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PSYCHOLOGICAL FACTORS ON RURAL PRODUCERS' INTENTION TO LEGALISE SANITARY CHEESE IN BRAZIL

(FATORES PSICOLÓGICOS SOBRE A INTENÇÃO DO PRODUTOR RURAL DE LEGALIZAÇÃO SANITÁRIA DA PRODUÇÃO DE QUEIJOS NO BRASIL)

Author: Ana Carolina Viscardi Plefh

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FATORES PSICOLÓGICOS SOBRE A INTENÇÃO DE LEGALIZAÇÃO SANITÁRIA DA PRODUÇÃO DE QUEIJOS NO BRASIL

Autora: Ana Carolina Viscardi Plefh
Orientador: Prof. Dr. Ferenc Istvan Bankuti

TITULAÇÃO: Doutora em Zootecnia - Área de Concentração Produção Animal

APROVADA em 18 de fevereiro de 2025.

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Orientador

“- Pois isto é o que eu, o Senhor Todo-Poderoso, digo: (...) então o novo Templo será ainda mais belo do que o primeiro, e dali eu darei prosperidade e paz ao meu povo. Eu, o Senhor Todo-Poderoso, falei”.

Livro de Ageu, capítulo 2, versículo 9.

Em nome de Jesus, dedico este trabalho.

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To God.

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Sociopsychological factors influencing Brazilian farmers' intention to regularize their cheese production

RESUMO

A produção de queijos no Brasil representa uma atividade econômica relevante entre os pequenos produtores. Grande parte da produção de queijos ocorre de forma não licenciada, marcada pela ausência de registro sanitário. Nesta pesquisa investigamos a intenção do produtor rural em licenciar a produção dos queijos. A pesquisa foi desenvolvida com 286 produtores de queijos nos Estados de Minas Gerais e Paraná, Brasil. Para atingir esse objetivo, foram coletados dados sobre a tipologia das fazendas – características estruturais e produtivas e a tipologia social do produtor rural. Para a analisar a intenção do produtor rural, utilizou-se a Teoria do Comportamento Planejado (TCP) como metodologia principal, permitindo analisar como a atitude, normas sociais e percepções de controle comportamental influenciam a intenção dos produtores sobre o licenciamento da produção de queijos. Os resultados mostraram que os produtores possuem intenção de licenciar a produção de queijos, influenciados principalmente pelo controle comportamental percebido – os produtores se sentem capazes de licenciarem a produção de queijos e pelas normas subjetivas – os produtores percebem que pessoas importantes para eles desejariam que o licenciamento da produção fosse feito. Já o construto atitude não influenciou a intenção dos produtores em licenciarem a produção de queijos. Também foi observado pelo uso da TCP, que os resultados da intenção dos produtores são influenciados pelo tema da pesquisa, pela diversidade da amostra e por fatores não previstos no modelo da teoria do comportamento planejado.

Palavras-chaves: Agricultura familiar; Agroindústria; Barreiras econômicas; Produção de leite.

ABSTRACT

Cheese production in Brazil is an important economic activity for small producers. A large part of cheese production is unlicensed, characterized by a lack of sanitary registration. In this study, we investigated the intention of rural producers to license their cheese production. The research was carried out with 286 cheese producers in the states of Minas Gerais and Paraná, Brazil. To achieve this objective, data were collected on the typology of farms - structural and production characteristics - and the social typology of rural producers. To analyze the producers' intention, the Theory of Planned Behavior (TPB) was used as the main methodology, which allowed us to analyze how attitudes, social norms and perceptions of behavioral control influence the producers' intention to license cheese production. The results showed that producers' intention to legalize cheese production was mainly influenced by perceived behavioral control - producers feel able to license cheese production - and subjective norms - producers perceive that people important to them would want production to be licensed. The attitude construct did not influence producers' intention to license cheese production. Using the TPB, it was also observed that the results of the producers' intention are influenced by the subject of the research, the diversity of the sample and factors not foreseen in the model of the Theory of Planned Behavior.

Keywords: Agribusiness; Economic barriers; Family farming; Milk production

1. INTRODUCTION

In the last ten years, Brazil has observed a steady increase in cheese production (EMBRAPA, 2024a), driven by higher domestic demand, improvements in dairy farming practices, and increasing investments in cheese-making facilities (BENINCÁ et al., 2020). The dairy industry, including cheese production, is an important part of Brazil's agricultural sector, contributing significantly to the country's Gross Domestic Product (GDP) and presented, in the last agricultural census published, production of 222,652 tons of cheese (IBGE, 2017). Although Brazil mainly produces cheeses for domestic consumption (EMBRAPA, 2024a), according to the Foreign Trade Report, in 2020 the volume of exported cheeses grew by more than 20%, totaling more than 4 thousand tons (IBGE, 2020), and the country began to explore international markets, particularly in Latin America and Europe, increasing its economic impact (EMBRAPA, 2023).

The country produces a wide variety of cheeses, including traditional Brazilian cheeses (PENNA; GIGANTE; TODOROV, 2021b). Some types of cheeses have a significant cultural and economic presence in the country and their production mainly from small and medium-sized farms plays a crucial role in rural development (CORRÊA DA SILVA; CARTES PATRÍCIO, 2022) and they can have different production characteristics depending on the region of the country in which they are made (DARGÈRE et al., 2023). Being part of Brazil's culinary heritage, cheese, especially in the regions of Minas Gerais, Paraná and the interior of São Paulo, has added cultural value in addition to monetary value, since traditional cheese-making techniques are often passed down from generation to generation. In addition, they stimulate local tourism (DARGÈRE et al., 2023; DE MEDEIROS CARVALHO et al., 2019a).

