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Knowledge and attitudes of smallholder dairy farmers regarding the use of antibiotics to manage mastitis

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KNOWLEDGE AND ATTITUDES OF SMALLHOLDER DAIRY FARMERS REGARDING THE USE OF ANTIBIOTICS TO MANAGE MASTITIS

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O presente trabalho em nível de mestrado foi avaliado e aprovado por banca examinadora composta pelos seguintes membros:

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Certificamos que esta é a **versão original e final** do trabalho de conclusão que foi julgado adequado para obtenção do título de mestre em agroecossistemas.

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RESUMO

O objetivo deste estudo era explorar atitudes e práticas dos produtores leiteiros em relação ao uso de antimicrobianos (AMU) e a resistência antimicrobiana (AMR) no contexto do tratamento da mastite. Utilizamos entrevistas pessoais aprofundadas, com 57 produtores de leite de cinco municípios que pertencem à microrregião de Tubarão, uma das principais regiões produtoras de leite do estado de Santa Catarina, Brasil. A produção das fazendas era a baseadas de pasto, os rebanhos eram compostos em média por 28 vacas em lactação e a produção de leite era de 13 (de 7 a 25) L/ vaca/dia, composta principalmente por vacas Jersey (77%) e suas cruzas. Todos os agricultores consideravam a AMU essencial tanto para a prevenção como para o tratamento da mastite, mas consideravam a AMU caro. Identificámos uma potencial má utilização de antibióticos nos relatos de: 1. AMU generalizado na ausência de diagnóstico ou indicação veterinária; 2. molécula, dosagem e duração dos tratamentos com base na experiência empírica dos produtores, construída a partir de recomendações veterinárias de visitas passadas de emergência, vendedores agrícolas, ou anúncios comerciais; 3. dosagens frequentemente aumentadas ("para melhorar a eficácia"). Todos os agricultores relataram ter comprado antibióticos sem receita nas agropecuárias, ou na fazenda de vendedores de insumos agrícolas. Os veterinários só eram chamados quando percebiam uma necessidade extrema; a prevenção da mastite nunca era discutida, contudo a assistência veterinária era frequentemente associada à venda de antibióticos. As vendas eram também promovidas em seminários e dias de campo. Os agricultores nem sempre conseguiam explicar como os antibióticos e a resistência funcionavam e alguns tinham uma ideia equivocada, de que era a vaca que se tornava resistente ao antibiótico. A maioria dos agricultores alimentava os bezerros com leite de vacas tratadas e poucos estavam conscientes do risco associado à AMR. Discutindo políticas que visavam um uso prudente de antibióticos para reduzir a AMR, alguns agricultores argumentaram que isto iria aumentar os custos de produção, a perda de leite e o abate das vacas devido à mastite, e que devido a isto alguns agricultores iriam abandonar a produção leiteira. Outros foram mais optimistas, esperando se beneficiar de incentivos financeiros baseados na qualidade do leite. Os produtores expressaram atitudes negativas em relação a realizar a transição para produção orgânica.; a impossibilidade de utilizar pesticidas, sementes transgênicas e o não AMU foram os principais obstáculos apontados pelos produtores. O uso prudente de antibióticos na área exige uma mudança cultural do atual tratamento reativo para a gestão preventiva; um melhor controle de vendas; assistência veterinária centrada na prevenção da mastite; e apoio financeiro aos produtores para que possam cumprir as normas de qualidade do leite.

Palavras-chave: antimicrobiano; AMU; AMR; mastite; atitudes; pecuária

ABSTRACT

The aim of this study was to explore attitudes and practices of dairy farmers regarding antimicrobial use (AMU) and antimicrobial resistance (AMR) in the context of treatment of mastitis. We used in-depth face-to-face interviews, with 57 dairy farmers from five municipalities that belong to the micro-region of Tubarão, one of the main milk producing regions in Santa Catarina state, Brazil. Farms were pasture based, herds were on average 28 lactating cows and milk production of 13 (from 7 to 25) L/cow/day, mainly composed by Jersey cows (77%) and their crosses. All farmers considered AMU essential both for the prevention and treatment of mastitis but considered AMU expensive. We identified potential misuse of antibiotics in reports of: 1. widespread AMU in the absence of direct veterinary diagnosis or indication; 2. molecule, dosage and duration of treatments based on farmers' empirical experience, built from past recommendations from emergency veterinary visits, agricultural sellers, or commercial advertisements; 3. Use of dosages often increased ("to improve effectiveness"). All farmers reported buying antibiotics without prescription in farming stores, or on-farm from agricultural inputs sellers. Veterinarians were only called when perceiving extreme necessity; prevention of mastitis was never discussed, but veterinary assistance was often associated with the sale of antibiotics. Sales were also promoted in seminars and field days. Farmers not always could explain how antibiotics and AMR worked; some expressed misconceptions, for example that the cow was the one becoming resistant to the antibiotic. Most farmers fed the calves milk from treated cows and few were aware of the associated risk of AMR. Discussing policies aiming at prudent AMU to reduce AMR, some farmers argued that this would increase production costs, loss of milk and cows' culling due to mastitis, and that some farmers would abandon dairy farming. Others were more optimistic, expecting to benefit from financial incentives based on milk quality. The farmers had negative attitudes about organic production; the impossibility of using pesticides, transgenic seeds and no AMU were the main obstacles pointed out by farmers. Prudent AMU in the area calls for a cultural shift from the current reactive treatment to preventive management; a better enforcement of controlled sales; veterinary assistance focusing on mastitis prevention; and financial support for farmers to meet the milk quality standers.

Keywords: antimicrobial; AMU; AMR; mastitis; attitudes; livestock

RESUMO EXPANDIDO

Introdução

O uso de antibióticos em animais produtores de alimentos é uma preocupação global, dada a sua contribuição para a resistência aos antibióticos (AMR). Parte do problema se relaciona ao fato de muitos princípios ativos dos antibióticos veterinários serem os mesmos utilizados na medicina humana (KIRCHHELLE, 2018). A AMR tanto na medicina humana como veterinária atingiu níveis alarmantes na maior parte do mundo e é reconhecida como uma ameaça emergente significativa à saúde pública global e à segurança alimentar (KENNEDY, 2013). Em 2015, a resistência microbiana foi reconhecida como um problema de saúde pública global (WHO,2015). Na mesma reunião, a Organização Mundial de Saúde (OMS) adotou o plano de ação global denominado "One Health" (FAO, 2010). Este plano propõe intervenções para controlar a AMR incluindo a redução do uso de antibióticos (AMU) em seres humanos e animais.

A utilização de antibióticos é generalizado na agricultura: em baixas concentrações e administrados rotineiramente a todo um rebanho com o objetivo de melhorar a conversão alimentar; como método preventivo, onde todo o rebanho recebe a mesma dose antes de um período crítico ou de transição; ou de forma terapêutica, onde a dose é individualizada, e geralmente recomendada por um profissional para tratar uma doença (BOKMA et al., 2014). A mastite é uma das doenças mais comuns na pecuária leiteira e muito custosa para os agricultores. As consequências de ter um animal com mastite são várias, incluindo a diminuição da produção de leite e deterioração da qualidade, a perda devido ao leite de descartado, custos com serviços veterinários, medicamentos e mão-de-obra (HUIJPS; LAM; HOGEVEEN, 2008; LEITNER et al., 2018). O uso de antibióticos tornou-se comum na produção leiteira nas últimas décadas como método de prevenção, ao invés de tratamento (LEBLANC et al., 2006). Porém, a decisão de tratar a mastite é complexa e envolve vários aspectos, como as características da vaca, sintomas da mastite, condição do rebanho, e a percepção das alternativas existentes (VAARST et al., 2002). RUEGG et al. (2017), mostrou que os programas de controle da mastite em todo o mundo se concentraram na incorporação de manejos diários para controlar patógenos contagiosos. No entanto, os produtores citam fatores como a falta de tempo disponível e trabalho extra como barreiras para adotar esses manejos ou recomendações (RITTER et al., 2017).

Qualquer que seja a forma com que o antibiótico entre no ambiente, seja através dos meios biológicos dos animais, como urina e fezes, ou através de meios humanos como a eliminação inadequada de medicamentos, as consequências para os ecossistemas são muitas. Alimentar os bezerros com leite com resíduos de antibióticos é uma prática comum em todo o mundo, e as consequências podem estar relacionas com um aumento do número de bactérias resistentes aos antibióticos dentro do intestino (RICCI et al., 2017), assim como também podem causar diarreia (LANGFORD; WEARY; FISHER, 2003).

A relação dos agricultores com técnicos é importante, e os veterinários têm um papel importante no aconselhamento e no ensino de métodos preventivos, uma vez que uma grande parte dos aconselhamentos está relacionada com o planejamento de manejos utilizados para manter ou melhorar a saúde do úbere (HOGEVEEN; HUIJPS; LAM, 2011). Os produtores confiam nos aconselhamentos de veterinários com quem eles têm uma representação positiva (FISCHER et al., 2019b; OLMOS et al., 2018). Fatores como a boa comunicação, o diálogo baseado na confiança, especializações e a disponibilidade fora do horário de expediente são fatores altamente valorizados pelos agricultores (FISCHER et al., 2019a).

Para compreender a relação da dependência do AMU da produção animal, é importante tentar elucidar o problema de uma forma sistémica e multifatorial (SCOTT et al., 2019). Por exemplo, é importante conhecer as características internas dos agricultores relacionadas com as suas práticas de tratamento com antibióticos, juntamente com características externas como as condições de criação de animais (MAGOURAS et al., 2017; VISSCHERS et al., 2014). Intervenções comportamentais, tais como campanhas educativas, poderiam capacitar os agricultores com conhecimento de práticas mais prudentes e racionais, essenciais para estimular um uso mais racional de antibióticos (DOEHRING; SUNDRUM, 2019; KRAMER et al., 2017). O papel dos técnicos extensionistas na adoção de mudanças é evidente (CARDOSO; VON KEYSERLINGK; HÖTZEL, 2016; HÖTZEL; SNEDDON, 2013; POIZAT et al., 2017). Assim, a compreensão dos conhecimentos e percepções dos produtores sobre o assunto, bem como a sua relação com extensionistas e veterinários, é essencial para apoiar tais programas.

Objetivo

Os objetivos deste estudo foram, em primeiro lugar, identificar comportamentos (práticas), conhecimentos e atitudes dos produtores de leite em relação à prevenção da mastite e ao uso de antibióticos (AMU) e, em segundo lugar, suas atitudes e motivações em relação ao uso prudente de antibióticos.

Aspectos metodológicos

Entrevistas pessoais e em profundidade foram realizadas com 57 produtores de leite de cinco municípios diferentes: Armazém, Braço do Norte, Rio Fortuna, Santa Rosa de Lima, São Martinho. O estudo foi baseado numa amostra de conveniência. A condição para participar no estudo era: ser agricultor familiar com produção a base de pasto, e estar disponível e disposto a participar. As entrevistas continham perguntas fechadas (demográficas) e abertas, a entrevista foi dividida em sete secções, que correspondiam a (1) doenças do rebanho e AMU; (2) assistência técnica; (3) rotina de ordenha; (4) mastite; (5) resíduos de antibióticos no leite; (6) resistência bacteriana aos antibióticos; (7) atitudes frente a um cenário de redução o AMU. O estudo tinha um carácter qualitativo, os resultados quantitativos foram analisados utilizando recursos estatísticos descritivos. As entrevistas foram transcritas e lidas exaustivamente para criar uma familiaridade com os discursos. Após esta etapa, a codificação das transcrições foi feita pelo autor e transformada em temas para análise. A fim de analisar o material das entrevistas, foi utilizada uma abordagem de análise temática dedutiva (BRAUN; CLARKE, 2006).

Resultados

Os rebanhos tinham em média 28 vacas em lactação com produção de leite de 13 (de 7 a 25) L/ vaca/dia. Esses rebanhos eram compostos principalmente por vacas Jersey (77%) e suas cruzas. A mastite foi a doença mais frequentemente relatada nos rebanhos (46%), apesar de alguns não identificarem a mesma como doença quando questionados. Os produtores tinham conhecimentos de métodos de prevenção e higiene, porém nem sempre os adotavam, devido à falta de tempo ou aos custos envolvidos. A detecção de mastite clínica e subclínica através de testes só era feito por uma minoria, sendo que a maior parte afirmava que os fazia quando percebia necessidade. Todos os agricultores consideravam o AMU essencial tanto para a prevenção como para o tratamento da mastite, o principal uso estava relacionado ao período de secagem das vacas onde antibióticos intramamários e ou injetáveis eram sempre usados. Contudo, a maior parte dos produtores consideravam os antibióticos caros. Identificamos, nos relatos, três potenciais más utilizações dos antibióticos: 1) AMU generalizado na ausência de

diagnóstico ou indicação veterinária; 2) molécula, dosagem e duração dos tratamentos com base na experiência empírica dos produtores, construída a partir de recomendações veterinárias de visitas passadas de emergência, vendedores agrícolas, ou anúncios comerciais; e 3) uso de dosagens frequentemente aumentadas ("para melhorar a eficácia"). Os entrevistados relataram que as vendas de antibióticos eram promovidas em seminários e dias de campo. Todos afirmaram ter comprado antibióticos sem receita nas agropecuárias, ou na fazenda, de vendedores de insumos agrícolas. Os veterinários só eram chamados perante necessidade extrema. A prevenção da mastite nunca era discutida, e a assistência veterinária era frequentemente associada à venda de antibióticos.

