (outside of the fenced area) at 0.5 m height of soil during the whole period that heifers spent in the shaded area. These data were used to calculate the heat index (NWS, 2014), e.g., the apparent temperature, calculated from a combination between temperature (average of the period) and relative humidity (average of the period) through the website of Center of Information of Environmental

Resources and Hydrometeorology of Santa Catarina (CIRAM, http://ciram.epagri.sc.gov.br) that was based on National Weather Service's (NWS) equation.

Data analysis

We used descriptive statistics for behavioral and climatic data to show averages and percentages. The frequency of behaviors observed in scans was calculated dividing the number of scans of each heifer by the total time (in minutes) of observation. The number of events (agonistic interactions and grooming) per day was calculated for all days of observation. Events (negative interactions under sun, composite or single shade, and grooming) were adjusted to be presented as number of events/h/heifer.

Statistical analyses were done with R (R CORE TEAM, 2017). Student paired t-tests were used to test differences between summer and autumn for maximum weight pushed, latency to push the gate, duration of training and tests period, time spent under sun and shade (composite + single); time spent under composite and single shade; time lying, standing up and ruminating, and time spent under sun. A simple t-test was used to compare data of the group for time spent in the shaded area in summer and autumn, and climatic data (maximum temperatures and heat index) in summer and autumn. To test for associations between social dominance and the type of shade used we chose the six heifers of higher rank and the six heifers of lower rank and applied a linear regression. Pearson correlation coefficient was used for test for correlations between maximum weight pushed in summer vs. autumn, and between maximum weight pushed vs. average body weight.

5.2.3 Results

Motivation to access shade

In phase 1, in the summer, the training phase was finished in 16 days, and all heifers (n=18) could be tested to access shade, which was completed in 22 days. Figure 12 shows a line representing the number of heifers that pushed the gate to access shade along the testing period. On average, the weight pushed by the 18 heifers to access shade during the summer was 38 kg (SD = 18.3), the minimum was 5kg and the maximum was 60kg. During the autumn, three heifers refused to push the gate closed with 0 kg during the re-training period. This Autumn phase had a total duration of 5 days, and the minimum weight pushed by

the heifers in this phase (n=15) was 20 kg, the maximum was 25 kg, and the average, 22 kg (SD = 6.32).

　　Heifers were individually more motivated to access shade during the summer than during the autumn, pushing on average 18 kg more weight during the summer (P<0.001). The weight pushed, considering the mean of the period, was not correlated with the heifer's body weight (298 kg, SE = 6.68) (Pearson correlation, summer: P> 0.01 and autumn: P> 0.01), nor with social hierarchy (linear regression, summer: P=0.94 and autumn, P=0.54).
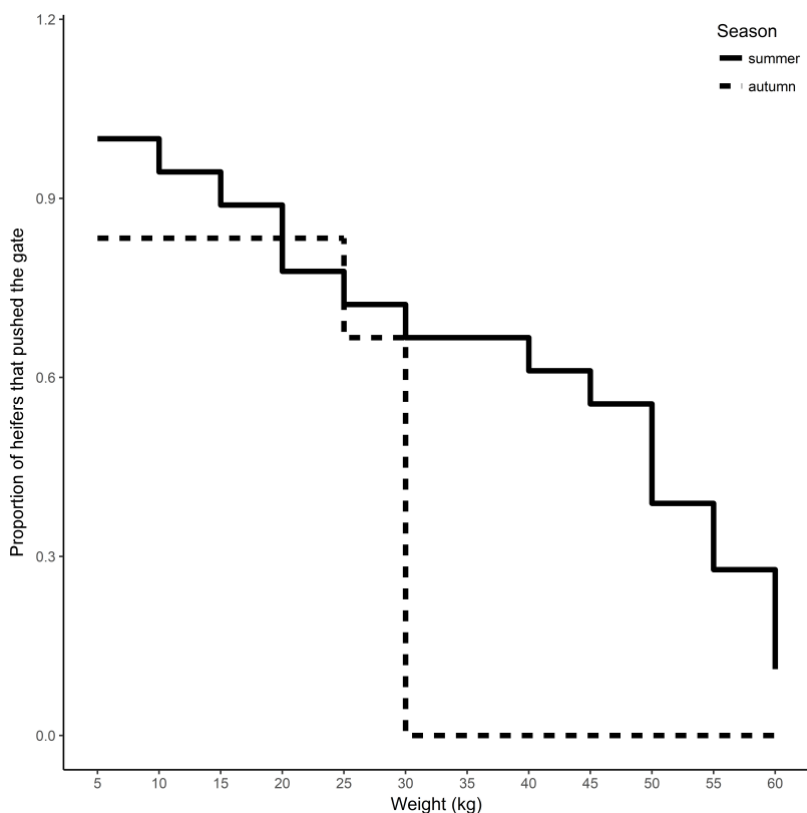
Figure 12. Proportion of heifers that pushed the gate in summer (dashed line, n=18) and in autumn (solid line, n=15); 5 to 60 kg, in 5 kg increments.

The average latency to leave the paddock and pass the gate to enter the shaded area was variable among heifers during the training period, varying from 6 sec to 2 min, which was the maximum time they were allowed. Latency to push the gate did not differ between summer (60.6 sec, SE = 8.64) and autumn (88.9 sec, SE = 17.8) testing periods (paired t-test, P>0.01). Latency to push the gate was inversely related to maximum weight pushed in both seasons (paired t-test, summer: P<0.05 and autumn: P<0.01).

Behavior of heifers in the experimental area

In the summer, heifers spent 69.3% (SD = 6.41) of their time ruminating, 48.8% (SD = 11.6) lying down, and 18% (SD = 11.1) of their time under sun in the experimental area. Also, the heifers spent more time under the composite shade (52.6% SE = 5.10) than under the single shade (27.4% SE = 3.50) (paired t-test, P<0.01).

In the autumn, heifers spent 54% (SD = 8.54) of their time ruminating and 43.8% (SD = 15.6) lying. They spent more time under sun (59.7% of their time, SE = 4.37) than under shade (40.3% of their time, SE = 3.52) (paired t-test, P<0.001) with no difference between the two types of shade (25.1% under single shade and 15.2% under composite shade) (paired t-test, P>0.01).

Comparisons between behavior when the heifers were in the experimental area in the two seasons are presenting in the Table 8.

Table 8. Differences in the heifers' behavior in the experimental area in summer and autumn during the experiment (mean ± SE).