However, part of the cheese production in Brazil is still carried out without a sanitary license, almost always on the milk production farms themselves (BRAGA, 2018). And over the years, unlicensed cheeses continue to represent a significant part of the Brazilian market (AMARAL et al., 2020; EMBRAPA, 2024a). This unlicensed production is prevalent on small farms, where regulation is often considered onerous and difficult to implement (EMBRAPA, 2023). Although the production of unlicensed cheeses has a strong cultural and economic value, the lack of regulation can lead to risks

to public health, in addition to limiting opportunities for expansion into national and international formal markets (AMARAL et al., 2020).

Food manufacturing laws in Brazil, including cheese production, were rewritten, and enforced from 1950 onwards by inspection agencies (BRASIL, 1950). These standards establish strict sanitary and quality standards, which often pose challenges for small-scale producers due to the high costs and complexity of adapting to the requirements established by regulatory bodies in Brazil (BRASIL, 2022). Faced with the difficulty of adaptation and important cultural and economic aspects in the production of cheese on farms, some initiatives of the Brazilian government emerged. Among these, the possibility of registering products classified as "Artisanal Product of Brazil" (BRASIL, 2022), which allows the regularization of traditional techniques. However, many producers remain in the informal market, highlighting the need to better understand the reasons for this resistance to legalization (EMBRAPA, 2024a).

The reasons that lead producers and even industries to remain unlicensed are still little explored – even in other countries, requiring further investigation and clarification (AMARAL et al., 2020; BIRTHAL et al., 2017; SUTTER et al., 2017; ZAPATA-SALAS; GUARÍN; RÍOS-OSORIO, 2024). Understanding the factors why producers are reluctant to regularize cheese production is essential to create public policies and solutions that encourage migration to the formal market, promoting food security and regional economic development (EMBRAPA, 2024a).

To explore these aspects, we used the Theory of Planned Behavior (TPB) in this research (AJZEN, 1991), to analyze and discuss the intention of producers in the State of Paraná and Minas Gerais, Brazil, to license the production of cheeses. The following questions were answered: (a) whether the producers analyzed intend to license the production of cheeses and; (b) which TPB constructs are the most important to explain the producers' intention to license cheese production.

1. LITERATURE REVIEW

1.1 SOCIOECONOMIC SCENARIO AND CHEESE PRODUCTION IN BRAZIL

In recent years, cheese consumption in Brazil has been on the rise, driven by an expanding middle class and growing urbanization (AMBROSINI, 2022). Cheese has become a staple in Brazilian households, leading to a diverse market with a wide range of products available (DARGÈRE et al., 2023). Another important factor for the increase in cheese consumption in Brazil was the search for healthier products with high nutritional value and, thus, the search for minimally processed cheeses grew (BENOS et al., 2022). The need to meet the market encourages producers to transform milk into cheeses on farms (AMBROSINI, 2022). This production scenario on farms requires training and education for rural producers, to improve production techniques and ensure compliance with sanitary standards for food production (BÁNKUTI; CALDAS, 2018b; DARGÈRE et al., 2023; FERREIRA DOS SANTOS; DE SANTANA RIBEIRO; BARBOSA DE CERQUEIRA, 2020; MARTINELLI et al., 2022b). Cheese production in Brazil seems to be a promising activity, with continuous innovation, investment, and expansion into new markets (EMBRAPA, 2024a). In the Brazilian economic scenario, the production of unlicensed cheeses is closely linked to the production of milk in small-scale production systems, almost always carried out by family labor (EMBRAPA, 2024a).

In Brazil, dairy farming contributes to regional development (BÁNKUTI; CALDAS, 2018c). Estimated at 35.30 billion liters per year (IBGE, 2017), milk production is concentrated mainly in the South and Southeast regions (Figure 1), with greater expression in the State of Minas Gerais, which has a share of approximately 28% in the national production, followed by the State of Paraná with a share of approximately 13% (EMBRAPA, 2024a). These states have a higher level of development and cheese production techniques due to the historical and cultural factor (DARGÈRE et al., 2023; SEAB, 2024).

The State of Minas Gerais (Figure 1) is an important center of cheese production and with the largest representation of small-scale cheese producers (IPHAN, 2006). For example, the Mantiqueira region – the border between the states of São Paulo and Minas Gerais – covers 42 municipalities and has milk production and cheese manufacturing as predominant in the family farming system, representing more than an economic activity, it is an essential part of local history and culture (DE MATOS et al., 2016). In this region, in 2019, 139 cheese dairies and a production of 58 thousand tons of cheese were counted (DA SILVA, 2020).

In 2024, cheese production in Minas Gerais reached significant milestones, both in cultural recognition and socioeconomic development (EMBRAPA, 2024a). This year, UNESCO (United Nations Educational, Scientific and Cultural Organization) declared the "Ways of Making Artisanal Minas Cheese" as Intangible Cultural Heritage of Humanity, highlighting the importance of this secular tradition for the identity of Minas Gerais (IPHAN, 2006). This international recognition boosted the visibility and appreciation of artisanal cheeses from Minas Gerais, directly benefiting about 7.7 thousand family agribusinesses in the state (EMBRAPA, 2024a). The State seeks advances that reflect the strengthening of the local economy and the preservation of cultural traditions, consolidating Minas Gerais as a reference in the production of excellent cheeses (EMATER, 2024).

In the State of Paraná (Figure 1), in 2023, 3.6 million liters of milk were delivered to dairy products (EMBRAPA, 2024a). Being the southwest of Paraná, a reference in the production of high-quality cheeses, maintaining regional traditions in the manufacture of these products (SEAB, 2024). Cheeses are among the most consumed dairy products in the state of Paraná, second only to fluid milk (IBGE, 2017).

In 2024, cheese production in Paraná recorded significant advances, driven by initiatives aimed at improving the quality and competitiveness of local products. Among these initiatives, an event that brought together producers and experts to discuss improvements in cheese production stands out, with a focus on the Colonial Cheese of Southwest Paraná, which in 2023, had a request for recognition for Geographical Indication (GI) filed with the National Institute of Industrial Property (INPI) (SEAB, 2024). With tradition and notoriety due to the production of Colonial Cheese, the expectation is that the Southwest of Paraná will soon obtain recognition for the geographical indication of cheese (DE MEDEIROS CARVALHO et al., 2019a), indicating how much cheese production in the State of Paraná is also expressive in the national context (SEAB, 2024).