Quando questionados sobre os nomes dos antibióticos utilizados para tratar mastite, 11 produtores (23%) dos 57 questionados disseram não saber os nomes das marcas ou dos princípios ativos utilizados. Dos produtores que disseram saber os nomes, muitos (ou alguns) confundiram e nomearam anti-inflamatórios e antiparasitários em vez de antibióticos. Os agricultores nem sempre conseguiam explicar como os antibióticos e a AMR funcionavam; por exemplo, alguns tinham a ideia equivocada de que era a vaca quem se tornava resistente ao antibiótico. Para 40% dos produtores, o AMU na bovinocultura leiteira no Brasil não era racional, enquanto 34% acreditavam que era adequado (26% não sabia expressar uma opinião sobre o assunto). Antes da nova regulamentação vigente sobre qualidade do leite, o nível de cuidado e preocupação dos agricultores com os resíduos de antibióticos no leite era praticamente inexistente, e com a nova regulamentação em vigor a preocupação com esta questão passou a aumentar. A maioria dos agricultores alimentavam os bezerros com leite de vacas tratadas e poucos estavam conscientes do risco associado à AMR. Discutindo políticas que visavam um uso prudente de antibióticos para reduzir a AMR, alguns agricultores argumentaram que isto iria aumentar os custos de produção, a perda de leite e o abate das vacas devido à mastite, o que levaria alguns agricultores a abandonarem a produção leiteira. Outros se mostraram mais otimistas, esperando se beneficiar de incentivos financeiros baseados na qualidade do leite. Os produtores não conseguiam se imaginar produzindo leite orgânico e tinham atitudes negativas em relação a realizar esta transição, barreiras como a impossibilidade de utilizar pesticidas, sementes transgênicas e o não AMU foram apontados.

Discussão

Os produtores descreveram o AMU como necessário durante a vida das vacas leiteiras e essencial durante o período de secagem. O acesso aos antibióticos foi considerado fácil por todos os participantes, pois podiam comprá-los sem receita veterinária no balcão de qualquer agropecuária, o que em alguns casos resultou numa utilização excessiva, escolha errada da molécula e falta de diagnóstico profissional. A maioria dos agricultores considerava os antibióticos como caros, porém tinham maior probabilidade de os utilizar, do que de fazer mudanças no manejo ou de comportamento para evitar mastite. Mudanças nos comportamentos de rotina são consideradas extremamente difíceis, uma vez que depende da forma como as pessoas veem os impulsionadores e os obstáculos (ALBERNAZ-GONÇALVES; OLMOS; HÖTZEL, 2021; SPEKSNIJDER; WAGENAAR, 2018). Quando se trata de AMU e práticas de manejo de mastite, os agricultores valorizam muito as experiências atuais e passadas com antibióticos, antes de considerarem a adopção de novos manejos (RITTER et al., 2017). A mastite é uma das doenças mais prevalecentes no gado leiteiro e ficou claro nas entrevistas que os agricultores nem sempre a viam desta forma. O não reconhecimento da mastite como uma doença mostra-nos como a coexistência diária com esta doença pode mudar a forma como os agricultores veem a doença, o que afeta diretamente a forma

como ele se veem em relação a mudança de comportamentos em direção a métodos preventivos.

Conclusão

Os agricultores deste estudo tiveram dificuldade em ver a mastite como uma doença, bem como tinham uma compreensão limitada da AMR, o que está diretamente ligado às suas motivações para aderir manejos preventivos. Além disso, a assistência veterinária centrada na prevenção da mastite é um pilar central para a redução do AMU nas fazendas leiteiras, mas pouco presente na região. O uso prudente de antibióticos na região exige uma mudança cultural do atual tratamento reativo para um manejo preventivo. Melhor controle de vendas para evitar o uso excessivo e apoio financeiro aos produtores para que possam cumprir as normas de qualidade do leite também se fazem necessárias.

FIGURE LIST

TABLE LIST

SUMMARY

1 INTRODUCTION

1.1 ANTIMICROBIAL RESISTANCE AS A GLOBAL CONCERN

The use of antibiotics in food-producing animals is a global concern, given its contribution to antibiotic resistance. Part of the problem has to do with the fact that the many active principles of veterinary antibiotics are the same used in human medicine (KIRCHHELLE, 2018). Antibiotic resistance in both human and veterinary medicine has reached alarming levels in most parts of the world and is recognized as a significant emerging threat to global public health and food security (KENNEDY, 2013). In 2015, microbial resistance was recognized as a global public health problem by the 68th World Health Assembly (WHO,2015). At the same meeting, the World Health Organization (WHO) adopted the global action plan called *One Health* (FAO, 2010). This plan proposes interventions to control antimicrobial resistance, including reducing antibiotic use in humans and animals. Recognizing the urgent need for cooperative action, the World Organization for Animal Health (OIE) and the United Nations Food and Agriculture Organization (FAO) adopted resolutions to support this global plan. In Brazil, the Ministry of Agriculture, Livestock, and Supply (MAPA) is preparing the National Action Plan on Antimicrobial Resistance, together with other bodies, such as the Ministry of Health and the Brazilian Health Regulatory Agency (Anvisa). This plan is an offshoot of the WHO's Global Action Plan on Antimicrobial Resistance approved in May 2015, within the concept of the One Health Global Action Plan (MAPA, 2016; PAN-BR, 2018).

Antimicrobial resistance is the ability of microorganisms such as bacteria to become increasingly resistant to a determined antimicrobial agent to which they were previously sensitive. This resistance can occur either by natural selection or by genetic mutations; the inadequate use of drugs and the constant exposure of microorganisms to antibiotic molecules provides the selective pressure for these pathogens to become resistant (ROCA et al., 2015). The use of antibiotics is widespread in agriculture: in low concentrations and routinely administered to a whole herd with the aim of improving food conversion efficacy; as a preventive method where all herd receives the same dose before a critical or transition period; or in a therapeutic way, where the dose is individualized, and usually recommended by a professional to treat a disease (BOKMA et al., 2014).

1.1.1 Use of antibiotics in dairy cattle to prevent and treat mastitis

Mastitis is one of the most common diseases in dairy farms today and also very costly for farmers. The major causes of mastitis are bacterial as coliforms, Streptococci, coagulase-positive staphylococci (mainly *Staphylococcus aureus*), and coagulase-negative staphylococci. Mastitis can be expressed in two different forms, clinical and subclinical. The first occurs in moderate to severe cases and it is possible to see the inflammatory symptoms in the udder and teats, like swelling, heat, hardness, redness. In milk, some visible changes can also be seen, such as the presence of flakes, clots, or pus. The subclinical form of mastitis is harder to detect, as there are no visible changes in the animal or the milk; thus, farmers often believe not to have a problem when, in fact, they cannot see it. The consequences of having an animal with mastitis are several, including a decrease in milk yield and deterioration in milk quality, loss due to discarded milk, costs with veterinarian service, medication, and labor (HUIJPS; LAM; HOGEVEEN, 2008; LEITNER et al., 2018). Mastitis can cause several harms to the farm, and after production losses, a large part of the total economic losses is related to the decision to cull cows with severe or recurrent cases (HOGEVEEN; HUIJPS; LAM, 2011; HUIJPS; LAM; HOGEVEEN, 2008). Thus, the use of antibiotics has become more usual in dairy farms in the past decades as a method of prevention, instead of treatment (LEBLANC et al., 2006).

Farmers cite mastitis as the most common reason for the use of medicines (HIGHAM et al., 2018; TONIAL; A. P., 2017). The decision to treat mastitis is complex and involves several aspects such as cows' characteristics, mastitis symptoms, the situation of the herd, and perception of existing alternatives (VAARST et al., 2002). Farmers' decision is mostly made based on own experiences, and veterinarians' involvement in mastitis cases usually occur only in acute cases (VAARST et al., 2003).

Another frequent use of antibiotics is the well-established and standard protocols adopted to dry-off dairy cows. Antibiotics are administered to cows independent of their conditions, i.e., whether they are or not presenting intramammary infections. This treatment is done at the end of lactation and can be performed to all quarters, known as blanket therapy, or selective dry cow therapy, where selected cows and quarters are treated with the aim of treating current intramammary infections and preventing further infection (VILAR et al., 2018). The use of antibiotics as a way to dry-off cows can bring

several benefits, such as lower chances of new infections, a reduction in the somatic cell count and in clinical mastitis cases (BERRY; HILLERTON, 2002). This method has been recommended for decades by extensionists advising dairy farmers and veterinarians. Consequently, many farmers have adopted this method as usual and passed experiences among them. A study showed that the use of blanket therapy increases with the increase on herd size and use of automatic milking systems (VILAR et al., 2018), which is a big concern, given that this use of dry cow therapy is associated with overuse of antibiotics (BERRY; HILLERTON, 2002). The use of antibiotics as a preventive method is concerning, because of the potential for selection of resistant pathogens (GARCIA; OSBURN; CULLOR, 2019), and the risk related to antibiotics' residues left in meat and milk products, which can harm animals and humans (BERRY; HILLERTON, 2002).

A review (RUEGG, 2017) showed that mastitis control programs around the world focused on the on-farm incorporation of daily routine procedures such as post-milking teat dipping, hygienic milking procedures, and strategic use of antibiotic therapy at dry-off to control contagious pathogens. To diagnose the subclinical mastitis in its early stages it is necessary to adopt managements in the routine of the farm, such as the California Mastitis Test or CMT. This test is an indicator of the somatic cell count of milk, and it is relatively simple, as it consists in a four-well plastic paddle where the milk of each quarter is combined with the test reagent, that depending on its consistency (unchanged milk to solid gel) is considered positive.

Farmers cite factors such as lack of time available and extra labor as barriers when deciding whether or not to adopt certain managements or recommendations (RITTER et al., 2017). Farmers have associated managements such as daily strip cup test and California mastitis test (CMT) as laborious (LEITNER; MERIN; SILANIKOVE, 2011), despite studies showing that CMT is effective for detection of mastitis cases and helpful for prevention and early diagnose, avoiding the evolution of the infection and inflammatory process (FERRONATTO et al., 2018). Many dairy farmers adopt few preventive measures of mastitis control and associate its prevention only and exclusively to antibiotic use (MARQUETTE, 2018; TONIAL; A. P., 2017). Attempting to train farmers on the proper use of antibiotics often runs into conflicting advice and information from prescribers (REDDING et al., 2013).

1.1.2 Antibiotic residues from discarded milk

Milk containing residues of antibiotics resulting from treatments can cause several consequences to human health and the environment. The presence of antibiotics in animal origin food is concerning because of antibiotic resistant microorganisms, carcinogenic and mutagenic effects, and possible allergic or hypersensitivity reactions (KUMAR; PATYAL; PANDA, 2018). Farmers have the closest contact with their animals and are often the ones who treat them with antibiotics, or the ones disposing of waste milk, being more likely the first victims of antimicrobial resistance. According to several studies, farmers are more likely to develop antibiotic resistance than people with no farming contact (AUBRY-DAMON et al., 2004; KHANNA et al., 2008; VOSS et al., 2005).

Whatever way the antibiotic gets into the environment, for example via animals' biological means, like urine and feces or through human means, such as improper disposal of medicines, the consequences to the ecosystems are many. Animals can excrete 30 to 90% of the antibiotics' compounds, as the gut absorption is low (SARMAH; MEYER; BOXALL, 2006). This, added to the problem of old medications that come to expire, the discharge from wastewater treatment facilities, and many other ways of medication waste, leads up to a route of accumulation in the environment (SARMAH; MEYER; BOXALL, 2006). The presence of antibiotics' accumulation in the environment can disturb the micro-ecosystem of the soil by disturbing the microorganisms that are responsible for fixing nitrogen (KUMAR; PATYAL; PANDA, 2018). Also, improper handling of milk containing antibiotic residues may increase the problem of water contamination (SANDERSON et al., 2018).

Feeding the calves with the milk of cows treated with antibiotics for mastitis solves the problem of how to discard and save this milk that cannot be sold to the dairy (HALASA et al., 2007). However, calves that drink this milk can have an increase in the number of bacteria resistant to the antibiotics inside the gut, especially if fed with the milk with higher antibiotic concentrations from cows that are initiating the treatment for mastitis (RICCI et al., 2017). Feeding waste milk can also cause diarrhea due to intestinal microflora disorder, especially in young animals (LANGFORD; WEARY; FISHER, 2003). Other long-term effects of feeding this milk with antimicrobial residues are still poorly understood and studied.

1.1.3 Farmers' role in reducing the use of antibiotics

The prudent use of antibiotics is a necessary step to reduce bacterial resistance to antibiotics, considered one of the major challenges for human and animal health in the coming decades. Understanding the knowledge and attitudes of dairy farmers regarding the use of antibiotics to manage cows' health is essential to support interventions aiming to achieve this goal.

The relationships of farmers with their advisors are important here. Veterinarians have an important role in advising and teaching preventive methods, as a large part of advice is related to planning of managements used to maintain or improve udder health (HOGEVEEN; HUIJPS; LAM, 2011). Farmers trust the advice of veterinarians of whom they have a positive representation (FISCHER et al., 2019b; OLMOS et al., 2018). Factors such as good communication, trust-based dialog, medical expertise and being available outside office hours are factors that are highly valued by farmers (FISCHER et al., 2019b).

For farmers, investments in preventive measures that require changes in their milking routine or extra labor are less preferred than investing money in other areas of their business (HUIJPS et al., 2009). Besides, as it is a multifactorial change, the results from these changes are not clear. It is essential to consider these factors when suggesting changes on-farm to prevent diseases. When advising farmers, it is essential to discuss potential losses, as they are more averse to losses than keen on gains (HOGEVEEN; HUIJPS; LAM, 2011).

To understand the relationship of the dependence of antibiotic use on animal production, it is important to try to elucidate the problem in a systemic and multifactorial manner (SCOTT et al., 2019). For example, it is important to know farmers' internal characteristics related to their antibiotic treatment practices, along with external characteristics such as animal husbandry conditions (MAGOURAS et al., 2017; VISSCHERS et al., 2014). Behavioral interventions, such as educational campaigns, could empower farmers with knowledge of more prudent and rational practices essential for stimulating a more rational use of antibiotics (DOEHRING; SUNDRUM, 2019; KRAMER et al., 2017). The role of extension technicians in adopting changes is evident (CARDOSO; VON KEYSERLINGK; HÖTZEL, 2016; HÖTZEL; SNEDDON, 2013; POIZAT et al., 2017). Thus, understanding farmers' knowledge and perceptions about

the subject, as well as their relationship with extensionists and veterinarians, is essential to support such programs.