Behavior	Summer (46 days)	Autumn (12 days)	P-value (paired t-test)
Total time experimental area	2h20min ±5.53	1h30min±14.4	P<0.01
Lying	49% ±2.74	44%±3.69	P>0.05
Standing	48%±2.59	56%±3.62	P<0.05
Ruminating	69%±1.51	54%±2.01	P<0.01
Time under sun	18%±3.52	60%±4.37	P<0.001

In relation to negative interaction, during the time the heifers spent in the experimental area in summer, we registered 0.3 events/heifer/observation hour; more than half of these events were under the composite shade. We registered a total of 156 events of grooming on the tree trunks, or 0.5 events/heifer/observation hour. In autumn heifers spent more time under sun and had 0.4 events/heifer/observation hour of negative interaction, more under sun than under the composite shade. During this period there were also 58

events of grooming on the tree trunks, or 1 event/heifer/observation hour.

There was a significant association between dominance and use of shade in summer, but not in autumn; in summer the heifers of low social rank used the composite shade less (39.0%, SE = 5.89) and the heifers of high rank used it more (66.5%, SE = 8.51) (linear regression, P<0.05). Also the heifers of low social rank used the single shade more (39.2%, SE = 5.35) and the heifers high rank used it less (19.2%, SE = 6.43) (linear regression, P=0.01).

Climatic data

There was significance difference between maximum temperatures and heat index under sun and under shade in summer and in autumn (t-test, Table 9). Also, under shade, the maximum temperatures in summer were higher than in autumn (P<0.001), as well the heat index (P<0.001).

Table 9. Differences between maximum temperature (°C) and heat index (°C) in summer and autumn during the whole time of the experiment (mean ± SE).

Season	Max. T sun	Max. T shade	P-value	Heat index sun	Heat index shade	P-value
Summer	41.3 ±0.45	34.0±0.45	P<0.001	43.4±0.71	36.0±0.70	P<0.001
Autumn	30.3±1.07	25.4±0.77	P=0.001	28.1±1.05	24.4±0.78	P=0.01

5.2.4 Discussion

The heifers pushed more weight to access shade in summer than in autumn; however, they did not push weight to access the empty space, when the shaded area was closed, altogether indicating that weight pushed was associated with motivation to access the shade. Weight pushed was inversely related to the latency to push the gate in both seasons, i.e. more motivated heifers not only pushed more weight but completed the task faster. Further supporting that heifers were motivated to access the shade, they spent more time in the shaded area in summer than in autumn, and spent more time under the shade provided in this area in summer than in autumn. The maximum temperatures and heat index were higher in summer than in autumn and higher under sun than under the shade in both seasons, indicating that shade provided a cooler environment for the animals. Our results indicate that shade is a valuable resource for dairy heifers managed on a pasture system, more in summer than in autumn, possible because shade

provides a cooler environment than the pasture without shade. Furthermore, the individual differences in the motivation to access shade identified in the study suggesting that different animals value differently the resources, as discussed by Val-Laillet (2008).

The maximum weight pushed by cows in summer represents 20% on the average of their body weight. In other studies, lactating Canadian Holstein cows pushed, on average, a maximum of 11% of their body weight (VON KEYSERLINGK et al., 2017), and Angus-Hereford cross beef heifers pushed 18% of their body weight (VAN OS et al., 2017) both to access feed. Lactating animals are more susceptible to heat stress given the metabolic heat generated by milk production, indicating that heifers would suffer less from heat stress (WEST, 2003). So, our findings indicate that shade is important even for non-lactating dairy heifers, adding to other studies that showed that shade is important for lactating dairy cows (SCHÜTZ; COX; MATTHEWS, 2008), and a factor that could affect motivation to access pasture (LEGRAND; VON KEYSERLINGK; WEARY, 2009).

The weight pushed to access shade in summer was not related to the heifers' body weight, corroborating results of Manser et al. (1996), and showing that heifers' physical abilities do not explain individual differences. However, this and other studies suggest that motivation is an individual characteristic (MAIA et al., 2017; MAIA; VOLPATO, 2016). As pointed by Van Os et al. (2017), individual personality may play a role in the motivation. Personality in animals can be defined as "those characteristics of individuals that describe and account for temporally stable patterns of affect, cognition, and behaviour" (GOSLING, 2008). Yet, personality is focused on behavioural traits (GOSLING, 2008), so individual behavioural differences, like motivation to access shade, could be explained by an individual's personality. For example, characteristics like fearfulness, sociability, exploratory behaviour, or response to novelty (HASKELL; SIMM; TURNER, 2014; RÉALE et al., 2007) could differently influence the individual motivation of a heifer to push the gate to access shade.

Space restriction was possibly the reason why heifers did not to push any weight to access the empty space, as the space available in the empty space (7m2/animal) was much smaller than in the whole experimental area (~28m2/animal). It is possible that the heifers were showing a "dispreference" for the empty space, using the term coined by (MAIA et al., 2017) for items that animals avoid. Although we did not perform a preference test neither measured the heifers' index preference to assess their preference to access the area with and without shade as

suggested by Maia and Volpato (2016), we argue that, as pointed by Kirkden and Pajor (2006), motivation is associated with preference, so that if animals have a high preference they will show high motivation. Given that when we opened the shaded area again in autumn the heifers pushed weight to access it, we can conclude that heifers did not want to access the empty space, suggesting they did not like it.

The fact the heifers pushed some weight to access shade in autumn suggests that shade was valuable for them not just because of its cooling properties, but because they enjoyed the environment provided by the shaded area. This is supported by the fact that they spent more time under sun than under shade in the experimental area in this phase, and that temperature to maintain the homeothermy is at up to 24°C without sweating (BERMAN; MELTZER, 1973) so in autumn the heifers were not under heat stress. However, climate conditions are not the only reason why cows enjoy natural shade; in a study comparing natural shade and an artificial shelter with similar climate conditions, cattle preferred to stay under natural shade (VAN LAER et al., 2015). In both seasons the heifers performed rumination and grooming in the experimental area, and spent half of their time lying down. Ruminating and lying are associated with resting and are important to conserve energy (BROOM; FRASER, 2007, p. 199, 122). Heat stress, on the other hand, decreases pasture consumption, milk production in lactating cows and body weight in heifers (reviewed by WEST, 2003). Also, the trees allow animals to perform grooming. Tree-grooming refers basically to scratching parts of the body that cattle cannot do by themselves, and is related to body care and comfort (BROOM; FRASER, 2007, p. 93). Kohari et al. (2007) investigated the role of trees on pasture for grazing cattle and concluded that this type of grooming is not replaced by others like auto and allogrooming, and that trees provide a good environmental enrichment that satisfies cattle's need for grooming. In addition, McConnachie et al. (in preparation) concluded that dairy cows are strongly motivated to access a mechanical brush, which they use for scratches, showing that it is a valuable resource for cows in free-stall housing. Our results suggest that trees are important for the cattle and highlight the importance of natural shade on pasture-based systems.