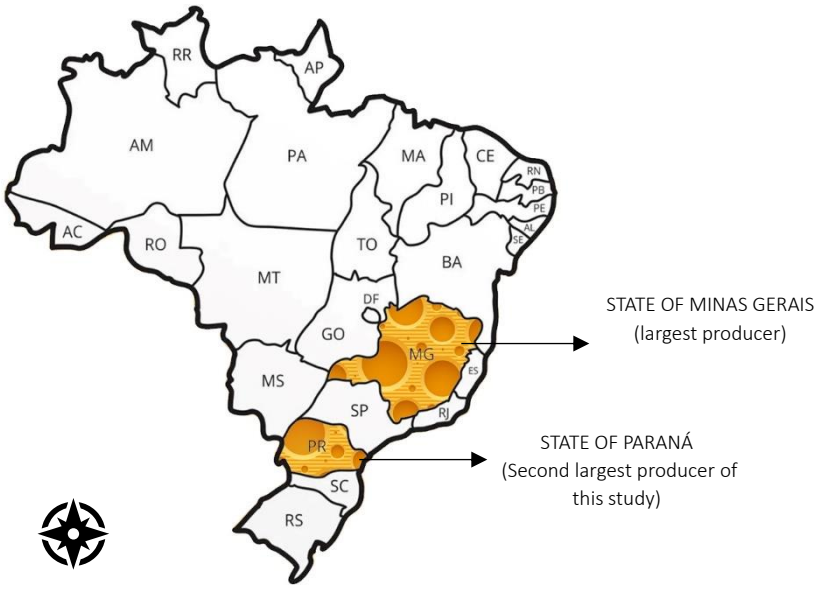

Figure 1 – Graphic representation of Brazil with emphasis on the states with the highest cheese production.

The search for recognition of the cheeses produced reflects the commitment of producers to raise quality standards, boosting the regional economy and consolidating Paraná as an important center in cheese production in Brazil (DE MEDEIROS CARVALHO et al., 2019a). This scenario can encourage educational and research institutions to study alternatives that provide the producer's access to the formal means of production and marketing of cheeses (SEAB, 2024).

It is worth noting that most cheese producers in Minas Gerais and Paraná come from small rural properties – that is, they have up to 4 fiscal modules and have small-scale production (BRASIL, 1972). The Agricultural Census (IBGE, 2017), highlights that 77% of dairy farms are family-based - characterized by having agricultural activity as the main source of income and managed by family members (DA SILVA MOTA CARVALHO et al., 2022) and and 64% of milk produced in Brazil comes from family farming (IBGE, 2018). This results in lower productivity, combined with other obstacles such as the deficient infrastructure of rural areas, which further raise costs per unit of production (TEIXEIRA et al., 2020).

Faced with this scenario, rural producers are looking for alternatives to improve their income, including the production of cheese on farms (BÁNKUTI; CALDAS, 2018c). From an economic point of view, the transformation of milk into cheese adds value to the product and sustains many families, especially in rural communities (PENNA; GIGANTE; TODOROV, 2021b). The transformation of milk into cheeses also

increases the unit price of processed milk, a fact that fosters the production of cheeses - regardless of whether or not they are inspected and registered cheeses (DA CRUZ, 2012; FERREIRA DOS SANTOS; DE SANTANA RIBEIRO; BARBOSA DE CERQUEIRA, 2020; TIBOLA et al., 2018). In the production of cheese on farms, the milk producer avoids the main difficulties encountered in commercial relations with the industry, such as: minimum production volume requirements and physical-chemical and microbiological quality criteria institutionally required by the industries (BÁNKUTI; CALDAS, 2018c; SOON et al., 2019).

1.2. PRODUCTION OF UNLICENSED CHEESES IN BRAZIL

The unlicensed production of cheese and other dairy products is considered illegal and in turn gives rise to so-called "informal", "clandestine" or "unlicensed" products (BRAGA, 2018). Essa produção caracteriza-se como sendo aquela realizada fora das indústrias legalizadas.

Certification and support initiatives have contributed to improving the quality and reputation of artisanal cheeses in Brazil, ensuring a promising future for artisanal production (EMBRAPA, 2024a). Some well-known varieties of cheeses, such as Artisanal Minas Cheese, Curd Cheese, Butter Cheese and Serra da Canastra Cheese, began to be produced without licensing and were later legalized. Subsequently, some of these, such as Serra da Canastra Cheese, obtained certification of origin, protecting, and valuing the product (DARGÈRE et al., 2023).

The non-licensing of cheese production in Brazil generates public health problems and economic problems that negatively impact tax collection, create unfair competition with legalized companies and raise the costs of the public health system due to the consumption of potentially contaminated products (BÁNKUTI; CALDAS, 2018; KAMIMURA et al., 2019[a]). It is estimated that, annually in Brazil, of the 17 billion liters of milk destined to produce cheeses by the industries, 6 billion liters of milk are part of the unlicensed production of cheese (IBGE, 2017). In the State of Minas Gerais – for example, many cheese dairies identified in the agricultural censuses do not have sanitary registration with the inspection agencies. Therefore, information on marketing and infrastructure of producers is still limited (EMBRAPA, 2024a). However, the

commercialization of these products is observed in various parts of the country, in fairs, small markets and in direct relations between rural producers and consumers. As reported in several studies, most of these products have microbiological contamination problems, not meeting the sanitary requirements provided for in the Brazilian Food Law (ALLAION; BARRIONUEVO; FRANCO, 2021b; ANDRETTA et al., 2019b).

Unlicensed cheese production responds to a local demand, with consumers who value these products for their tradition, flavor, and cultural representativeness, often ignoring quality and safety standards (AMARAL et al., 2020). This relationship of trust between producers and consumers is a factor that perpetuates informality (HORODNIC et al., 2022; SUTTER et al., 2017).