2. OBJECTIVES

The aims of this study were firstly, to identify behaviors (practices), knowledge and attitudes of dairy farmers regarding mastitis prevention and antibiotic use and, secondly, their attitudes and motivations regarding prudent antibiotic use.

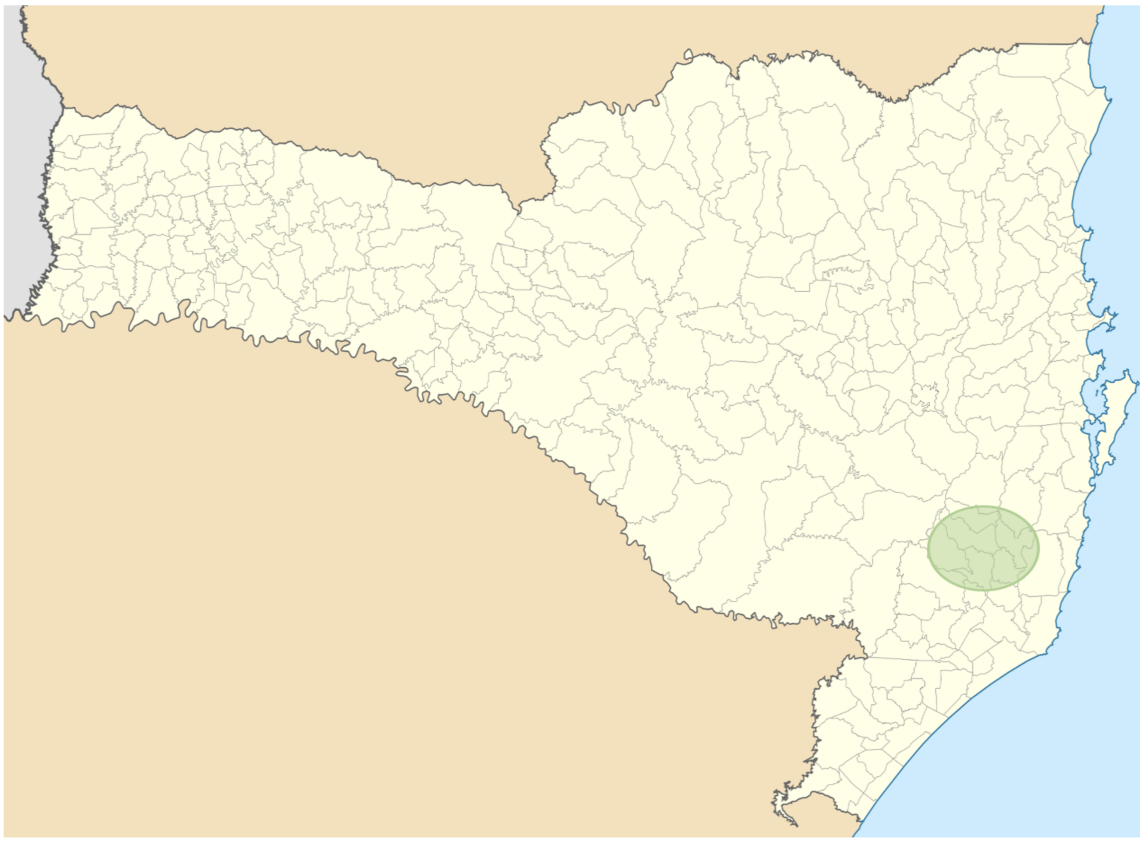
3. METHODOLOGY

The project was approved by the Ethics Committees on Research on Human (07234918.8.0000.0121) of the Federal University of Santa Catarina. Face-to-face semi-structured interviews were conducted in the southern area of the Santa Catarina state.

3.1 STUDY LOCATION

Santa Catarina is the fourth largest milk producer of Brazil, maintaining milk production relatively constant on the last two 4th yearly quarters of 2021 and 2020 (-0.6%). For example, the other five of the top six states had a milk production drop ranging from -5.5% to -11.6% (IBGE- INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA, [s.d.]). Most of the state's milk (90,5%) is produced by small-scale family farms, highlighting the importance of family farming for the milk chain (IBGE, 2020). Participants were distributed in five municipalities that belong to the micro-region of Tubarão, namely Armazém, Braço do Norte, Rio Fortuna, Santa Rosa de Lima, São Martinho (Figure 1). Together, these five municipalities produce 129.670 liters per year (IBGE, 2020). These sites were chosen for the study because they reflect the small-scale family farms in the state and country, and for the importance that milk has on families' monthly income. Dairy farming is one of the main activities carried out by family farmers and is present in 36% of establishments in the country, in addition to representing 52% of the gross value of production. Farms in the south and Midwest regions of Brazil are the most involved in dairy farming, being present in 61% of the establishments classified as family economy (GUANZIROLI; FAO; CARDIM, 2000).

Figure 1. Map of the state of Santa Catarina, with the location of the five municipalities highlighted (Armazém, Braço do Norte, Rio Fortuna, Santa Rosa de Lima, São Martinho).



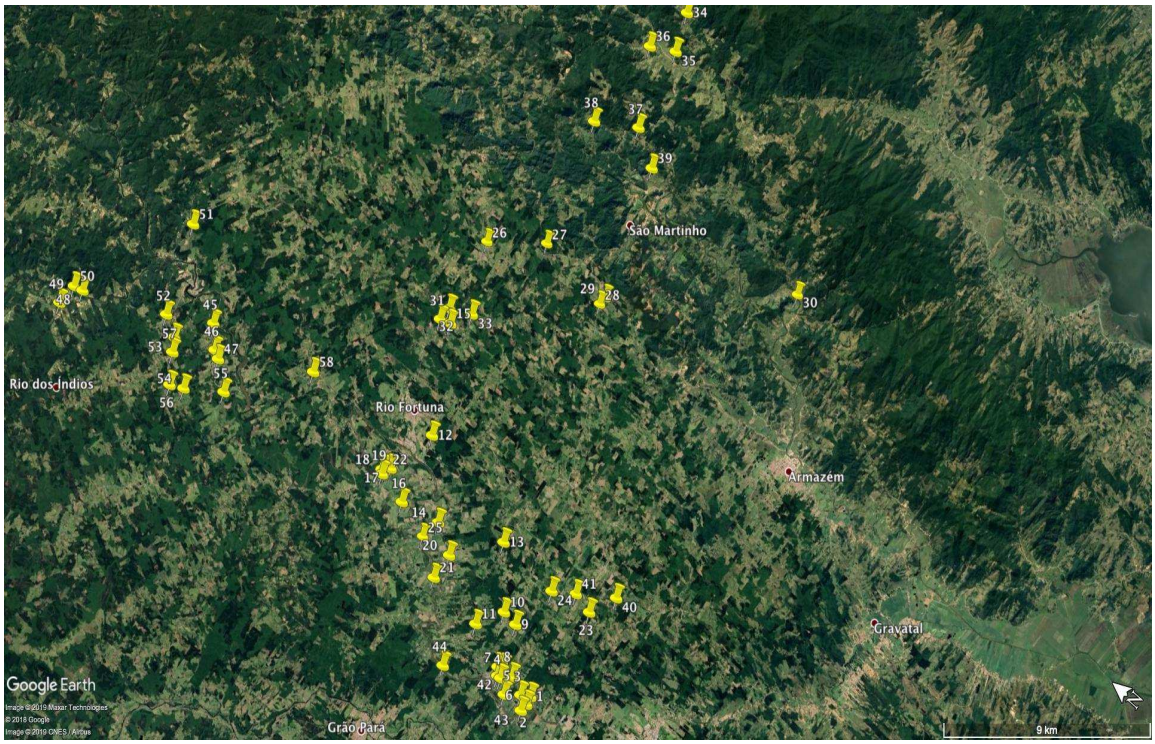
Source: Public domain image (modified).

3.2 PARTICIPANTS' SELECTION AND RECRUITMENT

The study was based on a convenience sample. Farms and farmers' characteristics conditions to participate in the study were to be a family-run dairy farm, meaning that the family owned the farm and was responsible for the milk production; managed the herd on a pasture-based system, as the majority of the farms in the region, and were available and willing to participate. Interviews were conducted in two stages. The recruitment of participants was done based on the knowledge of the region acquired from a previous study (ALBERNAZ-GONÇALVES; OLMOS; HÖTZEL, 2021), where most of the pig producers of the region also had a herd of dairy cows, something very usual among small producers of this region. Recruitment involved five municipalities, with a good distribution between them (Figure 2), to ensure that we were talking to farmers who were getting professional assistance from different veterinarians and professionals. After

interviewing some of these farmers, further participants were recruited using the snowball technique (BRAUN et al., 2019), where the initial interviewees were asked to recommend other dairy farmers nearby that had similar characteristics. In some cases, after visualizing a cattle herd on pasture the team approached the barn and asked if the producers had time to participate in the interview. In the first stage of the interviews, we interviewed 30 farmers and following a preliminary analysis of the responses, we returned to the region for the second round of 28 more interviews. This number of participants was decided after the second analysis of the 28 interviews, since no new elements were identified in the responses obtained. We considered that the number of participants allowed us to have a diverse and in-depth report on the topic.

Figure 2. Distribution of the participants (57) on the map of Santa Catarina.



Source: Public domain image (modified).

The objectives of the study were explained to all the participants, who were informed that their participation was voluntary, their identity would be kept confidential, and the data would be used for scientific purposes only. Authorization to record the interviews was obtained from all participants. The participants could ask the interviewer questions during the conversation or withdraw from the study at any time. All interviews were carried out by the same interviewer, RW. The interviews were done face to face in

Brazilian Portuguese, during the month of July of 2019; the length ranged from 30 to 80 minutes.

3.3 INTERVIEW SCRIPT

The interview contained semi-structured and open-ended questions (supplementary Appendix B). The interview was divided in seven sections, which corresponded to (1) herd diseases and antibiotic use; (2) technical assistance; (3) milking routine; (4) mastitis; (5) antibiotic residues in milk; (6) bacterial resistance to antibiotics; (7) attitudes towards a scenario of reducing antibiotics' use. All interviews started with some demographic questions and questions about the farm's characteristics, the number of animals, farmers' experience with dairy production, which aimed to start a conversation and build a rapport with the interviewee(s), then followed by one of the sections listed above. To maintain the interview as a conversation and keep participants comfortable to discuss the different topics there was no strict order for the sections to be followed, the themes were raised and discussed as the farmer(s) commented, meaning that not all questions were answered by all the participants.

3.4 DATA ANALYSIS

This project had a qualitative character, so the quantitative results were analyzed using descriptive statistics resources. The Excel® program was used for data tabulation and generation of tables. The interviews were transcribed and read exhaustively to create a familiarity with the speeches. After this step, the coding of the transcripts was performed by the author and transformed into themes for analysis (BRAUN; CLARKE, 2006).

For the purpose of discussion and presentation some quotes from each theme were selected, as described in Appendix A. For example, F30a refers to the first excerpt from the interview with Participant F30; F15b is the second excerpt quoted from the interview with Participant 15.

4. RESULTS

4.1 DEMOGRAPHIC DATA AND CHARACTERIZATION OF FARMS

Of 68 dairy farmers invited, 57 agreed to participate. Farmers that did not agree to participate because were busy at the time we approached them. All farms, except three that used the Compost barn system, used a pasture-based system.

Herds were on average 28 lactating cows and milk production of 13 (from 7 to 25) L/cow/day (Table 1). The herds were mainly composed by Jersey cows (77%), and some had Jersey and Holstein (11%), Jersey and their crosses (7%) and just a few had only Holstein (5%). Participants had relevant experience in dairy farming as most of them (80%) had been working in the milk industry for more than 10 years. Farms were mostly family-run, i.e., 85% had exclusively family members running the farm and 15% hired one or more employees to aid on the farm.

Table 1. Demographic data of the farm interviews (57).

Demographic	**Variable**	**Dairy farmers (n=x)**	**%**
Age*	18-30	11	17
	31-40	9	13
	41-50	11	17
	51-60	22	33
	Over 60	13	20

Sex*			
	Male	41	62
	Female	25	38
Experience in dairy farming (years)**	0-10	10	20
	11-20	17	34
	21-30	11	22
	Over 30	12	24
Herd size (Lactating cows)***			
	15-25	22	39
	26-40	17	30
	Over 40	18	31

* Age and sex were calculated by the total number of participants, considering that sometimes there were two in the same property (n=66). ** Number of farmers responding to this question (n=50). *** Number of farmers responding to this question(n=57).

The most frequent disease in the herd cited by farmers was mastitis (Table 2). However, they did not always mention mastitis as a disease when asked about the main diseases. As the interview progressed it was clear that those farmers did have mastitis in their herd, they just did not recognize it as a disease at first, with some even asking the interviewer if mastitis could be a response to the question.

Table 2. Most frequent diseases in the herd cited by participants (57) of the study.

Most Frequent Diseases *	Total n (%)
Mastitis	43 (46)
Babesiosis	27 (29)
Others	14 (15)
Transition diseases	7 (8)
Do not know	2 (2)

* These items were cited more than once by the same participants, so the sum of citations is higher than the number of farmers. The percentages were calculated based on the number of participants (n = 55).

4.2 MANAGEMENT PRACTICES ADOPTED BY FARMERS

Most farmers used pos-dipping (78%), and only a few used pre-dipping (8%), the others cleaned the teats with water every time or when they judged them to be too dirty. Some participants justified not using the pre-dipping and paper towels because of the cost of the products (F30a). Others claimed the opposite, saying that having a better-quality milk would result in better financial return and would compensate for the extra costs (F54a). To dry the teats most of the participants started using paper towels in the last years (52%), but some still used a cloth (31%) or would just let them air dry (17%). Some participants identified that this change helped with mastitis control (F17a) and could explain how it would help (F15a; F52a).