The majority of the heifers stopped pushing the gate to access shade in autumn at the same weight, suggesting that they perceived the effort to push the gate excessive for the reward. Animals work until a certain point for a given reward and stop to work when the effort becomes an inefficient use of time to get the reward (COOPER;

ARNEY; PHILLIPS, 2010). In other words, Fraser and Duncan (FRASER; DUNCAN, 1998) suggest that animals have "motivational affective states" and work to access resources that they feel pleasurable if the cost is sufficiently low. Apparently temperature was no different in the last days of experiment, when the heifers did not push the gate nor other event that could potentially affect that behaviour. A possible explanation could be that the leaders (the group of heifers who usually started the tests) were not interested to go to the experimental area and she influenced the other heifers.

In summer, when it was cooler under the shade compared to the paddock without shade, heifers preferred the composite instead of the single shade; also, in the same season the composite shade was more used by heifers of higher social rank, probably because it provided better refreshment than the tree shade alone. Although we could not measure the climatic difference under the two types of shade, the fact that the heifers preferred the composite shade suggests that it was the most comfortable. In fact, Schütz et al. (2009) concluded that dairy cows have preference for shade that offers greater protection against solar radiation in summer. Complementarily, in summer, but not in autumn, most agonistic interactions occurred under the composite shade, suggesting that heifers competed to obtain relief from the heat. High ranking individuals have priority of access to resources over low ranking individuals (KEELING; GONYOU, 2001, p. 22). As social hierarchy was not correlated weight pushed to access shade, it seems that some low ranking heifers had great motivation to access shade but could not use the better quality of shade due to social competition. The available amount of artificial shade (4m2/shade/heifer) was close to the 2.4 and 9.6 m2/shade/cow used by Schütz et al. (2010), who found that agonistic interactions where inversely related to the amount of shade available, mainly when heat load increased. Overall it is recognized that dominance aggression is expressed to access essential resources (BLAUSTEIN; LAJTHA, 2006, p. 288), which suggests that the amount of composite shade provided in our study was not sufficient to prevent agonistic interactions. As Val-Laillet et al. (2008) concluded, competition for resources by dairy cattle depends on the resource, which is related to the motivation to access it. These results reiterate the findings of Tucker et al. (2008) and Coimbra et al. (2012) on the importance offering resources in enough amounts so all the animals of the herd can access it simultaneously. Independently of the amount of shade recommended, farmers could use agonistic interactions as an indication of adequacy.

Fraser and Duncan (1998) proposed there are two types of motivation: one that is to reduce or eliminate negative motivational affective states (e.g., in this case, accessing shade to avoid or eliminate heat stress), or motivation to respond to opportunity situations that involve pleasure (e.g., in this case, accessing shade to experience pleasure). Our findings suggest that the heifers experienced positive states when accessing the shaded area, as they worked to access it also in autumn when the climate condition was not a problem, so much that they spent more time under sun. Considering that, we strongly recommend the use of natural shade for cattle in pasture based systems, not just to avoid heat stress but also to promote positive states and thus improve animal welfare. We encourage future research to investigate the motivation of dairy cattle to access shade compared with other resources and in a different experimental design and investigate the influence of personality in motivation tests. We recommend the use of high quality natural (tree) shade in pasture based dairy farms, in enough amounts for all animals, because this is a valuable resource that lower ranking animals may not be able to access when it is restricted.

5.2.5 Conclusions

Dairy heifers reared in a pasture-based system showed strong motivation to access shade in summer, pushing a weight equivalent to more than 20% of their body weight. The motivation was stronger in summer than in autumn and it was positively associated with the latency to pass the gate. Heifers preferred to stay under a composite shade than under the simple tree shade, which was used more by the higher ranking than lower ranking heifers. Shade seemed important for the animals in summer for lying down and ruminating. Trees had also an importance for grooming in summer and in autumn.

6 GENERAL DISCUSSION

In this thesis we explored the relevant aspects for different stakeholders about what constitutes an ideal dairy farm and associated reasons, to investigate if animal welfare was considered an important characteristic. In two studies, one with Brazilian lay citizens and stakeholders involved with agriculture (e.g., farmers and veterinarians) and another with U.S. lay citizens, participants pointed animal welfare as a concern in dairy production. In Brazil, lay citizens were concerned with animal welfare and with milk quality, and many considered that both features are associated. For those involved with agriculture animal welfare was considered important because it was viewed as a societal demand. In the U.S. lay citizens were mainly concerned with the quality of treatment of animals. In a second study we explored in more detail which characteristics related to animal welfare were important for lay Brazilian citizens. Surprisingly they cited a range of characteristics, showing concern encompassing all constructs of animal welfare: health and biological functioning, animal's feelings and ability to perform natural behaviors. Not less important, Brazilians massively rejected four common practices on commercial dairy farms: early cow-calf separation; zero-grazing; culling the male newborn calf; and dehorning/disbudding without pain mitigation. In these three studies, all groups of stakeholders mentioned the importance of pasture for cattle, where animals can express natural behaviors and graze. This issue drove us to the second part of studies, where we focused on the importance of shade on pasture. In the first study, lay citizens valued shade for dairy cattle, demonstrating a negative attitude towards a scenario where cows were reared on pasture without shade. In the second study, dairy heifers made an effort to push a gate to access shade during summer more than during autumn, showing a high motivation for this resource.

A salient finding was related to the concept of animal welfare for the two different Brazilian stakeholders. Lay citizens in both studies cited a range of characteristics related to animal welfare, encompassing the three constructs theorized by Fraser et al. (1997): biological functioning (related to health), affective states (related to suffering and pain), and naturalness (related to ability to express natural behavior like grazing), but only rarely used the term "animal welfare". In contrast, dairy farmers and agricultural advisors cited the term "animal welfare" as an important characteristic of a dairy farm, mainly because it is demanded by society, however, they did not explore the term, so it is not possible to conclude what they understand as animal welfare. That these

two different groups of stakeholders have divergent values is not new for scientists (e.g., BENARD; DE COCK BUNING, 2013), but their limited understanding of animal welfare is very concerning, and a crucial point to improve animal welfare in Brazil – if stakeholders involved in agriculture do not know what is animal welfare, how will they improve it? In our analysis, farmers and other agricultural professionals need to internalize a broader concept of the term to understand lay citizens' expectations and ways to change management to improve animal welfare on dairy farms. Including animal welfare in the curriculum of agricultural courses (e.g. veterinary, agronomy and animal science) could be an important step to train professionals capable to work together with farmers to improve animal welfare. Ventura et al. (2016b) also pointed the importance of education of veterinarians, and other solutions to change cattle welfare, such as communication between different stakeholders. This issue was also well explored by Meijboom (2017) who discussed the current needs for veterinarians and changes that these professionals might to do to accommodate different stakeholders' expectations. Technical assistance from veterinarians, animal scientists and agronomists who directly work with farmers is scarce in a world where animal welfare is becoming growingly important, including in Brazil. We highlight that awareness about the term animal welfare may act as a barrier for change, at least in Brazil.