1.3. BRAZILIAN FOOD LEGISLATION

In Brazil, it is necessary that food manufacturers, including those who produce cheese, be legalized with the inspection agencies, as stipulated in their own regulations (BRASIL, 1950). Compliance with the regulation proves the quality requirements of the raw material and the processes so that the food is fit for consumption (BRASIL, 2017a).

The organizational structure of the Inspection Service in Brazil is through the Ministry of Agriculture (MAPA) and Ministry of Health (MS), in the capital Brasília, followed by the Secretariats of Agricultural Defense. In the States, it is separated into Departments for supervision and control of actions related to the production and supply of food, from the origin and sanitary control of animals and raw materials on farms to the distribution of the product in the market (Figure 2).

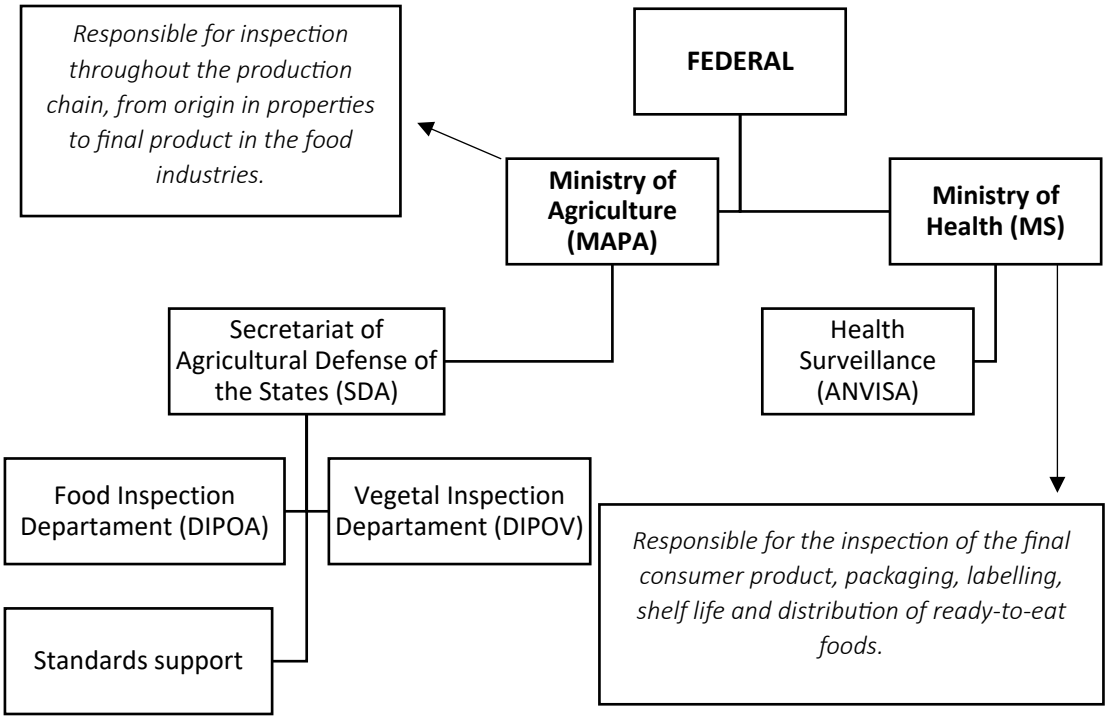

Figure 2 – Organizational structure of complex food inspection agencies in Brazil.

The Brazilian Food Legislation provides specific rules for each type of food produced and marketed in Brazil, ranging from the conditions of receipt of the raw material, in this case defined as how the milk is received by the industry that will produce the cheese, to labeling and packaging information. These act directly with the consumer market, being vehicles of information and validity regarding the sanitary registration of the cheese, also indicating the inspection body responsible for the sanitary inspection of that product (BRASIL, 2017a). The production of cheeses falls under "Products of Animal Origin – POA", and the set of rules that first provides for the industrial inspection of POA, was first drafted by Decree No. 1,283 of 1950 (MAPA), where:

> *"Article 1 - It is established the obligation of prior inspection, from the industrial and sanitary point of view, of all products of animal origin, edible and inedible, whether or not they are added to vegetable products, prepared, transformed, handled, received, packaged, deposited and in transit." (Translated by the author)*

Law No. 6.198 of 1974 established the Inspection Service as a food inspection agency in Brazil. Subsequently, other decrees and ordinances were created to regulate products of animal origin separately and systematically (BRASIL, 2017a).

With the wording of Decree No. 9,013 of 2017 and No. 10,468 of 2020 (MAPA), the production and sanitary inspection actions of products of animal origin were arranged in more elaborate ways (BRASIL, 2017a). Consequently, the Decrees join other Normative Instructions (IN) and Technical Regulation of Identity and Quality (RTIQ). Therefore, the structure of technical knowledge of laws and standards for the adoption of sanitary measures in Brazil is as shown in Figure 3, below:

Figure 3 – Hierarchical structure of Food Legislation in Brazil.

When it comes to the unlicensed production of cheeses, it is common in Brazil to refer to names such as "homemade product" or "artisanal product". However, the Law defines the concept of artisanal animal products, as well as categorizes the production of true artisanal cheeses, such as:

> *"I - food products of animal origin produced in an artisanal way - edible products subject to the control of the official inspection body, made from raw materials of animal origin of their own production or of determined origin, resulting from predominantly manual techniques adopted by individuals who have full control of the production process, whose final manufacturing product is individualized and genuine and maintains its own uniqueness and characteristics, cultural, regional or traditional product;(Translated by the author).*
>
> *II - artisanal cheeses - those made by traditional methods, with territorial, regional, or cultural attachment and valorization, according to the specific elaboration protocol established for each type and variety, and with the use of good agricultural practices in*

> *artisanal production and manufacturing;" (Translated by the author).*

In other words, although it is common, the use of the term "artisanal" to characterize unlicensed cheeses is erroneous, and it should be noted that unlicensed cheeses cannot receive the concept "artisanal", according to Decree No. 11,099 of 2022, Ministry of Agriculture (MAPA), since they are not "subject to the control of the official inspection body" (BRASIL, 2022).