The cleaning routine of the milking machines and parlor was similar among all participants, i.e., with hot water and alkaline detergent after every milking and acid detergent every other day or twice a week, depending on the farm. However, none of the farmers checked the pulsator of the milking machines regularly, and most would only get it looked when something was wrong or when they got other parts changed, such as the milk liners (F2a; F15b). Some farmers reported that the lack of management on pulsators would cause cows to experience some sort of pain (F43a) and that this pain could lead to mastitis (F41a; F13a; F30b). In contrast for some of the farmers the importance of making these adjustments was not clear (F58a); a few related the importance of the time it would take to milk all the cows (F38a) and the difference that adjusting could make on specific cases (F49a). Farmers also relied on technology to tell them when the pulsator was not

working properly or even thought that, because of the technology, this management was no longer needed (F48a; F3a).

Most farmers claimed to try to use preventive measures such as milking cows with mastitis at the end of milking (67%), but many argued that sometimes this was not possible because it was difficult to separate cows with mastitis from the rest of the herd (F16a; F25a). Farmers had knowledge that this practice could avoid mastitis from being spread to the herd (F26a; F45a; F52b) and one of their main concerns regarding this topic was that milk containing antibiotics from cows being treated for mastitis would get mixed in the refrigerator with good quality milk (F39a; F3b). To avoid this from happening, some of the farmers (25%) had a separate set of equipment, such as teat liners and buckets for cows that had mastitis (F42a; F54b). Others that did not have a specific set of equipment for cows in treatment would use other strategies, such as disinfecting the teat liners with specific cleaning products after milking cows with mastitis (F43b). Few commented that this strategy was implemented because of past experiences, where antibiotics were detected on the milk by the dairy industry because they had not adopted a preventive routine of cleaning equipment between treated cows (F37a).

The strip cup test was only used regularly by 29% of the farmers, while the majority (54%) stated not to do it; the remaining would do it only if they thought to be necessary or would say that they could have the same information by striping the milk on the floor and making the observation then, as that is already part of their milking routine (F49b). Farmers that implemented the test daily considered it important because it could help with early diagnoses and prevent losing a quarter or the animal (F43c; F54c); farmers also believed that the main reason for other famers not do the test was the amount of extra labor that it demands (F4a; F43c). Farmers also raised the point that by not doing the early detection of mastitis the producers were losing money on the price paid on the milk, as by the new regulation that paid for milk quality (F48b). The normative (regulation) referred on many of the interviews was an additional challenge for Brazilian dairy farmers at the time of this study. The normative 76 and 77, establishes new milk quality criteria and production procedures, packaging, conservation, transportation, selection, and reception of raw milk (BRASIL, 2018a; b). As a way of encouraging farmers towards better milk quality, some dairy industries in the region were paying according to milk quality.

The detection of subclinical mastitis thru the California Mastitis Test (CMT) was not part of the daily routine of most farmers (Table 3). Some of them would only do it when perceived as necessary, for example after seeing signs of mastitis such as lumbs when striping, swelling or other symptoms (F26a). Regularity of CMT testing was linked to services provided by the dairy companies they sold milk to or the veterinarians that sold inputs and medications to the properties. Even though most participants did not do the test frequently, they had knowledge about the test and just saw it as unfeasible because of the amount of work and time to get it done (F55a; F11a). However, some participants disagreed, as they thought that people who were not doing regular testing were not worried with milk quality (F19a).

Table 3. Detection of subclinical mastitis through the California Mastitis Test (CMT).

Frequency	**Total n (%)**
Does not do it	20 (38)
If necessary	20 (38)
Once or twice a month	8 (15)
Once a week	3 (5)
Once a day	2 (4)

Some interviewees were participating in a government assistance program from the SENAR (National Rural Apprenticeship Service) where they received information about the management and herd health (SENAR, [s.d.], [s.d.]), through which they claimed to have learned about preventive measures to control mastitis (F47a). Others started implementing the preventive methods (pre-dipping, pos-dipping and paper towel) because of the new regulations regarding milk quality and the money incentive given according to the standards established (F48c).

4.3 ANTIBIOTICS MISUSE

The main use of antibiotics on dairy farms was related to dry cow therapy and treatment of specific cases of mastitis. Misuse of antibiotics was identified in reports as use of larger doses than prescribed by the veterinarian “to improve effectiveness”; use of antibiotics in the absence of diagnosis, and choice of molecules without veterinary prescription or based on commercial advertisements. Many times, treatments were determined by the farmers themselves, often using several active principles (F30c). Some farmers reported difficulties in treating mastitis and some reported that it is sometimes more advantageous to cull cows than to treat them (F43e).

The use of antibiotics in the moment of drying off cows was a consensus among the farmers. Some cited intramammary products and others a combination with an injection of penicillin. The method used for drying the cows had minor variation among farmers. Usually, farmers started to reduce the grain-based ration a few weeks before the moment of drying off and then moved the cows to a pasture considered of lower quality until the production of milk was reduced or stopped, and subsequently, the antibiotic of choice was applied. The usual dry period was 60 days. Different participants commented on the risk of residual antibiotics if the dry-off period were shorter (F3c). The biggest concern regarding antibiotic treatment during the drying-off period was related to early calving, as it would result in milk with antibiotics residual, which had as consequence money loss. Some farmers cited examples of times when they treated a cow with antibiotics at dry-off, anticipating the cow to calve only after the antibiotic’s withdrawal period, but the cow calved earlier than expected, and their lack of control over animals’ medication date caused them to mix the milk with residuals with good quality milk.

4.4 VETERINARY SERVICES: SOURCES, AVAILABILITY AND DRUGS’ SALES

Farmers indicated that they had easy access to antibiotics in local agricultural stores over the counter, without veterinary prescription. They would also buy antibiotics on the farm, from the veterinarian or the salesman from the agriculture store who was there selling them other agricultural inputs. Some of the farmers were not aware of what they were using to treat mastitis (F54d; F47b), even though they were the ones who usually bought and chose the prescriptions over the counter in agricultural stores. When

questioned about the names of antibiotics they used, 11 farmers (23%) out of the 47 farmers questioned did not know the brand names or the generic names. Brand names of anti-inflammatory and antiparasitic drugs were mentioned as names of antibiotics most used in the treatment of mastitis (Table 4).

Table 4. Names of drugs to treat mastitis according to farmers.

Generic names	**Brand name***
Amoxicillin	Clamoxyl
Benzypenicillin	Pencivet
Cefquinome	Cobactan
Ceftiofur	Acura; Ceptiomax; Lactofur
Ciprofloxacin	Ciprolac
Getamicin	Gentamox
Marbofloxacin	Forcyl
Penicillin	Shotapen
Sulfadoxine and Trimethoprim	Borgal
Antibiotic + Anti-inflammatory	
Amoicillin, Colistin, Dexamethasone	Agroplus
Benzylpenicillin, Piroxicam	AgroVet
Cefapirin, Prednisolone	Mastiplan
Flumetasone, Spiramycin, Neomycin	Flumast
Sulfonamide and Trimethoprim, Piroxicam	Fortgal

Anti-inflammatory	
Bacitracin of zinc and neomycin	Neomastic
Cefoperazone	Mastizone
Flumethasone + Sulfate of Neomycin + Spiramycin adipate	Newmast
Flunixin meglumine	Flumax
Antiparasitic	
Doramectin	Detomax

*Brand names are described in Portuguese as the participants stated them during the interview

Most participants, 84% considered antibiotic treatments and their consequences (loss of milk contaminated with antibiotic residues) expensive (F14a; F49c), 6% considered not expensive, 6% as reasonable, 2% said that depended on the case, and the other 2 % said that did not use as much antibiotic to have an opinion. Due to the low remuneration per liter of milk paid by the dairy industry, some farmers considered the treatment with antibiotics economically unviable (F9a) and would rather discard the sick animals (F8a). The combination of these factors as antibiotic price, milk disposal and low remuneration per liter make the treatment of mastitis extremely expensive for farmers to bear.

Farmers called veterinarians only when perceiving extreme necessity. Thus, they based most mastitis treatments on their own empirical experience or from neighbors' accounts of successful experiences. Several mentioned that veterinary assistance was linked to the sale of other inputs for the farm, that would consequently give them "free" veterinarian assistance when needed (F30d; F17b; F38b). Some farmers complained that they felt pressured to buy medicines from these veterinarians even when they thought they were not needed (F32a). Vendors' harassment also happened through the promotion of lecturers, field days, and dinner parties to promote sales of a given product (F22a; F57a).

Farmers accessed veterinarians' assistance in different ways, such as farming stores, dairy industry, rural producers' unions, city councils, and privately (Table 5). Some farmers commented that they had free veterinary assistance available all the time from the farming stores but preferred not to use it because they did not trust these veterinarians and believed they were moved by drug sales rather than helping with the health of the herd. Veterinary service was also provided by the city council and other professionals from Epagri (Company of Agricultural Research and Rural Extension), but they did not consider these services adequate for the purpose of udder health because the professionals were not available at all times (F58b; F57b; F32b).

Table 5. Type of professional assistance that farmers received.

Type of assistance*	**Total n (%)**
Private veterinarian	20 (24)
Farming stores veterinarian	43 (52)
Public veterinarian (city council, EPAGRI)	16 (19)
Dairy industry veterinarian	4 (5)
Number of veterinarians assisting the farm	
One	33 (58)
Two	20 (35)
Tree	4 (7)

* Some farmers had more than one veterinarian assisting, so the sum of citations is higher than the number of farmers.

Most farmers claimed that veterinarians did not discuss mastitis prevention on a regular basis and would only communicate if something was outstandingly unusual. Veterinarians were usually there to treat problems that farmers had identified beforehand and required assistance with, like dystocia calving, injuries, or metabolic diseases (F57c; F16b). Although farmers preferred to call the private veterinarians because they trusted

them, only a few did so because they considered it an expensive service, and they never called them for mastitis cases, because to them the cost benefit was not justified.

4.5 ANTIMICROBIAL RESISTANCE A CONSEQUENCE OF ANTIBIOTIC USE

Farmers not always could explain how antibiotics worked and mostly would say that antimicrobial resistance was “when an antibiotic stopped working after a certain period of time” (F4b; F30e). They also claimed that the way of resolving this issue was changing the antibiotics but could not give more details on their response. On their statements, farmers would often say that the cow was the one resistant to the antibiotic (F6a; F31a; F20a) and just a few of the participants were able to give a more detailed answer on how they perceived the process of resistance to work on the bacteria (F3d; F39b; F38c). Some of the farmers believed that to resolve resistance cases it was necessary to change the antibiotic used to a “stronger one” or even increase the dosage given previously (F40a; F37b; F28a).

Thirty-seven percent of the farmers had not heard about antibiotics’ resistance in humans, and some did not see residual of antibiotic in milk as a threat to human health; they considered that antibiotics would get diluted in the dairy industry, and the major concerns were related with cheese yield not being the same in the presence of antibiotic (F54e). However, some farmers believed that there was a relationship built up over time between the consumption of milk with residuals and the development of resistance to antibiotics in humans in the moment of need, and that was the reason why they could not mix the good milk with the one with antibiotics residuals (F15c; F11b; F28b).

Farmers did not have the habit of requesting antibiogram tests to detect cases of bacterial resistance, even when recommended to take one only sample of the tank (F55b). Those who used such tests did not always adopt the results as a course of action when medicating the animals (F37c).

4.6 THE PROBLEM OF ANTIBIOTIC RESIDUES IN MILK

Some farmers also commented about situations where the laboratory analyses from companies where they sold the milk accused antibiotics in the milk over the limit allowed and how these situations happened (F3c; F39c). Those who did not have the

experience were scared just by the idea of it (F46a). Something interesting brought up by the participants was that prior to the new regulations, farmers' level of care and concern regarding antibiotics residues in the milk was practically nonexistent, but with the new regulations in place concern regarding this issue increased (F12a; F35a). Despite the fact that the new legislation established national criteria for milk production, farmers had different production tolerances depending on where they were selling milk to, some being more lenient others having a stricter policy.

Most of the farmers often fed calves with residual milk and did not associate this practice with any major problems (F5a; F39d; F16c). The professional assisting the farms gave different recommendations on the topic. Some farmers never heard about feeding calves discarded milk being a problem and said that the practice was recommended by the veterinarians (F9b; F19c; F17c). In contrast, few farmers claimed that veterinarians told them that feeding calves milk with antibiotics residues could lead to a potential bacterial resistance in their future life as milking cows (F1a; F14b). Discarding milk containing antibiotics meant using milk good for sale to feed the calves, which discouraged many farmers from changing their practice (F6b; F38d). Therefore, some of the farmers, after assessing the cost of not using this waste milk decided not to follow the recommendation (F26c; F55c; F37d). Few farmers claimed to be trying not to feed calves with this milk because of the risk of antibiotic resistance (F37e; F49d; F52c). Some mentioned different strategies that in their opinion were effective to prevent future consequences, like discarding only the "worse quarter" and utilizing the others (F38e) or only feeding the older calves the milk with residues (F43f).

The majority of the farmers believed that the consumers from the city did not have knowledge about basic steps of milk production and were even less aware about antibiotic residues (F28c; F42b). Some claimed that the people from the city and consumers are more concerned with the final price of milk than any other aspect of the production chain (F31b; F6c). One of the farmers brought up that people from the upper middle class worry about milk quality but also about all the other food they ate, and that was the reason for the new legislation on milk quality (F38f).