We could also note a difference between lay citizens from U.S. and Brazil regarding animal welfare constructs. U.S. participants focused their concern on ethical treatment and animal's feelings, and Brazilian participants seemed more concerned with animal welfare because its perceived effect on milk quality, thus valuing more the biological functioning construct than the affective states. Of course there were many Brazilian citizens concerned with animals' treatment (the second major theme in one of our studies). As discussed in the specific section, these results are probably anchored in two different contexts: in the U.S., many scandals involving animal abuse on dairy farms were reported by the media in recent years (ANDREWS, 2017; GIBSON, 2015; KOWALSKI, 2014); in Brazil, many scandals involving milk adulteration in several parts of the country were reported by the media in recent years (DEBONA, 2014; FOLHA, 2007; LEHMEN, 2017). But in general, comparing survey participants' expectations of the ideal dairy farm in Brazil and U.S., we could say that lay citizens of both countries want the same, in general. Both expect a farm that cares for the animals, the quality of milk, the environment, and profit. The particular concern regarding animals to receive an ethical treatment is also shared by other

societies around the world (CLARK et al., 2016; VARGAS-BELLO-PÉREZ et al., 2016; YOU et al., 2014).

Media reports are probably increasing awareness of the lay public regarding dairy cattle welfare. For example, an issue cited very often by lay participants of both countries was cow-calf separation; this specific practice is currently well known by many participants, probably due to media reports. If in one way lay citizens are paying attention and are interested on how food is produced, in other way awareness about contentious practices can put in risk the consumption of dairy products. As awareness increases, support of people for farming practices decreases (HÖTZEL et al., 2017; LEMOS TEIXEIRA et al., 2018; VENTURA et al., 2016a), which could affect products' consumption if the production systems are not aligned with people's expectations. Many people involved with agriculture may judge that the lay public's views about dairy production are not important because they are ignorant about farming practices (BENARD; DE COCK BUNING, 2013), or that several practices are justified by economic reasons, or yet that farmers do not have to change all practices that the lay public does not like because the last group of stakeholders have not enough knowledge to judge what is better for the chain and they are not working with the cows daily like the farmers are. When different stakeholders learn about each other's point of view, the differences could ameliorate and both parts may better understand the complexities of each other's contexts (BERGSTRA; HOGEVEEN; STASSEN, 2017). Benard and De Cock Buning (2013) argue that shared values could be an important step for mutual learning of these stakeholders. This suggestion is not the same as suggesting to "educate" the public because in our understanding all stakeholders should be included in the discussion (for more, see HÖTZEL, 2016; TUCKER; MENCH; VON KEYSERLINGK, 2013; WEARY; VENTURA; VON KEYSERLINGK, 2016).

Naturalness in dairy production was extensively reported by lay citizens in all studies. When invited to imagine an ideal dairy farm, lay citizens freely reported an opposition to the use of chemicals, which included any agrochemicals used on the pasture, genetic modified organisms (GMOs) on feed, as well as hormones and antibiotics for treating animals. To better understand the meaning of naturalness, Rozin conducted a series of studies and found that, for citizens, naturalness means "no processing" and "no additives" (ROZIN; FISCHLER; SHIELDS-ARGELÈS, 2009) and is related to health (ROZIN; FISCHLER; SHIELDS-ARGELÈS, 2012). So we could conclude that absence of chemicals is important for people because they related it to

healthy food. In fact, healthy food is currently an important topic of research (e.g., O'BRIEN et al., 2014); also, more and more people become aware of "additives" used on animal production (e.g., Brazil: DE OLIVEIRA, 2018; US: DERBYSHIRE, 2011) and the possible risks for health, as antibiotics, for example (FAO, 2018a; VAN BOECKEL et al., 2017) through media reports. When people learn that a given additive is potentially dangerous, it is common that they become concerned about the effect of other additives, which is based on the precautionary principle. Rozin (2005) points out that, for people, chemical transformations reduce naturalness much more than physical transformations do (e.g., changing the fat on milk, a chemical alteration, reduces more naturalness than pasteurization, a physical alteration), but food processing is more important than the content in determining naturalness. Van der Hoeven (2015), a Ducth science journalist, brought the issue about different acceptability for biotechnological products: why are drugs from genetically engineering acceptable, but not food? How natural is the cow-free milk (http://www.perfectdayfoods.com) and how much is it acceptable for the public? The same author argues that public judgment is built by three dimensions: health, fashion, and ethics; if the product is not adverse for health, fashion is the strongest factor (and natural is currently fashionable), but ethics should not be neglected – and scientists might be aware of that. Arnot (2015) made recommendations for biotechnologists about how to build trust, considering these confused/inconsistent public' views (at least for scientists); for example, perceived shared values and ethics and a belief that an individual or group will do the right thing. But when additives have known adverse effects, like antibiotics, should be avoided on animal production, and researchers need to learn to listen to the public (van der Hoeven (2015).

Cow's access to outdoors and to pasture, either for grazing or just to walk freely, was another issue related to naturalness often cited by the lay citizens. In their views, pasture is a natural environment for cattle and depriving them from going outside impoverishes their welfare. As discussed before, in fact pasture is positive for animal welfare (ARNOTT; FERRIS; O'CONNELL, 2016), but cows are likely to suffer from heat stress (CHARLTON; RUTTER, 2017). Because of that, we performed two experiments, one to investigate the relative importance of shade for dairy cattle for lay citizens and another to assess how important shade is for dairy heifers in a pasture based system. We concluded that this resource is highly valued by both "stakeholders": lay citizens did not support pasture based systems without shade, preferring

an indoor housing system with fans, and the heifers showed strong motivation to access shade in warm days. These are very important findings for the dairy chain because U.S. dairy farmers may feel pressured to change their systems for pasture based, but we argue that if they do not plant trees, it would not be acceptable by society. In fact, a mixed system that provides all needs for the cows indoors but with outdoor access may be better supported by U.S. lay citizens than a pasture based system that does not provide the basic needs of the cows. Also, farmers who use pasture based systems may wrongly think that they are aligned with public expectations.