Normative Instructions No. 76 and No. 77 of 2018 of the Ministry of Agriculture (BRASIL, 2018a), they regulate specifically the conditions for milking, collecting, transporting, and processing milk and evaluate how establishments should process milk as raw material. Pasteurization is the technological process regulated by the Legislation, which uses time and temperature to control microorganisms (DE BUYSER et al., 2001). The control of the microbial load of milk is one of the minimum requirements for the production and commercialization of dairy products in Brazil (BRASIL, 2018a).

One of the main problems of unlicensed cheese production in Brazil is production from raw milk (D'AMICO; DONNELLY, 2010; DE MEDEIROS CARVALHO et al., 2019a). The production of cheese from raw milk in Brazil is not allowed by law, except in cases where: (1) the property and the industry are registered and have permission for the use of raw milk; (2) the cheese is matured for at least 60 days; (3) controls are established for the microbiological quality of the milk throughout the process – receipt of raw material until the end of the maturation process and (4) studies are carried out on the shelf life and shelf life of the cheese (BRASIL, 2017a) - otherwise, pasteurization is mandatory.

1.4. THEORY OF PLANNED BEHAVIOR (TPB)

The Theory of Planned Behavior (TPB) can be seen as an advance on the Theory of Rationalized Action (GARMENDIA-LEMUS et al., 2024), since the latter had limitations in the treatment of behaviors over which people had incomplete volitional control. TPB is based on the premise that individuals make their decisions in an eminently rational manner and systematically use the available information (Figure 4), considering

the implications of their actions before deciding whether or not to act in a certain way (AJZEN, 2002).

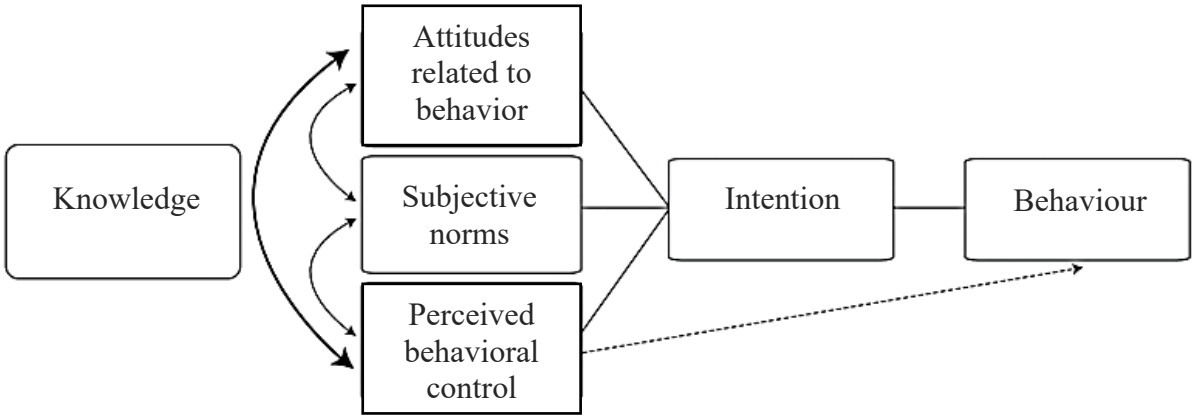

Figure 4 – Premises of the Theory of Planned Behavior (Adapted from Ajzen, 1991).

According to Ajzen (2011), beliefs provide a detailed view of the cognitive underpinning of a population's behavior at a given time, allowing us to understand why people have certain attitudes, subjective norms, or perceptions of behavioral control. Several characteristics of TCP explain its wide use as a model to predict and modify behaviors. The theory focuses directly on the factors that determine behavior; Unlike other theories in the social and behavioral sciences, it can be applied to any type of behavior that is of interest to the researcher (AJZEN, 2020).

The TPB considers that the actions of the agents are influenced by the individual's perception of self-decision-making capacity; acquired knowledge; expectations about the future of production; production structure; influence of people that individuals deem important to them, among others (AJZEN, 1991). In this sense, the theory of planned behavior suggests that behavioral beliefs (i) attitude; (ii) subjective norms, and (iii) perception of control (AJZEN, 2020).

Behavior is the human ability to perform an action, which can be positive or negative, which in turn involves an individual's attitude towards performing a specific action, as well as their beliefs about what others expect of them in each situation (HILL; FISHBEIN; AJZEN, 1977). Normative beliefs, on the other hand, are influenced by the individual's motivation to follow the norms (AJZEN, 2020). Behavior affects perception and vulnerability, and the choice to take an action is determined by internal and external factors (AJZEN, 2020; SI et al., 2020).

A person's intention is determined by his attitude toward action and the subjective norm. Thus, attitude toward an action can predict behavior, establishing a significant correlation between intention and action (AJZEN, 2020). These intentions, previously specified, can be influenced by the general needs of individuals to act in various situations. Several studies confirm that intention has a significant impact on behavior (ALBAYATI; ALISTARBADI; RHO, 2023; ALDAPE GARCÍA; TORRES RODRÍGUEZ; PATIÑO PALOMARES, 2024; HOPPE et al., 2012). Databases of studies prior to CPT already predicted that attitudes usually result from experiences or education and can have a significant influence on behavior (WARSHAW, 1980). However, Ajzen (1985) corroborated that the individual's attitude can also change due to external influences. A person's attitude toward a particular action is shaped by the perceived outcomes of that action and the values and beliefs that the individual attaches to himself or herself (AJZEN, 2011, 2020).