4.7 KNOWLEDGE AND ATTITUDES ABOUT PRUDENT USE OF ANTIBIOTICS

Farmers were unfamiliar with the legislative guidelines for the prudent use of antibiotics but were aware of the new normative regarding milk quality (F29a). Due to this new normative, some cooperatives were offering support to farmers during milking to improve milk quality; however not all farmers found it interesting, because they considered it incompatible with their workload (F17d; F35b).

For 40% of the farmers, the use of antibiotics in dairy farms in Brazil was not rational, and 34% believed it to be adequate (26% did not know how to express an opinion on this subject). Most farmers claimed that in a hypothetical future scenario of prescriptions of antibiotics becoming compulsory, there would not be enough veterinarians to support all dairy farms' demand. Farmer's opinions towards policies aiming to restrict the use of antibiotics were divergent. Most farmers argued that with such restrictions dairy production would become unfeasible (F52d). Many of the producers ended up linking this hypothetical scenario with what they were living at the time of the interview; the new legislation was beginning to be put into practice and they were being pressured by the dairy industry to follow these new quality criteria. Some of them stated that they saw themselves in a complicated scenario, where demands for milk production are increasing, and the financial return is decreasing (F32c). A few of the farmers saw this future scenario and what they were experiencing at the time with the new legislation as beneficial for farmers but claimed that it required changes in daily practices and routines, and for that, technical assistance would be lacking (F45b). Therefore, they could see some farmers failing to adapt to these changes (F24a). Others put themselves out of the equation by declaring that they already used the minimal antibiotic amount necessary, and therefore would not be affected (F35c). However, a few were optimistic about the implementation of antibiotics restriction policies, stating that everyone wants to reduce cost with antibiotics as the prices of medication is so high and that it could be beneficial (F37f). One of the farmers made the relationship with the purchase of antibiotics for humans, in which case a prescription is needed, and said that it would be the same but with the assistance of a veterinarian (F40b).

Some farmers raised the lack of information and support given by the government at the moment of changes towards the new standards of the normative 76 and 77. Any stated that not everyone knew the reasons behind not using antibiotics, that they felt that

these changes were imposed on them, and that in their opinion the change could have been done differently. The lack of financial incentives to make the required changes was very commented on; in the opinion of the farmers, many people were stopping milk production due to the new regulation and the impossibility of making the necessary investments for this common goal (F41b; F22b).

4.8 ORGANIC DAIRY FARMING AS A FUTURE FOR FARMERS?

The farmers interviewed were not able to see themselves producing organic milk and were negative about doing this transition. The impossibility of using pesticides and transgenic seeds was one of the main obstacles pointed out by farmers (F45c; F41c). Some farmers were extremely pessimists and thought that it was not necessary to try to produce pasture or corn with no fertilizers and pesticides, that this organic scenario was not an option to think of (F47c). Other farmers thought this was a multifactorial problem, where the prohibition to use transgenics, fertilizers and pesticides was a limitation for the production of food for animals, but they could also see the dependence on antibiotics as a concern factor (F39e; F48d; F35d). Antibiotic treatments were seen as a quick-acting solution by farmers, and, in contrast, homeopathic treatments used in organic farming were considered useful but only in the long term (F33a); some farmers claimed not to trust homeopathic treatments over antibiotics (F34a). Homeopathic products were cited by most farmers as an alternative treatment method to antibiotics. However, most did not know how the method worked and associated its use with antibiotics — using homeopathic only as a preventive method, and when the cows had an udder infection or in the moment of drying off the treatment usually would be done with antibiotics. Others believed that homeopathic treatments did not work, based on failed previous experience. Higher cost of organic production was also raised as a barrier by one of the participants, who said that a more frequent visit to the veterinarian would be necessary and become an obstacle for this scenario (F48e).

5. DISCUSSION

Farmers described the use of antibiotics as necessary during the life of dairy cows and essential during the dry-off period. All the participants considered the access to antibiotics easy, as they could buy them without a veterinarian prescription over the counter in any agricultural store. This in some cases resulted in overuse, wrong molecule choice and lack of professional diagnosis. Most farmers considered antibiotics expensive but were more likely to use them than to adopt routines to prevent mastitis. Changing routine behaviors is considered extremely difficult, as it depends on how people see drivers and barriers towards a change (ALBERNAZ-GONÇALVES; OLMOS; HÖTZEL, 2021; SPEKSNIJDER; WAGENAAR, 2018). When it comes to antimicrobial use and practices to manage mastitis, farmers highly value current and previous experiences with antibiotics, before considering the adoption of new managements (RITTER et al., 2017).

Mastitis is one of the most prevalent diseases in dairy cattle and antibiotics are widely used to treat it (HALASA et al., 2007; JONES et al., 2015), as confirmed in this study. It was clear from the interviews that farmers did not always see mastitis as a disease. Not recognizing mastitis as a disease shows us how coexisting with this disease daily can change how farmers see it, which affects directly how they see themselves changing behaviors towards prevention methods. A number of different models have shown that, in order to change behavior, a person must first recognize the need for change and establish an intention to change (EDWARDS-JONES, 2006; PROCHASKA, 2008). Only after recognizing the need to change, this intention can be translated into action, followed by a maintenance phase in which relapse into old habits must be avoided (AJZEN, 1991; PROCHASKA, 2008). It is evident that the farmers in this study struggled to see themselves making changes, as they could not always see the problem in front of them.

It was interesting observing a contradiction, where farmers considered antibiotics as an expensive product but at the same time used them excessively, and in certain cases, there was evidence of antibiotics dependence. This could be related to a “culture” where antibiotics are seen as the best treatment with the best prognosis. Vaarst et al., (2003), showed in their study that even farmers already transitioned to organic systems perceive antibiotics as the treatment method with the best prognosis in treatments of mastitis. This

notion is supported by Albernaz-gonçalves et al., (2021) and Jones et al., (2015), who reported that farmers' main reason to reduce antibiotic usage was to attempt to reduce costs, more than to reduce antibiotics resistance in humans or animals.

Given the association between antimicrobial agents in humans and animals, policies aiming for prudent use of antibiotics have been implemented all over the world to minimize antimicrobial resistance selection pressure (WORLD HEALTH ORGANIZATION, 2022). The OIE and the WHO deliberated a list of antibiotics that are classified as "Highest Priority Critically Important Antimicrobials" (OIE, 2018), eight of the antibiotics cited by the farmers in this study were on that list (Ceftiofur, Cefquinome, Benzylpenicillin, Amoxicillin, Ciprofloxacin, Marbofloxacin, Sulfadoxine and Trimethoprim). A study done by Albernaz-gonçalves et al., (2021) in the same region of the country with pig farmers found similar results and emphasized the concern of using broad-spectrum active ingredients regularly, as well as the potential development of antimicrobial resistance. The low knowledge about the drugs that they were using to treat mastitis emphasizes the problem of self-medication, where farmers do not use specialized advice from veterinarians when medicating their animals, which can have as a consequence antibiotic resistance. If farmers do not know what antibiotics they are using to medicate their herd, they certainly cannot not have control of how much they use. Doidge et al., (2020), highlights in their study the importance of farmers knowing and accounting for their antibiotic use so that they can work with new policies aimed at reducing the use of antibiotics.

Farmers in this study had a very shallow knowledge and understanding of antimicrobial resistance. Most of them equated microbial resistance to antibiotic not working when used, and saw the solution to this issue in trying a new antibiotic or culling the animal. According to a previous report done by WHO (2015), a large section of the farming population lacks knowledge of antimicrobial resistance and prudent use of antibiotics, although this varies greatly depending on the place of study (FARRELL et al., 2021; THORNBER et al., 2020). Likewise, knowledge and awareness of antimicrobial resistance is higher in high-income countries and the opposite scenario is reported in lower-income countries (ALBERNAZ-GONÇALVES; OLMOS; HÖTZEL, 2021; CHAUHAN et al., 2018; JONES et al., 2018; REDDING et al., 2014; SADIQ et al., 2018).

As a result of the indiscriminate use of antibiotics and the easy access, it is not surprising that farmers found very difficult to see themselves in a future scenario where antibiotic regulation changed to mandatory. Other studies have revealed that farmers consider themselves low users of antibiotics and not part of the problem of antibiotics resistance (COBO-ANGEL et al., 2021; SCHWENDNER et al., 2020; WEMETTE et al., 2020), which can contribute to them not being able to see themselves with stricter antibiotic regulation. In addition, the distance between farmers and veterinary assistance made such scenario impossible for most of the interviewed. This relationship can be either a potential barrier or a facilitator when reducing antibiotic use, depending on how the relationship dynamic is perceived (FARRELL et al., 2021).

5.1 ANTIBIOTIC MISUSES

Mastitis prevention treatment performed by farmers in this study was based on antibiotics and blanket dry cow therapy was part of the farmers' management. It was surprising to see that none of the interviewees talked about selective dry cow therapy, which involves antimicrobial selection based on the culture and sensitivity test results aiming a reduction of unnecessary antibiotic use (SHARUN et al., 2021). This may be due to the cost or even the lack of information regarding the need for and benefits of these tests. Selective dry cow therapy has been highly recommended among international organizations (MORE, 2020; WORLD HEALTH ORGANIZATION, 2014), and European farmers have been concerned about this transition (HUEY et al., 2021), as it has become the only way to produce in some countries since the new regulations. The new regulation on veterinary medicines (Regulation (EU) 2019/6) is a response to the WHO global, approved in 2018, with regulations that aim to fight antimicrobial resistance (EUROPEAN COMISSION, [s.d.]). One of the numerous new measures that became effective in January 2022, is to ban preventive use of antibiotics in groups of animals, meaning that methods such as blanket dry cow therapy is now not allowed.

Through the interviews with the farmers, it was possible to verify that they were not aware of any other way to dry the cows. Moreover, they were following the recommendations of the professionals that assisted them. From our study it is not possible to know the reasons why veterinarians and professionals who assisted these farmers did not talk more about different strategies in the drying off period; future studies should

investigate the reasons behind these actions. Regardless of why farmers were unaware of selective dry cow therapy, studies have shown different methods of identifying which cows should be treated at drying-off through the selective therapy. For instance, Zecconi et al., (2019) published a study that showed how to use SSC threshold as an accurate and relatively cheap method of selecting these cows (100,000 cells/ml for primiparous cows and 200,000 cells/ml for multiparous cows).

Farmers had concerns regarding economic losses as a consequence of antibiotic treatments during the drying-off period when cows calved earlier or even lack control regarding calving dates and antibiotics withdrawal periods. To our knowledge, no recent studies have addressed the issue of antibiotic usage at drying off and its risks of residual milk when calving earlier than expected. This issue was reported as a concern by farmers in the study. The consequence of extended use of antibiotics on methods such as the blanket dry cow therapy exponentially increases the chances of residues in milk when cows calve earlier than their due date. Calving earlier than expected is not that unusual of a situation (ABDISA, 2018; MEE, 2013), and these need to be addressed with due importance.

Moreover, what happens with milk that contains residues and cannot be sold to the industry is also a problem. A study conducted decades ago raised concerns regarding the presence of antibiotics in colostrum fed to calves, as a result of intramammary infusions after cessation of lactation (HILL; SMALL, 1985). To date, feeding calves waste or discard milk is a common practice among farmers (BRUNTON et al., 2012; RICCI et al., 2017), and it was no different among farmers participating in this study. Most farmers fed calves waste milk and did not link this practice with any health consequences or future antibiotic resistance issues in the herd. However, the act of continuously feeding calves milk with small amounts of antimicrobials has been widely discussed and brought to light in different studies. The European Food Safety Agency (EFSA) published a report on the possible risks of developing antimicrobial resistance when feeding calves waste milk. Feeding calves unpasteurized waste milk containing antibiotics results in a higher incidence of neonatal diarrhea and leads to significant changes in the fecal microbiota composition (PENATI et al., 2021). For family farmers of small scale like the ones we interviewed, this issue is even more difficult to be solved,

since they had no way to pasteurize milk on their farms and did not recognize this practice as a problem. Additionally, farmers reported that most veterinarians assisting them on the farm recommended feeding the waste milk to the calves and had not attributed concerns to this practice. The few farmers that had the knowledge about the possible consequences of feeding calves waste milk would still feed the calves this milk, going against the recommendations of the veterinarian, because of economic reasons.

The problem to face is that milk with antibiotic residues exists and is a common issue among dairy farms. However, to our knowledge, little has been said on how to deal with this issue avoiding health and environmental consequences. As previously stated, feeding calves this milk is only a partial solution where we solve the problem of how to discard waste milk, however, there are other consequences linked to this practice. Moreover, telling farmers to discard this milk also does not fully resolve the problem, as incorrect disposal of waste milk into the environment also has serious environmental consequences such as possible contamination of water (SANDERSON et al., 2018) and imbalance of the micro-ecosystem of the soil (KUMAR, ATUL.; PATYAL, ANIL.; PANDA, 2018). In our opinion, the best solution to this problem is to change management practices and consequently decrease the use of antibiotics to the point that waste milk is not an everyday problem.

Farmers had negative attitudes regarding consumers' knowledge about milk production and milk residues. They believed that people from the city were only interested in the products' final price in the stores. Indeed, one of the main concerns of consumers is the price (ANDREYEVA; LONG; BROWNELL, 2010), however, consumers are also becoming more aware of farm animals living conditions and are concerned about their welfare (CARDOSO; VON KEYSERLINGK; HÖTZEL, 2017, 2019; DE QUEIROZ et al., 2018; VON KEYSERLINGK; HÖTZEL, 2015). Some consumers have also shown to be aware of the relationship between antimicrobial resistance and livestock production, associating risk with these practices (BUSCH et al., 2020; WEMETTE et al., 2021). Citizens are not only becoming more aware of food production systems but are also demanding changes in these systems and improvements in animal welfare, which reflects in the activities of organizations and the improvement of legislations (MOYNAGH, 2000). The farmers in this study did not see consumers as

knowledgeable about food production or as drivers of change for dairy production systems.