Pastoral systems are more complex than simple grazing systems because they involve synergies between animals and farmers who decide the management; these systems have a potential to offer greater benefits to the animal, the environment, the farm, farmers and the product (GREGORINI et al., 2017). Concerns regarding environmental impacts of grass-fed cattle have been discussed extensively. On one hand, some studies pointed that organic and conventional systems produce the same environmental outputs, and that to produce lower environmental impact the systems have to be low-input (e.g., this study assessed sustainability of different animal production systems, CLARK; TILMAN, 2017), specially regarding carbon (suggested by FAO, 2018a). Others, in contrast, concluded that well managed pastoral systems have a potential to be more environmentally friendly than conventional crops (e.g., SEÓ; MACHADO FILHO; BRUGNARA, 2017). Probably pasture managed in a more complex way than monocultures, as suggested by Gregorini et al. (2017), have to be more taken into consideration in the studies about environmental impact of cattle production. In our studies of the first part, it was clear that for lay citizens the ideal dairy farm includes a range of characteristics in a farm: the quality of the product, the animals, the environment, the farmer and the community, which means food produced in an ethical way. Thus, systems that take into account all of these aspects would be considered more sustainable. Also, it is complex to consider many dimensions simultaneously when evaluating sustainability in one study; for example Clark and Tilman (2017) did not include animal welfare in their analysis when comparing different agriculture production systems in terms of sustainability. Animal welfare, social and environmental issues are concerns that should be taken into account by animal scientists (e.g. the "One Welfare" approach, by PINILLOS et al., 2016) as well of lay people, as this document shows. If on one hand, according to Clark and Tilman (2017) egg production causes the less environmental impacts

among all animal products, on the other hand hens have many welfare related problems, which also negatively affect productivity and profitability (i.e., economic sustainability) (BROOM; FRASER, 2007, p. 290–294; TUCKER; MENCH; VON KEYSERLINGK, 2013). We believe that changing from indoor housing to mixed-systems is the beginning to transitioning for more complex systems (pastoral, or silvopastoral, for example), which will probably be required by the public in the future. Silvopastoal systems as well as agro-forestry are cited as ways to reduce greenhouse gas emissions from livestock (STEINFELD, 2006) because of the trees. These changes could be applied by farmers who want a differentiated product, for example, organic, animal and environmentally friendly and socially fair.

Sustainable agriculture would be, in theory, what our lay participants want: environmentally friendly, economically viable and socially fair (ALLEN et al., 1991; GLIESSMAN, 1995). Actually, participants of our studies mentioned four of six dimensions of sustainability named by Caporal and Costabeber (2002): the ecological, economical, social and ethical; plus animal welfare that is argued to be part of social sustainability by some authors (BROOM, 2010; TUCKER; MENCH; VON KEYSERLINGK, 2013). Sustainable agriculture is well studied by agroecologists, who use concepts of nature to design agroecossystems with the goal to achieve more sustainable systems, integrating economical and social aspects. In this approach, Caporal and Costabeber (2002) explain that to achieve sustainable systems three steps are necessary: 1) improving efficiency to decrease external inputs; 2) replacement of inputs and traditional practices for alternative ones; and 3) redesigning the agroecosystem to a more ecological one. One example of that is reported by Groot Koerkamp and Bos (2008), of a sustainable system for laying hens in the Netherlands. Since the 1980's, a movement of agroecologists in Brazil had ideas to change the national rural extension policy; this was possible in 2003 with the change of a center-left government and then the establishment of a specific normative for public extension, the PNATER (Rural Extension and Technical Assistance National Policy) with the orientation on agroecology (for more details, see DIESEL; MINÁ DIAS, 2016). In 2006 the government also published the MEXPAR (Participative Methodology of Rural Extension for Sustainable Development) to guide the changes (RUAS et al., 2006). This book is a new theoretical approach to change rural extension, rooted on agroecological principles, with the idea that to change current scenarios on farms, an educational process is necessary, and these processes

should be participatory (for more details, see CARDOSO, 2014), although in practice its implementation is difficult (DIESEL; MINÁ DIAS, 2016). It is interesting that participatory methodological tools could change some farmers' practices and contribute to sustainable development (GUZMÁN CASADO; ALONSO MIELGO, 2007). For example, as mentioned before, milk quality standards in Brazil are not aligned with the currently legislation (BALCÃO et al., 2017; BRUZAROSKI et al., 2017; OLIVEIRA et al., 2011; PAIXÃO et al., 2017), although basic hygiene could guarantee high quality standards. Such techniques are not implemented by farmers even after workshops, so the problem is not resolved, as discussed by many extensionists in the field. But involving the farmers on the process of change seems to be effective to improve milk quality (SOUZA et al., 2014). Social aspects including culture should be considered when changes are proposed. In some cases, legislation does not change realities, it just excludes some types of farmers, usually those with less capital, which would increase rural exodus. In our survey with Brazilian stakeholders involved with agriculture participants showed a high concern about social aspects involving farmers and workers, and their quality of life. This is important to be considered because potential changes in the regulations could affect the life of those involved with agriculture, and if there are people concerned with that, problems could be avoid.

In Brazil the organic regulation IN 46, which guides certification of products, includes, animal welfare aspects (BRASIL, 2011). There are also some labels for organic products that could aggregate value for farmers and a guarantee of many advantages on the final products for consumers. The IN 46 points that: cattle should be reared on free-range systems; pasture has to be shade for the animals; calves or any other animal must not be tied; cattle cannot be fed with any GMO product, and many medicines for example antibiotics and hormones, cannot be used. All these characteristics are in accordance with the ideal dairy farm described by our participants. Therefore, we highlight this as an opportunity for the dairy chain in Brazil, which is currently tremendously shy to offer organic dairy products to the population. In the U.S. organic dairy products means that cattle have access to pasture a minimum of 120 days/year; total confinement for animals over 6 months is prohibited; cattle are fed organic feed; hormones to promote growth, as well antibiotics and GMO-derived products, and tail docking are prohibited (USDA, 2011). However, we highlight that lay citizens who participated of the studies, in Brazil and U.S. wanted more than that: they wanted farmers to take care of the environment and the farm

to be profitable, to provide a better quality of life for the farmers and workers. Currently it seems that the ideal dairy farm is utopian, but in the future more of these characteristics may be incorporated in the systems.

7 GENERAL CONCLUSIONS

All stakeholders we worked in this thesis – lay citizens, those involved with agriculture and the animals – perceived animal welfare as an important issue. Also, shade is a high valued resource for lay citizens and animals and then, should be considered by those involved on dairy chain as an issue to improve animal welfare and social acceptability. Organic dairy production offers part of what lay citizens want on an ideal dairy farm, but not entirely; they expect that in a farm the animals would cared out in an ethical way, as well the entire population, farmers and workers and the environment. Agroecological approaches for dairy production could be a way to transition to the ideal dairy farm.