The subjective norm, the external pressure that individuals perceive to perform or avoid certain behaviors, which is measured based on the expectations of significant people in their lives and which represents the opinions that the individual has about how others expect him to behave (AJZEN, 2020). Several studies indicate that correlations between individuals and within the same individual are useful for predicting behavioral intentions, considering both attitudes and subjective norms (HILL; FISHBEIN; AJZEN, 1977; WANG; ZHAO; PAN, 2024). Furthermore, it is already known that social expectations directly affect behavioral intentions, and for the individual, behavior is more satisfactory when the subjective norm is stronger (LAM; PINE; BAUM, 2003).

Another construct, perceived behavioral control, refers to the combination of the individual's beliefs about their ability to perform an action, considering the resources and opportunities available (AJZEN, 1991), which measures how much the intention to perform a behavior can make that goal easier or more difficult to achieve. Actions that can be measured involve the effective use of systems or services, balancing skills, resources, and opportunities (LAM; PINE; BAUM, 2003) and it depends on beliefs about the availability of resources needed to facilitate behavior (AJZEN, 2020).

Thus, the theory is based on three constructs of influence on intention: attitude (ATT), which refers to the way the individual perceives behavior; subjective norm (SN), which reflects how much social pressure influences the behavior of the cheese producer analyzed and; Perceived behavioral control (PBC), represents the way in which the

individual perceives himself as acting in the action and sees himself with the ability and knowledge to perform the behavior (AJZEN, 1991).

The greatest limitation of studies using TPB is due to the collection of information, that is, problems in the preparation of questionnaires and the lack of considerations regarding the identification of factors (IWAYA et al., 2022). It is interesting that all the questions proposed in the questionnaires use the same scale of response measurement and that they all have sentences that have the same grammatical agreement so that the agent understands the questions objectively and equally for the entire sequence to be answered in the survey (HAIR JR. et al., 2021; HILL; FISHBEIN; AJZEN, 1977). TPB involves effects at different levels of influence, while focusing on individual factors, we must consider that people do not act in isolation, especially in organizational environments, so it is essential to recognize the relevance of the questions proposed in the questionnaire so that there are no biased answers (AJZEN, 1991; HILL, 1977).

The questionnaires that can be used as data collectors and measures of belief are subsequently supported by consolidated methodological tools, which allow the theoretical constructs of TPB to be reliably measured. The well-defined structural model provides a basis for understanding the determinants of human behavior and is applicable to empirical testing with multiple regressions and structural equation modeling (MÜLLER et al., 2024). In addition, the theory is corroborated by several experimental studies and is useful for predicting the use of technologies (ALBAYATI; ALISTARBADI; RHO, 2023), consumer attitudes, awareness actions, beliefs of populations (BORGES; OUDE LANSINK, 2016b; CORREA; ALVARO; YILDIRIM, 2019), among other works in animal production and agroecology (GARMENDIA-LEMUS et al., 2024; MÜLLER et al., 2024).

To attribute values to each of the constructs of the TPB, some authors start by characterizing the individuals – made by means of descriptive statistics: mean values, standard deviation, and maximum and minimum values, to characterize the typology of the groups of individuals studied (MÜLLER et al., 2024).

Confirmatory factor analysis is used to generate the constructs, and the results are verified based on the value of the factor loadings of each item (> 0.5) and the reliability of the construct based on Cronbach's alpha (> 0.7) (HAIR JR. et al., 2021).

From the confirmatory factor analysis, the constructs are defined, INT, ATT, SN and PBC, using the measurement model and structural equation modeling (SEM) (HAIR JR. et al., 2021; MÜLLER et al., 2024).

Some authors, after defining the constructs, use the INT construct, together with variables of the structural typology of the group of individuals, based on correlation analysis – Speraman's rho. Which verifies whether there is a relationship between INT and individuals' characteristics (HAIR JR. et al., 2021; LIMA et al., 2020b; MÜLLER et al., 2024).

The verification of the reliability indices of the measurement model are represented by the convergent validity - Average Variance Extracted (AVE), with acceptability above 50%, the Construct Reliability (CR), which must be greater than 0.7 and Cronbach's alpha (α), where values above 0.7 are accepted (HAIR JR. et al., 2021).

The fit of the measurement model is evaluated based on the indices, Root Mean Square Error of Approximation (RMSEA), with a confidence interval of 95%, Comparative Fit Index (CFI), Tucker-Lewis index (TLI) and Standardized Root Mean Squared Residual (SRMR). CFI and TLI should be greater than 0.95, while RMSEA and SRMR should be less than 0.08 (HAIR et al., 2009; HAIR JR. et al., 2021).

In the second step of structural equation modeling, the structural model (SM) is generated. In this model, the intensities of the relationships between the constructs are evaluated through multiple regression analysis (ALBAYATI; ALISTARBADI; RHO, 2023; HAIR JR. et al., 2021). The structural model shall be evaluated by the R2 coefficient of determination and by the Beta (β). The acceptability or rejection of the hypotheses was based on the analysis of the p-value ($p< 0.05$) (HAIR JR. et al., 2021; MÜLLER et al., 2024).

The statistical planning (Figure 5) of the structural model involves the clear definition of the objectives of the study, the selection of the variables, and the specification of the relationships between them (HAIR JR. et al., 2021; SENGER; BORGES; MACHADO, 2017).

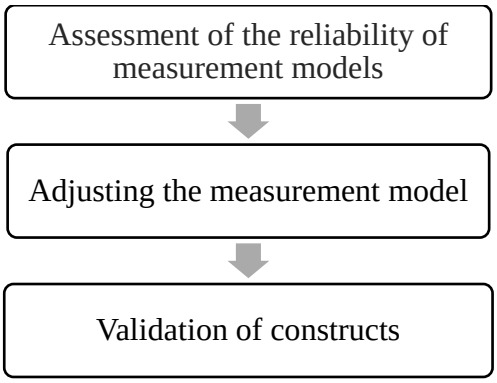

Figure 5. Formation of the measurement model using structural equations (Adapted from Hair. et al., (2021).