5.2 MANAGEMENT PRACTICES

Farmers were able to indicate changes that would help them to better manage mastitis on their farms, and most of them also knew about preventive methods. Nevertheless, they did not always adopt these managements in their routine. The importance of hygiene practices such as pre-dipping, pos-dipping, and use of paper towels to dry the teat has been proven for many years now (BARLOW, 2011; RUEGG, 2017), and farmers in this study were aware of these practices but still did not make the changes to prevent mastitis. The early detection of mastitis is critical for reducing economic losses, ensuring animal welfare, and producing quality milk (SHARUN et al., 2021; VIGUIER et al., 2009). All the farmers from this study had mastitis on their herd at some point and relied on antibiotics as their main control treatment. However, not much was said about the early detection of mastitis through tests such as strip cup test for clinic mastitis and CMT for subclinical mastitis. This conventional test methods are reasonably inexpensive, easy, rapidly available, and field applicable, but non-specific in detecting the different forms of mastitis (SHARUN et al., 2021). However, hygiene practices and detection tests demand more extra work and time, which the farmers in this study reported not having available as they already considered themselves overloaded with work. Another main argument is the extra cost of these products, and it is known that money is a big barrier when talking to farmers' adoption of new practices (FISCHER et al., 2019a; HUEY et al., 2021; PADDA et al., 2021).

Antibiogram was not used as a tool to detect the most effective antibiotics to use when treating the herd. Factors such as the number of samples or the cost of the test were not key points for farmers when deciding to use this tool or not. Raising the issue that perhaps even the few farmers who did perform the antibiogram did not fully understand its uses and benefits to the herd health. An antibiogram is primarily intended for bacterial identification, but it is also a powerful guide for professionals when prescribing drugs, as well as monitoring bacterial resistance over time (BOIREAU et al., 2018). This means that, if used correctly, antibiograms can assist in the moment of choosing the antibiotics,

avoiding the usage of agents that will not have a response and consequently reduce the use of antibiotics and the costs for farmers.

5.3 LACK OF TRUST ON THE RELATIONSHIP OF FARMER AND VETERINARIAN – VETERINARIANS ROLE

Farmers only contacted veterinarians in extreme cases, so they relied on their previous experiences to decide on mastitis treatments. Cobo-angel et al., (2021) conducted studies with similar results in which Canadian farmers displayed a high level of self-reliance in diagnosing and treating their livestock with antimicrobials. Dairy farmers often described consulting neighbors and family members before consulting the veterinarian. Technical assistance proved to be deficient in its role of encouraging innovative approaches and adding knowledge to the problem of antimicrobial resistance in dairy production. Despite being available and having a lot of interaction with dairy producers, technical assistance, in the opinion of the interviewees, refrained from discussing or got little involved in explaining and showing alternatives for mastitis prevention, placing sales objectives first. A study conducted by Olmos et al., (2018), also demonstrates this re-active treatment culture by famers and consultants when treating lameness in dairy cattle, where farmers only called in extreme cases and veterinarians felt like last option, having as consequence antibiotic treatment in most cases.

According to the farmers, veterinarians were often taking positions of drug salesmen, rather than taking care of the health of the herd. As a result, the relationship between these two parts seemed to grow apart. The lack of trust in the relationship made farmers doubt professionals and their diagnosis because they believed that in many situations the veterinarian had as main objective selling medication, rather than working on a solution of the problem. A study conducted with Dutch veterinarians showed conflicting interests while prescribing antibiotics, which included risk avoidance, financial dependence on clients and client pressure, on veterinarians' prescribing behaviors (SPEKSNIJDER et al., 2015). On the other hand, veterinarians from a study conducted in New York reported that farmers preferred immediate treatment as antibiotics, the reason behind being that they did not want to see their animals suffering and desired faster results (PADDA et al., 2021). Farmers' unawareness of what they were using to treat mastitis also emphasizes the problem that is this gap in communication

between these parties, first and foremost because farmers should not be the ones to choose the medication to be administered. Secondly, this practice is correlated to many consequences for farmers themselves, consumers, and animals. The lack of communication between farmers and veterinarians has been ascertained in the field, and effective communication is critical to the health of dairy herds and communication methods are essential to support disease control programs (CIPOLLA; ZECCONI, 2015; JANSEN; RENES; LAM, 2010). However, the relationship between farmers and veterinarians was not investigated in depth in this study. We suggest further studies on the opinion and attitudes of technical assistance regarding the use of antibiotics and mastitis prevention in dairy production.

5.4 FARMERS PERCEPTION ON ANTIBIOTIC USE AND MANAGEMENT – FARMERS ROLE

The decision about the treatment of sick cows comes from the farmer that has responsibility for his animals; however, it is known that this decision-making process is multifactorial and dependent on many pillars until it turns into action. One of the pillars is tradition, that is knowledge, beliefs or practice passed on from generation to generation, where phrases like “we’ve always done it this way” are recurrent (BALZANI; HANLON, 2020), and studied in practices such as dehorning, branding, weaning and handling animals (BASSI; GODDARD; PARKINS, 2019; CARDOSO; VON KEYSERLINGK; HÖTZEL, 2016; HÖTZEL; SNEDDON, 2013). It is not that different than methods or habits related to milking a cow. New management practices to prevent mastitis will most often be related to changes in farmers routines, which may become a challenge for farmers who have always done certain practices the way their parents or relatives taught them. This can be perceived as a barrier for farmers, as caring out preventive mastitis managements can be more challenging than medicating with antibiotics, as antibiotic treatments are seen as faster action and easier option (BALZANI; HANLON, 2020; BASSI; GODDARD; PARKINS, 2019; HÖTZEL; SNEDDON, 2013).

The bridge between knowledge and action, and the ongoing need to update information over time must be highlighted and given importance. Several practices performed in animal production in the past were considered correct and today are already banned or require adjustments, such as dehorning without the use of pain medication

(WEARY et al., 2006), the excessive use of growth promoters (CASEWELL, 2003; STOLKER; BRINKMAN, 2005), the use of gestation crates for sows (VANDRESEN; HÖTZEL, 2021). Actions that years ago would have been considered as “harmless” for the animals, sustainable for the environment and not related to the society are now outdated due to advances in research and should no longer be done. The role of veterinarians and technicians as intermediaries between new practices, research and new regulations, and farmers is of immense value. Especially given the high-value farmers place on the opinion of veterinarians, classifying them as reliable and influential sources of information in subjects such as antimicrobial resistance (FARRELL et al., 2021; GOLDING; OGDEN; HIGGINS, 2019; HIGGINS et al., 2017; JONES et al., 2015). However, it is not always easy to turn knowledge into action. On the other hand, there is also how veterinarians see their relationship with farmers. Padda et al., (2021) found that veterinarians saw barriers when trying to improve herd management and the use of antibiotics, such as accessibility to resources to test mastitis and the unwillingness of some farmers to make changes, making it challenging for this relationship to be successful.

Being open to receiving new information and changing routine practices is also a pillar when changing behaviors. As our participants, the majority of the rural population is getting older, and they have spent many years doing routine practices in a certain way and changing this becomes a challenge (MEDRANO-GALARZA et al., 2017), even when having knowledge about preventive mastitis treatments and their potential benefits farmers still preferred to maintain their routine and treat animals with antibiotics when they got sick. This, combined with the rural exodus of the younger population, who are typically more adaptable to changes in their environment (UDDIN; BOKELMANN; ENTSMINGER, 2014) and towards new technologies (MEDRANO-GALARZA et al., 2017), leads changes to take longer to occur or be more difficult to be implemented.

Another important point to be discussed is how farmers perceive the use of antibiotics compared to changes in management and practices carried out for years or generations. Farmers have difficulty to see different outcomes while implementing new preventive managements when time and adjustments are needed for those changes to have results (RUEGG, 2017). On the other hand, medicating an animal with antibiotics is highly recommended by professionals that assist the farm (HOCKENHULL et al., 2017; SPEKSNIJDER et al., 2015), and possibly with faster action than behavior change.

5.5 GUIDELINES AND LEGISLATION

Farmers were mostly unaware of guidelines for the prudent use of antibiotics. However, they knew about the new regulation regarding milk quality and felt under pressure to adapt to this new regulation, which was not feasible for everyone. Some farmers commented that smaller-scale producers would not be able to adapt to the measures required for the "new way of producing milk" since they considered it difficult to make these changes personally, despite believing themselves to be more prepared. Ducrot et al., (2021) highlighted in their study, how small farmers from Africa face specific challenges that are different from those faced by larger commercial farms and how governmental policies should consider that into account when designing policies that aim to control antimicrobial resistance. Along with this challenge, the lack of resources available to make the necessary adjustments on the property and the absence of the government in providing funds and assistance towards better milk quality, was raised by some of the participants. Consequently, the most affected farmers are the ones who need to make these adjustments on the property to be able to keep producing and depend on milk production for their survival.

Something farmers pointed out to the lack of transparency of the government with them and believed that the legislation was being imposed on them, even before an understanding of the problem, which made them feel unprepared to face the changes demanded. The demand for changes in milk quality standards to comply with the new legislation came from the dairy industries where farmers sold their milk. These measures are supported by what the industry calls a quality incentive system, meaning that the higher the quality and the more within the limits established by them, the higher the remuneration per liter of milk. In many cases this is an effective tool for improving quality, as demonstrated in previous research (HOFFMANN; MOSER; SAAK, 2019; TREURNIET, 2021). However, as milk quality standards become more widely demanded, not all smallholder farmers are able to meet them, placing them at danger of being excluded from modern value chains (TREURNIET, 2021). Some of the farmers interviewed felt that way, as they could not see themselves benefiting from the incentive system, as the necessary changes to be achieved in order to receive the financial return, in their opinion, were unattainable. Although this system can work in many cases, an initial effort is needed, where farmers are able to understand the problem they are facing,

and at the same time have the tools and support needed to work together with the parties involved towards the same goal.

5.6 ORGANIC PRODUCTION – NOT VIABLE FOR FARMERS?

A possible way for small-scale family-run producers like the interviewees to maintain themselves in the dairy market could be the transition to organic production, whereby they could attach greater value to their final product, being able to stay in the market. However, even being in a region known as the fourth-largest producer of organic vegetables in the country (EPAGRI, [s.d.]), farmers could not imagine themselves without the use of fertilizers, pesticides, and transgenic seeds to produce feed for the cows. Farmers also expressed concerns about not using antibiotics, as not all farmers have had successful experiences with alternative treatments such as homeopathic products (HONORATO et al., 2014).

Farmers who transitioned from conventional to organic systems felt that the overall health of their animals had improved and did not report serious disease problems in their herds after it (BROCK et al., 2021). Therefore, a possible way for small-scale family-run producers like the interviewees to maintain themselves in the dairy market could be the transition to organic production, whereby they could attach greater value to their final product, being able to stay in the market. However, even being in a region known as the fourth-largest producer of organic vegetables in the country (EPAGRI, [s.d.]), farmers could not imagine themselves without the use of fertilizers, pesticides, and transgenic seeds to produce feed for the cows. Farmers also expressed concerns about not using antibiotics. Although, several studies have shown that alternative therapies with homeopathic products can be effective in treating mastitis cases (MIMOUNE et al., 2021; WERNER; SOBIRAJ; SUNDRUM, 2010), other showed that not all farmers have had successful experiences with alternative treatments such as homeopathic products (HONORATO et al., 2014). Homeopathic products were sold only as preventive therapies in the region studied, and many farmers discontinued the use due to the lack of significant improvements in the SCC during the period tested and the recurrent monthly costs. Moreover, if cows got sick curative treatments were always carried out with antibiotics, regardless of what that cost was.

The farmers' lack of knowledge and information about the different production systems outside of which they are inserted, such as organic milk systems and alternative treatments for mastitis, draws attention to the type of professional assistance that these farms were receiving. We observed a gap in the transmission of knowledge from professionals who assist these farms to the farmers that put farmers in a position where they saw no other way to produce milk other than the way they have done for years. The relationship between farmers and technical assistance was not very close, which evidently does not facilitate this transmission of knowledge. The relationship between organic farmers and their veterinarians is not much different, as necessary treatment is found as a producer-level decision that is usually made without veterinary consultation (BROCK et al., 2021).

6. CONCLUSIONS

The farmers in this study had difficulty in seeing mastitis as a disease, as well as a limited understanding of antibiotic resistance, which is directly linked to their motivation to adhere to preventive management. Furthermore, veterinary assistance focusing on mastitis prevention is a central pillar for the reduction of antibiotic use in dairy farms but is lacking in the region, indicating a lack of commitment to the goal of reduction of AMU. The prudent antibiotic use in the area calls for a cultural shift from the current reactive treatment to preventive management, a better enforcement of controlled sales to avoid overuse; and financial incentives to farmers to meet the milk quality standers.

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APPENDIX A

SUPPLEMENTARY MATERIAL – FARMERS QUOTES

Quotes from interviewed farmers.
Note: Scheme **30a** refers to the first excerpt from the interview with Farmer 30; **F15b** is the second excerpt quoted from the interview with Farmer 15.

F30a I have used pre-dipping, but then last year there was the milk crisis, and we started cutting expenses here, cutting expenses there, and we had to go to water (cleaning the teats), and there's a lot of paper towel that used in this process, right?. It's a bunch of paper towel used, and the pre-dipping was also expensive, so we canceled pre-dipping.

F54a Now that they pay by quality, in the end you will do the math and it costs less than a penny for each paper and you can earn a penny per litre, it pays itself off.

F17a It certainly helped and improved mastitis control.

F15a We used to use the cloth... In fact, the cloth, if used, causes mastitis. Because if this cow here has it (mastitis), soon you will be passing it along (to other cows). You can wash the cloths, put it in with some product and everything, but you still pass it on to the others anyways. I stopped doing that and it was all over (mastitis). Because with the paper towel, you take one use it and throw it in the trash, right?. Get another one and start cleaning again (meaning less contamination).