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APPENDIX A - Methodological aspects

Social research

One important issue to consider is that in social research the studies are with human beings in some historical context, social group with their beliefs, values and meanings; it is complex, could be contradictory, unfinished and in permanent transformation, according to the moment (MINAYO, 2008). Because of that, social scientists not intend to extrapolate their findings to other groups of people (MOON; BLACKMAN, 2014); for this reason, their samples do not necessarily need to be representative of the population studied. The aim of social sciences is to understand social contexts. Thus, the results of this type of research are useful to generate insights about how and why some things happen (MOON; BLACKMAN, 2014). Another point, considered by Minayo (2008), is that the researcher and the subject are both human beings, so in social research ideology is more salient than in other areas of knowledge, because the researcher is closer to his subject than in other areas. Minayo (2008) also says that all the steps of the research are rooted in the researcher' worldview. Social research has several philosophical orientations, like positivism and structuralism, but we will not explore this issue; for that discussion, we recommend Moon and Blackman (2014), a social science guide for natural scientists.

The social researcher can use both qualitative and quantitative methods to understand social contexts (ROBSON; MCCARTAN, 2016). Broadly, qualitative and quantitative approaches are subjective and objective, words and numbers, respectively (CRESWELL, 2009; MINAYO, 2004, p. 28). The use of any of the two methods will depend of the exact objective of the researcher and many times they are used complementary. Also, we agree with Minayo (2004, p. 37) when she says that any method, qualitative or quantitative, has the total/complete comprehension about some social reality; and none of these approaches are neutral because the researcher makes choices to design the research, which reveals his worldview or paradigm of science.

Qualitative methods

Qualitative research is defined by Denzin and Lincoln (2005) as

> "a situated activity that locates the observer in the world. It consists of a set of interpretative, material practices that makes the world visible.

These practices transform the world. They turn the world into a series of representations (…) [and] involve an interpretive, naturalistic approach to the world. (…) Researchers study things in their natural settings, attempting to make sense of, or interpret phenomena in terms of meanings people bring to them."

Qualitative method is ideal to generate data about attitudes, perceptions, and opinions of people (MINAYO, 2008, p. 57). In this type of approach data collected are basically words instead numbers. Only with words we are able to interpret and understand points of view, attitudes, and values of people. Qualitative methods are subjective because "objective reality can never be captured"; the study of understanding of a given phenomena is an interpretation of its representations (DENZIN; LINCOLN, 2005). To study the universe of meanings, motives, aspirations, attitudes, beliefs and values, it is difficult to restrict the research to numbers (MINAYO, 2004, p. 28), which justify the qualitative methods being more used on social research.

The issue of trustworthiness is important, mainly for those not familiar with qualitative methods, who argue that qualitative methods are not "scientific". Triangulation, the most cited strategy to try to ensure something similar what in qualitative methods is called *reliability*, consists of: having more than one method of data collection; using more than one observer in the study; combining different research approaches; and using more than one theory (ROBSON; MCCARTAN, 2016, p. 171).

Quantitative methods

Quantitative methodologies are broadly known for the use of statistical/mathematical tools to analyze the data, which are usually numbers (or something quantified), the phenomena is quantified and different treatments for groups of people are used (CRESWELL, 2009, p. 4; ROBSON; MCCARTAN, 2016, p. 101). This approach helps to examining the relationship among variables (CRESWELL, 2009, p. 4) and multiple and complex causality of the phenomena, so we can understand the mechanism of things, but large data samples are needed to allow performing statistical analysis (ROBSON; MCCARTAN, 2016, p. 101–104).

Although it is well known that social research uses qualitative approaches, quantitative methods are used in psychology, for example on studies about intention, attitudes, behavior, and decision-making (e.g., BORGES et al., 2014; LIND et al., 2012; POPPENBORG; KOELLNER, 2013). The generalizability and replicability of the findings are an important issue on quantitative methods (CRESWELL, 2009, p. 4) to ensure trustworthiness. In this sense, a series of techniques could be applied to ensure that the research is consistent (referred as replicability) and generalizable (see more on ROBSON; MCCARTAN, 2016, p. 105–111).

Mixed-methods

Mixed-methods, the combination of qualitative and quantitative methods to collect data for one study, emerged in the 1990's (CRESWELL, 2009, p. 203; ROBSON; MCCARTAN, 2016, p. 174, 176). As pointed by Creswell (2009, p. 3) qualitative and quantitative methods should not be viewed as the opposite of each other; studies tend to be more qualitative or more quantitative, and the mixed-method is a middle term, with elements of both methods. There are many benefits of using qualitative and quantitative methods, such as neutralizing the limitations of both methods, because using the strengths of both allows for stronger inferences; it also permits gaining a greater understanding, producing a more complete and comprehensive picture of the research topic (CRESWELL, 2009, p. 203; ROBSON; MCCARTAN, 2016, p. 179). However, according to these authors, to develop a mixed-method study, researchers should consider the timing, the use of resources and their skill to deal with two types of data.

According to Creswell (2009, p. 206–207), data can be gathered at the same time, or in phases – for example the qualitative data could be collected first, to explore a topic and thereafter the quantitative data may be collected using a larger sample. Also, the same author says that mix of the methods can be applied at different stages of the study (data collection, analysis and interpretation) or at all stages.

There are several models (or types) of mixed-methods research, each one with different ways and goals. For example, when data collection is already mixed (qualitative and quantitative), the aim could be to compare the two databases; when the data collection is separated in terms of type of methods, for example qualitative followed by a quantitative part, the aim could be to focus on investigate deeply some issue raised using qualitative methods (see more models and details in

CRESWELL, 2009, p. 210–216). Also, this author argues that the weight of each approach can made well known for readers.

In the mixed-methods the validity can be ensured using strategies typical of each approach for the respective data, i.e. qualitative or quantitative. However, Creswell (2009, p. 219) reported that new strategies are being built for specific mixed-methods, which some authors are calling *legitimation* and is related to assessing validity on many phases of the study.

Sampling on social research

Sampling on social research varies according of the nature of the study, and is different for quantitative or qualitative approach. For quantitative studies a representing sample is necessary to allow appropriate statistical analysis and there are appropriate tools to calculate that; the same is not necessary for qualitative studies (ROBSON; MCCARTAN, 2016). For data from open-ended questions that will generate qualitative data, the sampling must provides a rich and diverse set of responses and achieve saturation for the proposed topic (ROBSON; MCCARTAN, 2016, p. 166–67). In practice, saturation happens when the topic becomes repetitive, exhausting the elements for analysis (MINAYO, 2004, p. 102). The same author points that in qualitative research the concern is not with the numerical representativeness but with the comprehension of what is studied.

Exploratory studies have the overall aim to gather information that could be used to generate more refined hypotheses for further investigations, and thus used non-probabilistic samples (Guest, 2012), for example, convenience sample that choose by the researcher as the nearest and most convenient participants for the research (ROBSON; MCCARTAN, 2016, p. 281).