Obtaining results in a valid and reliable manner requires the presentation of minimal evidence from previous studies or data from the research itself that proves the validity of the measures employed, considering both the content and the internal structure of the instrument (IWAYA et al., 2022). As for samples with high heterogeneity, the exploratory analysis of the data can explain the heterogeneous arrangement based on the formation of indicators (AJZEN, 2020; IWAYA et al., 2022).

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1. GENERAL OBJECTIVES

We aim to identify the influence of psychological constructs on the intention of cheese producers to legalize their production.

1. RESEARCH HYPOTHESES

H1: the attitude has a positive influence on the intention of producers to legalize the production of cheese.

H2: the subjective norm has a positive influence on the intention of producers to legalize the production of cheeses.

H3: perceived behavioral control has a positive influence on producers' intention to legalize cheese production.

I. ARTICLE

“Cheesemakers' intention to pursue licensing

Sociopsychological factors influencing Brazilian farmers' intention to regularize their cheese production”

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Sociopsychological factors influencing Brazilian farmers' intention to regularize their cheese production

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ABSTRACT

Milk and cheese products serve an important economic and social function in Brazil, as most of the production is carried out on small-scale family farms. Farmers who fail to meet institutional and market requirements related to production scale and milk quality often abandon the activity or turn to selling raw milk or unlicensed cheese. In this research, we adopted the Theory of Planned Behavior (TPB) as a theoretical framework to investigate unlicensed farmers' intention to regularize cheese production. Interviews were conducted on site with 286 cheese producers in Paraná and Minas Gerais States, Brazil. The data were analyzed using descriptive statistics, regression analysis, and structural equation modeling - the procedures recommended in the TPB. The results were discussed based on the TPB and Brazilian institutional and market characteristics. Farmers' intention to regularize cheese production was positively correlated with social characteristics (farmer's age and experience in dairy farming) and farm characteristics (milk/cheese production area and milk volume). The construct perceived behavioral control (PBC) (0.43, $P < 0.001$) was the most important in determining cheese producers' intention to regularize cheese production, followed by the construct subjective norms (SN) (0.23, $P < 0.004$). The high importance of the PBC construct suggests that farmers believe they have sufficient capacities to regularize cheese production. The importance of the SN construct suggests that people close to farmers would support the regularization of cheese production. The attitude (ATT) construct was not significant in determining farmers' intention (0.10, $P = 0.146$). The lack of significance of the ATT construct on farmers' intention indicates an absence of perceived incentive for licensing. The model defined by SN and PBC explained 24.9% of farmers' intention to regularize cheese production.

Key words: dairy production, unlicensed market, milk, sanitary standards, theory of planned behavior.

INTRODUCTION

Brazil is a major food producer and exporter, and agribusiness is one of the most important economic sectors for the country, accounting for 25% of the gross domestic product (CEPEA/CNA, 2024; FAO, 2021). Among the sectors of the Brazilian agribusiness, dairy production holds economic and social relevance. In 2022, Brazil was the third largest producer of milk, with a national production of 35.3 billion liters per year, equivalent to just over 4% of the global production (FAO, 2021). As for the social dimension, it is estimated that dairy production employs 4 million Brazilians, who rely on this sector for their livelihoods (EMBRAPA, 2024b).

Despite its economic and social importance, the Brazilian dairy sector is still considered uncompetitive (BEBER et al., 2019; BRITO et al., 2015). This is partly due to the characteristics of dairy farms, which are often small-scale and face challenges in meeting the sanitary and quality standards set by institutions and required by the market (BÁNKUTI et al., 2023; IBGE, 2018; LIMA et al., 2020a). Since the 1990s, the Brazilian government has established increasingly stricter criteria for the physicochemical and microbiological quality of milk (BRASIL, 2002, 2011, 2018b). Concomitantly to this, the dairy sector underwent a process of deregulation, which put an end to public policies that protected rural producers. From a market perspective, the opening of the Brazilian economy and the entry of foreign companies altered the competitive landscape of the dairy sector, and industries began to demand higher milk quality and greater production scale (BÁNKUTI; CALDAS, 2018a; SIMÕES et al., 2021).

Currently, farmers who do not meet scale, sanitary, or quality standards are either paid less or encounter difficulties in selling to the industry (BEBER et al., 2019; DEFANTE et al., 2019; SIMÕES et al., 2021). The difficulty that producers face in meeting institutional and market demands may have encouraged them to seek alternative sources of income, such as producing cheese on the farm, which is often carried out without

sanitary licensing (BÁNKUTI et al., 2023; PINEDA et al., 2021). Unlicensed cheese production violates Federal Decree No. 9.013/2017 and Regulatory Instructions N. 77 and 77/201 (BRASIL, 2017b, 2018b).

There are no official statistics on unlicensed cheese production in Brazil, and no available data allows for a reliable estimate. Nevertheless, unlicensed dairy products are commonly sold in several parts of the country, most commonly in street fairs, small markets, or direct transactions between rural producers and consumers (BÁNKUTI et al., 2023).

Cheese produced without adherence to regulatory standards is susceptible to microbiological contamination at various stages of production and processing. Contamination may stem from inadequate hand hygiene by milkers, poor conditions in the milking environment, inadequate production conditions, and improper storage, among other factors (CHIMUTI et al., 2024; DAS DORES; DA NOBREGA; FERREIRA, 2013; NTULI; NJAGE; BUYS, 2016; PINEDA et al., 2021).

Most of the studies on cheeses produced on Brazilian farms focused on the analysis and discussion of cultural aspects related to cheese production, sanitary quality, and consumer risks (ALLAION; BARRIONUEVO; FRANCO, 2021a; ANDRETTA et al., 2019a; BALCÃO et al., 2017; MARGALHO et al., 2020). However, no studies were found that analyzed and discussed farmers' intention to regularize cheese production.

Some studies indicated that the choice to produce unlicensed cheese may be influenced by several factors, including characteristics of production systems, farmers, markets, and the institutional environment (laws) (BÁNKUTI et al., 2023; PENNA; GIGANTE; TODOROV, 2021a; PINEDA et al., 2021). However, the decision to license cheese production ultimately depends on farmers' intentions.