F52a Because it (paper towel) doesn't have contact from one cow to another, right. You only use that paper on one cow, you can't pass it on to another. If you work with a material that touches a cow that has mastitis, you will automatically pass it on to another when contacting that material. (...) These are some small details that sometimes have big consequences later on.

F2a It is rare, only if there is a problem.

F15b Oh, we did it these days. That vacuum part had broken (the part that controls it) then we fixed everything. (…) Just when it breaks. Every 6 months we change the teat liners and the rubbers.

F43a It makes a difference (making the adjustment). You need to put your finger in inside (the teat liner), if you can fit you finger in there, you can put the cow’s teat. If you see that you finger starts to hurt, you can imagine the cows’ teat?

F41a It is always done when the regulation is not in order, if we notice that the cows are hitting each other, and it is hurting. (...) Because the milking unit can detach, hurt the cow and lead to mastitis. Maintenance is not cheap but it is necessary, later you will need anyways (if not done).

F13a We do it from time to time, sometimes every 3 or 4 months we do it, because otherwise, if the milking pulse is not right, it ends up hurting the teat and ends up causing mastitis.

F30b It makes a difference at the moment of milking and reduces mastitis.

F58a If it's important I don't know, but it must be, because if not, I wouldn't need to do it (regulate the pulsator).

F38a It makes a difference, and because there are many lactating cows, if something is unregulated it influences the time (the time taken to milk a cow), it ends up taking longer, hence the importance of regulating.

F49a Oh yeah, not long ago there were cows that wouldn't let the milk down, then it was regulated and now… (they release the milk), before this it wouldn't happen, there were teats that would release and others that wouldn't all (release milk).

F48a Actually, that's all electronic, (...) it doesn't deregulate.

F3a It was done (regulation of the pulsator), then an electronic pulsator was placed, so it was no longer needed (regulation). Now there's no more problem like that.

F16a I take it out by hand (milking), if she comes in the middle, because sometimes it doesn't work, she gets in the middle of the others, so it's hard for you... (separating the cow that has mastitis from the others). Otherwise, I put her first or last (cow with mastitis).

F25a Usually the cow that has mastitis is the best, right? It is the one with the highest production, usually the cow with the highest production will try to go ahead first to relieve herself and usually the ones with the highest production are also the dominant ones.

F26a But when we have (cows) with mastitis, we leave them for the end, because we know that if we pass that milking unit from that one (a cow with mastitis), the other one has a chance of getting it, if it's bacterial.

F45a Because it can leave some residue (of milk) and, during milking, pass it to another cow.

F52b Must be milked separately, usually left for last.

F39a When we given them the antibiotic you can't mix the milk,. Then, we leave it to the end, milk (the cow) separately.

F3b Usually yes, but there is also the ones we are treating or medicating, then it is done separately.

F42a The cows with mastitis stay in a separate lot, they are milked in the end and also with different milking units.

F54b I let her come in, in the order she comes, but as she is contaminated, that milk goes is discarded. Then I take it out (milk) with the discard milking unit. Because when the

cow gives colostrum you have to discard that milk too, then there is a milking unit that will be just for that.

F43b We have a separate bucket, that one (for cow with mastitis) we take separately and don't mix with the others.

F37a Normally, we wash the milking units (between one lot and another), because once we got antibiotics (detected) because once we didn't wash them.

F49b (The strip cup test) is done every day In fact, it's not a cup with a black bottom, it's a rubbered mat (flooring) that is black and if you take out some (milk) on the top you can already see it.

F4a It's a lot of work. It's easier to close your eyes. But it's worth doing it, so you don't lose control.

F43c Yeah, people mostly don't do it. Because it's work, it's a lot of work, right?

F43d I have already lost a cow in here, two cows, because of mastitis. To the point where the cow dies, there is no way of healing (...) It pays off. Because we can catch earlier (the mastitis), right? If you catch it in the beginning, then it heals. If it happens in the morning and I just see it at night, the cow already loses the quarter.

F54c It helps, because if there is something different you can go there and do the racket test (CMT). Then, if you see that there is something there you already do the racket (CMT test), then you can already identify which teat (quarter) is and you already do the complete treatment, so it does not reach the other teats.

F48b Actually, everything labor and I don't know, lack of will. In fact, it's the producer who loses, right, because that's how bacteria get in the milk, it goes beyond the amount (allowed by regulations/dairy), the producer looses. Today, when they are paying for incentives there … if you don't have the right control of the milk, you don't receive the incentive, right? Sometimes, for taking 10 minutes more in a milking, you are receiving 500 R$ at the end of the month.

F26b When summer comes, I do it a lot, because ours (cows) usually are due from August through summer, then sometimes we start to see clots and we do it (the test). There's no time. I do it more when I see it's necessary.

F55a Because it is too much work, the one of the racket (CMT) is very picky to do, it is more precise, but it takes too long.

F11a There's too much work, too little people. It's troublesome because from each cow we have to strip it four times, right? We're only three (working) then it's not enough people. (…) The right thing would be to do it on a weekly basis, but it takes too much time for this, and I have a lot to do.

F19a That is because they don't care about the milk quality, because if they cared about the milk quality, everybody would do it, *right?*

F47a After the technical assistant from SENAR started paying these visits she explained all that (preventive managements) to us, then we improved a lot the milk quality.

F48c Nowadays that they are paying by incentive systems. If the milk control is not right, you don't get the incentive. Sometimes for taking 10 extra minutes during milking you are receiving at the end of the month 500 Reais extra.

F30c For one cow we used 5 types of antibiotics. Only Acura worked. The cow wasn't dried out, it was sent to the laboratory (a sample), it had resistance to Acura, but it worked.

F43e That protocol I do of Lactofur and Flumax, if it doesn't get better (the mastitis) with that, then I think it's hopeless.

F3c Once there was a problem with antibiotics in the milk (being detected). But it was because of dry cow therapy, that (cow) was dried up too close to calving, then it showed the antibiotic in the milk.

F54d I don't know, because I got it over the counter.

F47b He (husband) has everything written down, but for me to remember medications name.. I don't know any.

F30d Without charging (for the veterinary assistance), even because he needs the results to be able to sell the product, *right?* depending on the result, the news spreads fast, it worked and if people ask, and it did, it sells.

F17b Of course, why do they offer you free veterinary service? So that you buy from them.

F38b One thing that is very common nowadays is sales assistance. They come here and they want to sell the product at any cost (…). One veterinarian was here saying that people (veterinarians) fall into the job market and then they are convinced by that consumption idea and forget all about college.

F32a This one (vet) from the farming store wants to sell a lot of medication, sometimes it's not even necessary (…) And the one (vet) from city hall doesn't, he sees what we have at home, if it works, they use those ones.

F22a People from the farming stores and the labs that give the lectures. Like when the lab launched Acura, he came and gave an explanation. The homoeopathic products too, when there's a new launch, they go through the farming stores and they host a dinner party and have the lecture explaining (…) It's good, of course. Because then we're in touch with other producers and with the technician. The lab representatives are vets, who give an explanation about the merchandise (medication).

F57a It's good (having lectures about mastitis prevention). But then I don't know, they come more to try and sell and when there's a lecture or a course, it's to sell fertiliser or corn seed or anything else.

F58b It would be good because they have only one vet to serve the whole town municipality. Then you ask for him and he's always busy (referring to the city council vet). Because when we ask (for veterinary assistance), we need him right away.

F57b There are two city council vets. They come when we ask for them. Earlier today I asked for one to come see a cow there, and he had to go somewhere else and also didn't show up.

F32b When we need him he eventually comes, but there's the matter of the days, only on weekdays. He says he's always busy (city council vet), because it's just him for the whole town. Then the farming store have many (vets).

F57c No,… he only comes and does what we ask him to do, but other things he doesn't say anything. If the problem is an intoxicated cow, the problem is that, he's only going to say what the cow has.

F16b If there's something more complicated, more out of the usual, then they let you know, they tell you, but if not, they don't. She comes, does it and sees it, if everything is up to date, she's not even going to say anything (…) We struggle to keep everything up to date.

F14a Too expensive, when we need to use antibiotics, then it's a loss for sure. That's why I think while we can get with that homoeopathic, it's better.

F49c To cure (the mastitis) and discard the milk, until the milk is good to go to the industry, a mastitis (treatment) costs about R$ 400. That's a lot.

F9a For what we get paid for the milk, it is very expensive. Any 50 ml bottle (of antibiotics), you pay 40, 45 reais. And then you get around R$ 1.40 for the litter of milk.

F19b Today a cow that you're already going to discard isn't worth a lot. Then if you still have to spend (with medication), it doesn't pay off, *right?* Then you go and discard it.

F8a The highest rate of (milk) discard is because of mastitis It's not worth it to treat, heifers are better than cows and they don't need as much investment compared to treating the sick ones.

F4b When you use one antibiotic for too long, after a while it doesn't work anymore.

F30e First the medication works, over time you use it and it gets used to it, it doesn't work and creates antibodies against it.

F6a We never use always the same kind of tube (intramammary infusion). We change it, use one for a while and change to another kind of tube, another name. Because if you put always the same kind, after some time, the microbes start to get used to the antibiotic.

F31a That's usually when you give a type of medication that doesn't solve the problem. Say the cow is already resistant to that type of antibiotic, or the virus itself is resistant.

F20a It's when you give too much antibiotic and then that one doesn't help anymore, sometimes you have to change it for another. The vet says sometimes the cow gets resistant to the antibiotic and it doesn't take effect anymore, then they change it.

F3d Yes, sometimes there's some antibiotic that doesn't work, it depends on the type of mastitis (…) That's because depending on the antibiotic, it doesn't work on that type of bacterium that's in the udder. For some bacteria its easy, and there are some that are resistant. That's because each antibiotic has a specific line of bacterium that it works on. There are some antibiotics that don't get that type of bacteria. As there are antibiotics that you can medicate and medicate and have no effect. You medicate the cow and the medication has no effect. The bacteria is resistant to the antibiotic that we are using.

F39b The bacteria gets resistant, right! it's not the animal. And if that happens, of getting resistance, that medication doesn't work anymore. And then if that doesn't work anymore you have to eliminate the animal.

F38c …it's the agent that's resistant and not the cow.

F40a When one day you need it, the antibiotic doesn't take effect anymore. Then, to take effect, you're going to have to change to another one, much stronger.

F37b Resistance is like I said, some cows were once treated with one antibiotic and it worked. I used one dose (of the antibiotic). Today I already have to use a stronger one (antibiotic) because we notice the effect is not the same anymore.

F28a It's when you start to use it a lot, only one type (of antibiotic). Then the cow doesn't get better anymore, and you need to give her a stronger antibiotic.

F54e I don't know if it is (a problem for humans) because it's going to dilute out too much (the antibiotic). Because they say the biggest problem with the antibiotic is that it ends up reducing the yield of the cheese, they say that's the biggest problem of antibiotic in the milk, it's in the yield of the milk because it kills the bacteria that make the fermentation of the cheese.

F15c And it's like that for us too. That's why they say we can't mix that milk, because our body can't get used to it. (…) It's because when you get sick and take the antibiotic, it no longer takes effect. And it's the same with the animal.

F11b Say you got sick then the doctor prescribes you the antibiotic, then the antibiotic is already in your body, the antibiotic doesn't do you harm. The problem is that when the doctor medicates you for one thing, the medicine (antibiotics) is not taking effect, then you go see and it is the antibiotic that you took for something else.

F28b If you start to sell this milk it won't cause any harm, but this antibiotic will go into your body and when you need an antibiotic you won't have it, it won't take effect.

F55b It was a technician from EPAGRI who recommended it, that it was a cheap examination and that it doesn't need to be collected from the cow. It can be just from the milk tank, just to see the type (of antibiotic) that will take more effect. At the time, he said it was around forty or fifty reais for each sample examination. It's actually a cheap examination for this, but I haven't done it yet.

F37c We have already done a milk antibiogram. Then we tried to use the products in that line. Tylosin actually wasn't even in the list of medications to use, but, as it was a product I used, I kept on using it. Then others that showed up that the bacteria were sensitive, thise we use sometimes, that are ceftiofur, enrofloxacin.

F39c It has happened one day, because of a slip. We left a cow that was undergoing a treatment that was supposed to leave 4 to 5 days (withdraw period). I left only 3 days, but I told the dairy and then they collected it separately (the milk), did an analysis, but they were still able to use the milk. But even then, there was the accident of letting (get mixed), but they were aware. They collected it separately in the truck.

F46a For now, not here. And if needed to use antibiotics, I have already said it, that milk from that cow is all going to be thrown away, God forbid, because if I have to pay for a full milk truck and not be able to sell the milk, I said it, no way.

F12a Before, it happened, but after it came that (new normative) that nothing was allowed (antibiotic residual), now we watch for it.

F35a Only once, before the normative came out we did everything, but now that we're watching for it, it only happened once.

F5a I think it's only going to help, it's a medication, it's an antibiotic. If it's in the milk it's because the calf is going to get it, it can't do any harm.

F39d No, because if it was a problem, people wouldn't give it. Because you can ask anyone, people who raise calves, they use that milk to feed the calves. Even the neighbour here is one of them, he uses it.

F16c If the milk looks good, if only one antibiotic that doesn't harm the calves was given, then we give the milk to them.

F9b To this day, I've never heard anyone complain (that you are not supposed to give milk with antibiotic residue to the calves) because the technician that comes here now

always say you can give it. (…) They (the vets) say you can give it, it's good, it already goes with antibiotic, then it already prevents illnesses for the calves.

F19c No, they even say it, if you have been using antibiotic, they say discard it, but give it to the calves.

F17c We think there's no harm, as it is the vet himself who recommends it.