Methodological tools for social research

Questionnaires and interviews are common methodological tools for data collection on social research (ROBSON; MCCARTAN, 2016, p. 243). Questionnaires are usually considered a tool for quantitative studies, but they can be used for qualitative studies if open-ended questions are included; interviews are considered a tool for qualitative studies but they can also be used on quantitative studies, depending if the interview is with open-ended or closed-ended questions (CRESWELL, 2009, p. 217). Guest et al. (2012, p. 5) emphasize this

issue saying that many researchers ignore the fact that quantitative procedures can be used to generate qualitative data – and the opposite.

Questionnaires

Questionnaires are used on social research, for example, to "find out something about what is going on in society today" (ROBSON; MCCARTAN, 2016, p. 244), which was we intended with this thesis. Questionnaires can be applied face-to-face or online, which is useful to gather large amounts of data at relatively low cost in a short period of time (ROBSON; MCCARTAN, 2016, p. 248). When questionnaires are applied, participants respond the questions by themselves, without any involvement of the researcher. It can contain open-ended or closed-ended questions (like multiple choice); open-ended questions generate qualitative data, which can be used to elicit views and beliefs regarding the proposed topic (EADEN; MAYBERRY; MAYBERRY, 1999).

Although questionnaires can be a useful tool because of the low cost and fast, there are several issues to consider when planning a questionnaire. Boynton and Greenhalgh highlighted (2004),

> "Anybody can write down a list of questions and photocopy it, but producing worthwhile and generalisable data from questionnaires needs careful planning and imaginative design".

For more details about this issue we recommend the reading of the references used in this section.

Semi-structured interviews

Interviews involve the researcher, who asks the participants' the questions; in the case of semi-structured in-depth interview, which generates qualitative data, the interviewer follows a *guide* or *script* with *topics* or *themes* to be covered. These topics/themes are not closed-questions; instead, the researcher is free to formulate the question if and when it is necessary and the order of the topics/themes is not rigid, but can be changed during the conversation, which flows independently of the order (MINAYO, 2004, p. 99–101; ROBSON; MCCARTAN, 2016, p. 285). In this type of interview, the researcher just guides the conversation trying to explore the general issue, usually through the topics/themes.

Qualitative data analysis

In this section we will present the methodology used for the qualitative data analysis in this thesis. We used *thematic analyses*, based on Guest et al. (2012), Braun and Clarke (2006) and Miles and Huberman (1994). Thematic analysis is the most commonly method used in qualitative research, including data from open-ended questions, and it is useful to capture complexities of meanings in text data, which involves interpretation (GUEST; MACQUEEN; NAMEY, 2012). According to Braun and Clarke (2006) thematic analysis "is a method for identifying, analyzing and reporting patterns (themes) within the data. It minimally organizes and describes your data set in (rich) detail". These authors point out that the advantage of thematic analysis is that it is not rooted in any theoretical framework, so it is more accessible for those with early experience in qualitative research. Guest et al. (2012) summarize the process of analysis as describing explicit and implicit ideas from the material, identifying themes using a codifying process.

The *themes* can be explained as the core of sense that builds the coded response (MINAYO, 2004, p. 209). They capture some patterns important for the study, which is not necessarily related to their prevalence across the data set (BRAUN; CLARKE, 2006). This process involves careful reading and rereading of the transcriptions, identification of key words, phrases, trends and themes (Guest et al., 2012).

The specific steps to perform the analyses are described by Miles and Huberman (1994, p. 10–12) as *data reduction* (information is coded finding themes), *data display* (organization of the information allowing for conclusions to be drawn) and *conclusion drawing and verification* (noting of patterns and themes and using confirmatory tactics such as triangulation between three readers). Braun and Clarke (2006) organized the analysis in more detail, with six steps: 1) familiarization with data set (reading and re-reading); 2) generating initial codes (coding interesting features); 3) searching for themes (put the codes into initial themes); 4) reviewing themes (checking if the themes make sense with all codes extracted); 5) defining and naming themes (refine definitions and themes names); 6) producing the report (the final opportunity to analyze, selecting and extracting examples).

Minayo (2004, p. 229, 2012) proposes a different way to perform thematic analysis. This method can be cited as *hermeneutic-dialectic* and involves similar process: *exhaustive reading* the responses and coding these into themes, giving meaning to the content based on understanding, *interpretation* and *dialectic*. In this method of analysis Minayo argues that, to understand the meaning of the content, the coder

must organize the material into topics with the aim of better understanding the responses. The interpretation phase involves re-reading the responses to make sure that the ascribed meanings make sense. The dialectic phase involves re-reading and questioning critically the interpretations, editing as needed to improve reliability.

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APPENDIX B - Ideal dairy farm questionnaire – dairy farmers, agricultural professionals and lay citizens

Questões demográficas

- Idade
- Sexo
- Qual das opções melhor descreve sua escolaridade? (Ensino Fundamental incompleto, Ensino Fundamental incompleto, Ensino Médio incompleto, Ensino Médio completo, Ensino Técnico ou Profissionalizante incompleto, Ensino Técnico ou Profissionalizante completo, Ensino Superior incompleto, Ensino Superior completo, Pós-Graduação, Outro, por favor especifique)
- Qual das opções melhor descreve onde você viveu a maior parte de sua vida? (Urbano, Rural, Periferia)
- Qual a sua familiaridade com a produção leiteira? (Muita familiaridade, Alguma familiaridade, Nenhuma familiaridade)
- Por favor descreva seu envolvimento com a produção leiteira (Agricultor, Veterinário, Agrônomo ou Zootecnista, Estudante ou Professor na área de Ciências Agrárias, Profissional da indústria, Ativista, Não envolvido com a produção de leite, Outro, por favor especifique)

Questão principal: Como você imagina uma granja leiteira ideal, e por que essas características são importantes para você?

APPENDIX C - Script/guide for in-depth interview ideal dairy farm

Questões demográficas

- País de residência
- Nacionalidade (se fora do Brasil, há quanto tempo reside)
- Estado da Federação
- Familiaridade com a produção leiteira (muita / alguma / nenhuma)
- Qual envolvimento (Agricultor / Vet, Agro ou Zoot / Estudante ou Professor nas Ciências Agrárias / Profissional da Indústria / Ativista / Não envolvido)
- Área em que reside (urbana / rural)
- Idade
- Escolaridade
- Sexo

Questão principal
- Como você imagina que seria uma granja leiteira IDEAL?
- Por que esses aspectos são importantes pra você?

APPENDIX D - Questionnaire ideal dairy farm dairy farm that takes care of the welfare of their animals

Questões demográficas

1. Em qual região do país você reside atualmente?
( ) Norte
( ) Nordeste
( ) Centro-Oeste
( ) Sudeste
( ) Sul

2. Por favor, indique seu envolvimento com a produção leiteira:
( ) Agricultor
( ) Profissional das Ciências Agrárias
( ) Estudante das Ciências Agrárias
( ) Profissional da Indústria Leiteira
( ) Ativista na causa animal
( ) Não envolvido

3. Como você se descreve em relação à informação que você tem especificamente a respeito da produção de leite no Brasil?
( ) Totalmente desinformado
( ) Um pouco desinformado
( ) Intermediário
( ) Um pouco informado
( ) Muito informado

4. Em que área você reside atualmente?
( ) Urbana
( ) Rural
( ) Periferia

5. Idade:
( ) 18 a 24 anos
( ) 25 a 34 anos
( ) 35 a 44 anos
( ) 45 a 54 anos
( ) 55 a 64 anos
( ) Acima de 65 anos

6. Maior escolaridade:
( ) Ensino fundamental incompleto
( ) Ensino fundamental completo
( ) Ensino médio incompleto
( ) Ensino médio completo
( )Curso técnico ou profissionalizante incompleto
( )Curso técnico ou profissionalizante completo
( ) Curso superior incompleto
( ) Curso superior completo
( ) Pós-graduação

7. Sexo:
( ) Feminino
( ) Masculino

8. Você consome leite e/ou derivados?
( ) Sim
( ) Não porque sou alérgico/intolerante
( ) Não porque sou vegano
( ) Não porque não gosto

Questão principal
Em pesquisas anteriores realizadas por nossa equipe, algumas pessoas tem nos falado que uma granja leiteira ideal deveria se preocupar (entre outras coisas) com o bem-estar dos seus animais.
Se você concorda, poderia nos dizer o que você esperaria de uma granja leiteira que se preocupa o bem-estar dos seus animais? Considere, por favor, as vacas leiteiras e os seus bezerros.

Questão sobre as práticas de manejo
A sua opinião a respeito de alguns manejos na produção leiteira

"O bezerro recém nascido é separado da mãe logo após o nascimento." – Você sabia que isso é comum na produção leiteira?
( ) Sim
( ) Não
( ) Vagamente

Caso a resposta seja SIM, qual a origem desse conhecimento?
_____

Como você se posiciona em relação a essa prática?
Reprove totalmente   (1) (2) (3) (4) (5)   Apoio totalmente

"Em algumas granjas leiteiras as vacas são criadas em galpões, sem acesso ao pasto, durante toda lactação." – Você sabia que isso é comum na produção leiteira?
( ) Sim
( ) Não
( ) Vagamente

Caso a resposta seja SIM, qual a origem desse conhecimento?
_____

Como você se posiciona em relação a essa prática?
Reprove totalmente   (1) (2) (3) (4) (5)   Apoio totalmente

"Alguns bezerros machos são eliminados imediatamente após o nascimento, pois não servem para a produção de leite." – Você sabia que isso é comum na produção leiteira?
( ) Sim
( ) Não
( ) Vagamente

Caso a resposta seja SIM, qual a origem desse conhecimento?
_____

Como você se posiciona em relação a essa prática?
Reprove totalmente   (1) (2) (3) (4) (5)   Apoio totalmente

"Os chifres de bezerros jovens são removidos, sem o uso de nenhum medicamento para controlar a dor." – Você sabia que isso é comum na produção leiteira?
( ) Sim
( ) Não
( ) Vagamente

Caso a resposta seja SIM, qual a origem desse conhecimento?
_____

Como você se posiciona em relação a essa prática?

Reprove totalmente   (1) (2) (3) (4) (5)   Apoio totalmente

APPENDIX E - Ideal dairy farm questionnaire – U.S. lay citizens

Demographic questions

- Age
- Sex
- Country of residence
- Education (Some high school; High school graduate; Trade or vocational degree; Some college; Associate degree; Bachelor's degree; Graduate)
- Area of residence (Urban, Rural, Suburban)
- Familiarity with dairy production (Very familiar, Somewhat familiar, Not familiar)
- Please describe your envolviment with dairy production (Farmer, Veterinarian, Agronomist or Animal Scientist, Student or Professor on Agrarian Science, Industry professional, Activist, Not involved with dairy production, Other, please specify)

Main question:
What do you consider to be an ideal dairy farm and why are these characteristics important to you?

APPENDIX F - Scenarios shade and heat stress questionnaire – U.S. lay citizens

Read carefully the following scenario

Scenario A – A herd of dairy cows is kept on pasture where they can graze. The pasture has a shaded area; on warm days the cows are unlikely to suffer from heat stress.

Scenario B – A herd of dairy cows is kept on pasture where they can graze. The pasture has no shaded area; on warm days the cows are likely to suffer from heat stress.

Scenario C – A herd of dairy cows is kept in a barn where they have free access to food. The barn has fans; on warm days the cows are unlikely to suffer from heat stress.

Scenario D - A herd of dairy cows is kept in a barn where they have free access to food. The barn has no fans; on warm days the cows are likely to suffer from heat stress.

Now please answer the follow questions about the scenario above

1)How much do you disagree/agree with the way these cows are being raised?
strongly disagree   (1) (2) (3) (4) (5)   strongly agree

2)How inappropriate/appropriate do you consider the cow's living conditions to be?
completely inappropriate   (1) (2) (3) (4) (5)   completely appropriate

3)Do you consider the way these cows are living to be unacceptable/acceptable?
totally unacceptable   (1) (2) (3) (4) (5)   totally acceptable

Please explain your general opinion about the scenario you read. (open-ended question)
_____
_____

_____
_____
_____
_____

If there were one thing you could change about this farm what would
that be? (open-ended question)

_____
_____
_____
_____
_____
_____

1)How unlikely/likely do you think it is that the cows described in the
scenario are suffering?
unlikely   (1) (2) (3) (4) (5)   likely

2)In your point of view how are these cows feeling?
very bad   (1) (2) (3) (4) (5)   very good

3)How do you describe the welfare of the cows you read about it?
(Considering that animal welfare includes health, feelings and
naturalness)
very poor welfare   (1) (2) (3) (4) (5)   very good welfare

4)How would you describe the cow's quality of life?
very good life   (1) (2) (3) (4) (5)   very bad life

5)How natural do you consider the environment where these cows are
kept?
completely unnatural   (1) (2) (3) (4) (5) completely natural

6)How healthy would you say these cows are?
very unhealthy (1) (2) (3) (4) (5)very healthy

Socio-demographic questions

Age (years)
Sex (Male/Female)

Which of the following best describes the area where you have lived most of your life? (Urban / Suburban / Rural)
Education
Income

Finally, please respond "false" or "true" for the follow affirmatives:

1)The majority of dairy production in United States are housed indoors (False/True)

2)A dairy cow needs to have a calf to keep producing milk (False/True)

3)The majority of cows and calves are separated from each other within the first few hours of birth (False/True)

4)Most dairy calves have their horns removed when their are born, either with a hot iron or with a caustic paste (False/True)