F1a Talking to the vet, he said that if it's given (antibiotic) to a calf that is going to slaughter, there's no problem, but as it is a heifer for milk that is taking that medication, let's say it's penicillin. I give penicillin to the cow and discarding the milk I give it to the calf, it is taking that penicillin. The bacterium is resistant to it. When she becomes a cow, it will be resistant to penicillin and it doesn't work anymore. And then, in the future, it will create resistance and it no longer responds to the treatment.

F14b I have attended a meeting where they don't recommend giving it to the calf, because it may be a problem to the calf.

F26c The instruction we have they say no. We also think that maybe we shouldn't but then we end up giving it. We feel bad to throw it all away (the milk).

F55c Everybody uses it, they say there is (a problem to give it to the calves), but everybody uses it. To be honest, everybody uses it, the discards go to the calves.

F37d They say 'it's not to be given to the female calves'. But we end up using it sometimes.

F6b For the calves it is not good to use it, but we do it anyways. Is it all going to be thrown away? (…) Some cows sometimes give 15, 20 litres every milking, then throw it all away?

F38d If I had to choose, I certainly wouldn't (give milk with antibiotic), not to risk it in the future trying to treat some sick animal and it doesn't work. (…) But then taking everything out of the tank is complicated.

F37e We try not to give it because everybody says they end up creating some resistance to those bacteria or to the antibiotic.

F49d No, to the calves we don't usually use it. Because there's antibiotic in it, then it creates resistance and then we do the treatment, and it doesn't (work).

F52c No to the calf, I hardly give them. Not to take the chance of… I have heard some people commenting on the risk that the mastitis bacterium passing to another animal, then if I eventually give it (the milk) to a female calf I might be giving it the bacterium, be causing a problem in the future for the female calf I have in the herd.

F38e We are giving it to the female calves, but we try to avoid the sick quarter (teat), we discard that one into the manure pit, but the rest we use for the female calves. (…) The last instruction they gave us was that, to discard that quarter, that the worst thing for the female calf is having the contaminant agent, giving the agent to her, to the calf.

F43f Sometimes we give it to the female calves to the ones that are getting it in the nursery. But I try to never give it to the younger ones, always to the ones that are closer to be weaned, I give it to them. (…) Then they already have a little more immunity.

F28c People from the city have no knowledge on how it is done, how it is produced.

F42b Some don't even know if the milk comes from a cow, let alone if it has antibiotics.

F31b I think they only complain that the milk is expensive.

F6c They don't even know. They don't even care. You know what? They want to know the cheapest price. People don't appreciate people from the countryside. At least here, in our region.

F38f Upper middle-class people worry about milk and all food. These requirements come to the producer through price drops.

F29a Regarding the antibiotics we didn't hear, I haven't read anything, I've read about the milk quality, (…) because it interests us for us to do better, as we earn more for the milk.

F17d There was one time the dairy industry made an agreement with the veterinarians, then they came by, but it was more about milking hygiene. They came every 15 days or once a month, then they would take this milk, ran analysis, to see if the CCS and CBT had decreased, to regulate the vacuum air pressure in the milking units, see if the rubbers weren't too old, things like that, but not about the cow.

F35b I could even get it for free from Alfa (farming store), they come and do it (milking monitoring). It's just that I'm like that, they are going to be there every week, and I don't have time.

F52d Production would stop. I'm sure, because the situation is already not very good. If you can't even medicate the animal, then people will stop (producing milk).

F32c Each time they charge more and actually each time it's more difficult to work and we are left with less (…) it's a thing, it's a normative, it's everything. (…). Like, with milk, they are also moving towards paying for quality, but then price hasn't increased if you have a good quality, it's only reduced it if you have a bad quality. They say it's increased (for those who have good quality), but they actually already take it from the basic price.

F45b For many, it's going to change because they don't actually have the habit of these things, they are not worried about those who is going to consume the product they are producing (…). If they took it seriously, it's an advantage for the producer. But there's a whole habit that they are going to have to change, the way they work with it. And then there's not going to be enough technical assistance. Because, whether they like it or not, younger people might even follow that, but older people don't want to know about it.

F24a It will be good for those who produce correctly and those who don't, they will stop producing milk.

F35c I think mine now, the way we have the vet and everything, we are correct (…) but in the past we treated cows when there was no vet, treated very little or too much, you know. Nowadays he sends through WhatsApp, "it's this much, don't put more, it's this much".

F37f I don't know, I always say that everything that comes to bring improvement has to be done (…) everybody will want not to reduce the cost with antibiotics, because it's an expense, it's one of the most expensive things.

F40b It is the same with human beings, you go to a drugstore today, you can't buy anything without an antibiotic (prescription). Then it would be the same thing, the vet is there, he gives the assistance and will give you if it's necessary or not, and that's it, the person would automatically correct, police, what was wrong, that's why there's this law with humans, because it was the excess (use) (…). Not everyone has that maturity to discard the milk, but today the milk sampling are very strict, everything shows up (on the results)(…) with the milk control (normative), many have already corrected a lot (…). So it's good, as they say, it's like a camera, people who are afraid of the camera it's because they are doing something wrong, those who are not it's because they don't owe anything, right?!

F41b I think the government should help and help a lot, in awareness (…) they say you cant use antibiotics, but they don't explain the reason, just a few people know (…). That's wrong, they are punishing, but they don't show, explain, this kind of thing and that's what we are miss a lot (…) like now I think it's right that they demand the compliance of that normative of the clean milk, but they should give people the opportunity, for example, give money for people to invest and be able to work in that sense (…) how many people now are stopping (producing) dairy cattle because of this normative, they can't afford to make improvements (…) as they sometimes don't have money to invest, lack of investment (…) there's no incentive, then it's what I said, if they gave money, gave incentive, for people to be able to work. It lacks incentive and information, a lot of information (lacking), mainly information (…) I think they should have campaigned for that, to go changing it (…)

F22b I think they should educate the people, not demand compliance. Because they defend the laws every day, talking on television, but the producer (…) has to work on the farm, so sometimes they are not aware of what has been going on, and that's why the vet, the agronomist knows how to explain what it's like to the farmer.

F45c In terms of antibiotics, there was no problem. My problem was that I was still using some herbicide product on the grass to kill the weeds. And it is unfeasible here for now. (…) (…) How are you going to produce the feed , without it being transgenic, it is unfeasible, there's no way. You would have to buy from somewhere else, you can't support yourself.

F41c It is the food (the hardest), then the cow has to eat only the natural, it won't be able to eat silage, or concentrated feed.

F47c That is very hard, that doesn't exist (…) to make organic you can't use fertiliser, nor urea, nor nothing (…) you won't have pasture, won't give grass… how are the cows going to give milk? (…) because everything you're going to give them you'll have to get only from the land. And the fertiliser, where is the fertiliser going to come from?... here if you have to plant corn and other things without fertiliser and without urea, you don't even have to plant, nothing will grow (…) Like pig fertiliser, no way, because the pig is based on hormones, on those nuclei. Then I don't know.

F39e It would be very complicated for us to have to change the whole management. We would have to grow pasture, there couldn't feed silage, only treat on green grazing and corn that wasn't transgenic, not use the antibiotic. Very hard, we would have to start from scratch, like they say.

F48d Both parts (antibiotic and feed). We wouldn't be able to make enough silage to feed the herd and wouldn't be able to keep the animals because of illness, it is hard.

F35d I think both (antibiotic and feed), because I buy a lot of antibiotics and plant a lot at other people's properties and today it is easier for us with these transgenic corns.

F33a (…) the cow gets sick and if you go treat it with homoeopathic products, it sure helps, but on the long run, it doesn't help overnight. The antibiotic is different, it helps quickly. That's why I think sometimes it's an advantage to use the antibiotic, because it's quicker.

F34a It is very hard (without antibiotic). For example, a cow with a retained placenta, I don't know, I don't trust these other organic products, you have to use antibiotics.

F48e I know it has worked, this organic thing, this homoeopathic treatment. But then there has to be a vet constantly monitoring and the vet won't work for free. These vets today are a high cost.

APPENDIX B

SUPPLEMENTARY MATERIAL: INTERVIEW STRUCTURE

INFORMAÇÕES REBANHO/PROPRIEDADE

1. Há quanto tempo você trabalha na atividade?
2. Qual o sistema de criação?
3. Nº de vacas no rebanho?
4. Nº de vacas em lactação?
5. CCS da última nota? (mais de uma se possível)
6. Quantos litros de leite são produzidos por mês?
7. Como é a alimentação do rebanho? (toda a pasto/pasto+ração..)
8. Quanto de ração é dado por vaca? (kg/por animal)
9. Quem são as pessoas que trabalham na propriedade?
   (Somente familiares/ Somente pessoas contratadas/ Familiares e pessoas contratadas)
10. Quantas pessoas trabalham na propriedade?
11. A propriedade tem outras atividades além da bovinocultura de leite?
12. Quem é responsável pelo cuidado direto com as vacas?
13. Quem faz o tratamento das vacas quando alguma está doente?
14. Você participa da ordenha?
15. Qual sua escolaridade?
16. Qual a sua idade?

DOENÇAS E ANTIB.

17. Quais são as doenças mais comuns? Que te dão mais problemas?
18. Qual foi a última vez que você tratou animais com algumas dessas doenças?
19. Como você trata essas doenças?
20. Quais causas mais comuns para uso de antibióticos?
    (Se não responder mastite, perguntar sobre)
21. Como você escolhe qual antibiótico vai usar numa vaca ou bezerro doente?
22. Como você escolhe a dose de antibióticos que vai usar?
    (veterinário/ bula/ agropecuária)
23. Por quanto tempo você faz o tratamento com antibiótico?

(Uso medicamentos de dose única/ Até desaparecerem os sintomas/ De 1 a 3 dias/ De 4 a 7 dias/ De 7 a 10 dias/ Mais de 10 dias/outro)

24. Quando usa um antibiótico em uma vaca doente e mesmo assim ela não melhora, o que você faz?
25. Onde você compra os medicamentos veterinários?
26. Qual a sua opinião sobre os preços dos antibióticos?
27. Quais antibióticos que você usa? Quais usou no último mês? (listar nomes)

EXTENSÃO

28. Que tipo de extensão você recebe? Se recebe, com que frequência?
29. Como é o seu contato com extensionistas e veterinários? Falam sobre prevenção de mastite?
30. A assessoria que vocês têm é suficiente e de qualidade? E sobre a prevenção de mastite?
31. O que (especificamente) poderia melhorar?
32. Vocês recebem alguma assistência/extensão de pessoas da prefeitura, CIDASC, EPAGRI..?
33. Se tivessem palestras oferecidas pela prefeitura ou algum desses órgãos vocês iriam?

ROTINA DA ORDENHA

34. O que você faz para prevenir a mastite?

Na rotina da ordenha da propriedade você faz uso das seguintes práticas:

Se faz? e seria qual o problema de não fazer?

a. Lava os tetos da vaca?
b. Seca os tetos da vaca? Como? (pano ou papel)
c. Toma alguma medida para as vacas não deitar depois de ordenhadas?
d. Faz teste do caneco de fundo preto?
e. Faz o teste da raquete?
f. Faz pós-dipping?
g. Lava a ordenhadeira com água quente e produtos de limpeza? Quando foi a última vez que fez? Quantas vezes por semana?

h. É feito ajuste da pressão da ordenhadeira? De quanto em quanto tempo?
i. Ordenha as vacas com mastite no final da ordenha?

MASTITE

35. Na sua experiência, quando você usa antibiótico para tratar mastite, ele funciona? (quando falar as vezes.. especular.. pq as vezes? Pq as vezes não funciona??)
36. Conhece algum outro tratamento além do antibiótico pra mastite?
    a. usa ou já usou?
    b. Por que não usa?
    c. Ou pq não usa mais (homeopatia..)
37. Quantas vacas você descarta por ano?
38. Por quais motivos você descarta vacas do seu rebanho? Mastite é um motivo?
39. Na sua opinião, o uso de antibiótico pode ter alguma influência no tempo de vida (tempo útil) das vacas?
40. Como você seca as vacas?
41. Quanto tempo deixa seca?

RESÍDUO NO LEITE

42. E você já passou por alguma situação de resíduo no leite? Que acusou leite com antibiótico pelo laticínio?
43. Quando você faz o tratamento de suas vacas, qual destino é dado ao leite?
44. Para os que descartam, perguntar: Por quanto tempo o leite precisa ser descartado para consumo humano? E por animais?
45. Fornece esse leite as bezerras? E aos machos? Porque fornece esse leite a elas?? (motivo.. R$..)
46. Que consequências você acha que pode ter em fornecer esse leite aos bezerros?
47. Você acha que os bezerros estão tomando antibiótico junto?
48. E você acha que as pessoas que não trabalham com leite, se importam com a questão do antibiótico no leite?

RESISTÊNCIA A ANTIB.

49. Você já ouviu falar em resistência a antibióticos? E o que você entende por isso? (conhece o termo/ como define?)

50. Você conhece alguém ou tem alguém na sua família que já teve resistência a antibiótico?
51. Os antibióticos são efetivos para resfriados em seres humanos?

RETOMANDO PONTOS IMPORTANTES – FINAL DA ENTREVISTA

52. Você acha que tem algo aqui na propriedade que contribui para a mastite?
53. Você acredita que os antibióticos são usados de forma correta na bovinocultura de leite?
54. Você já ouviu falar em políticas de uso prudente de antibióticos, ou de programas para reduzir o uso de antibióticos na produção animal? ou "programas de controle da resistência de antibióticos"?
    a. SIM, onde? (tv, internet, veterinário/técnico..)
55. Imagine um cenário em que uso de antibióticos nos tratamentos das vacas fosse regulado pelo governo, com controle de receita e limite de uso de acordo com o número de animais no rebanho. As propriedades que não respeitassem essas normas seriam multadas. O que você pensa sobre a viabilidade desse cenário?
56. Vocês já pensaram em produzir leite agroecológico ou orgânico? O que acham a respeito? Por que fariam ou não fariam?