Several studies analyzed farmers' intentions from the perspective of the theory of planned behavior (TPB). Borges and Oude Lansink (2016) studied the intention of Brazilian rural producers to use natural pastures in cattle production. Bagheri et al. (2019) investigated the intention of cereal producers in Iran to use pesticides. de Oliveira Müller et al. (2024) analyzed the intention of Brazilian dairy producers to engage in family succession planning.

The TPB posits that the behavior of agents is influenced by their intentions, which are defined by three psychological constructs, namely attitude, subjective norms, and perceived behavioral control (ICEK AJZEN, 1991). In this article, we adopted the TPB framework to analyze the intention of cheese producers to regularize their production. The following questions were raised: (a) Do the analyzed producers have the intention to regularize cheese production? (b) Which TPB constructs are the most important in explaining producers' intention to regularize cheese production? Based on the research objectives and in accordance with the assumptions of the TPB, we generated and tested the following three hypotheses: (H1) attitude has a positive influence on farmers' intention to regularize cheese production, (H2) subjective norms have a positive influence on farmers' intention to regularize cheese production, and (H3) perceived behavioral control has a positive influence on farmers' intention to regularize cheese production. We believe that the findings of this research may contribute to the development of public and private policies aimed at reducing unlicensed cheese production in Brazil and addressing the issues arising from this market.

MATERIAL AND METHODS

This study used data and information collected on farms to assess the intention of farmers in Paraná (PR) and Minas Gerais (MG) States, Brazil, to regularize their cheese

production. A semi-structured interview was used for data collection. Characteristics of the institutional and market environment of the dairy sector were used to support the defined objectives and inform the discussion of the results. The TPB provided the theoretical framework for data analysis and discussion. Research procedures are described in detail below.

Framework

Characteristics of the institutional and market environment of the Brazilian dairy sector

The research was conducted in two Brazilian states, Paraná and Minas Gerais. In these states, as well as in other states throughout the country, the 1990s were marked by significant institutional and market changes that had a profound impact on economic agents. The main changes included the opening of the Brazilian market to foreign companies and the deregulation of certain economic sectors (BEBER; LAKNER; SKEVAS, 2021). Specifically for the milk processing sector, the opening of the economy and the subsequent entry of foreign companies and products into the country intensified competition and contributed to the closure of numerous Brazilian dairies. Newly entered companies and those that remained in the Brazilian market began demanding higher production scales and higher physicochemical and microbiological quality of raw milk from their suppliers (i.e., dairy farmers) (BÁNKUTI; CALDAS, 2018a; BEBER; LAKNER; SKEVAS, 2021).

In addition to these changes, the Brazilian government promoted the deregulation of the dairy sector in the 1990s, which was marked by the cancellation of policies that protected rural producers, including the cessation of the minimum price per liter of milk that the industry was required to pay in transactions with dairy producers. This condition brought to light the vulnerability of numerous milk producers, especially those with

smaller production scales, who began facing difficulties in remaining in the activity (Bánkuti and Caldas, 2018; Beber et al., 2019; Tonet et al., 2023).

Over the 1990s and the following years, the Brazilian government gradually released stricter physicochemical and microbiological quality standards for milk, as well as for other processes related to the production and storage of raw milk on farms (BRASIL, 2002, 2011, 2018b). These institutional and market changes had important impacts, including the shift of milk production to other regions of the country, the concentration of the activity, the search for alternative sources of income, and, for some, the abandonment of milk production (BÁNKUTI; CALDAS, 2018a; BEBER et al., 2019; TONET et al., 2023).

Theoretical Framework

In this research, we applied TPB constructs to measure the intention (INT) of farmers to regularize cheese production. The TPB considers that an agent's behavior is determined by their intention (INT), which, in turn, is driven by attitude (ATT), subjective norms (SN), and perceived behavioral control (PBC). Intention, as well as other aspects of the TPB framework, can be measured through the assessment of constructs expressing an agent's perception of their own behavior. Constructs are determined from variables or items that represent them (ICEK AJZEN, 1991). The theoretical model of the TPB is presented in Figure 1.

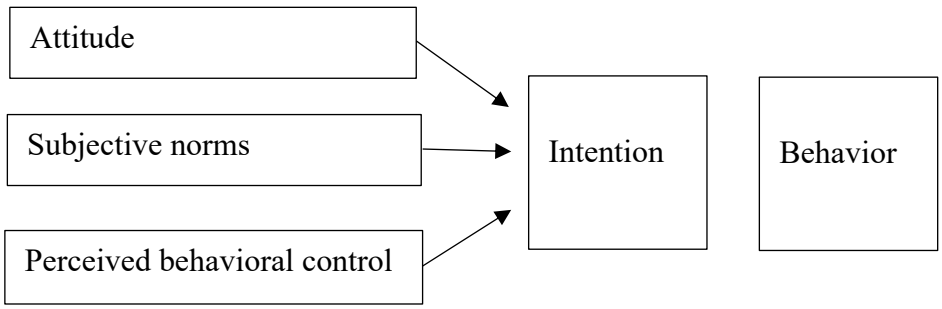

Figure 1. Theoretical framework of the Theory of Planned Behavior (Azjen, 1991).

According to the TPB, INT represents the willingness of individuals to perform a certain behavior. This construct is treated as a dependent variable influenced by three other constructs (independent variables), namely ATT, SN, and PBC (ICEK AJZEN, 1991).

The construct ATT expresses how positively an agent perceives a certain behavior (ICEK AJZEN, 1991). In this research, we will examine whether farmers perceive regularizing their cheese production as positive or negative behavior. The SN construct represents the degree to which social pressure from close individuals and those deemed important by the agent can influence the decision to perform a certain behavior (ICEK AJZEN, 1991). Here, we will analyze whether people close to rural producers, such as family members, peer farmers, and other agents of the dairy production chain exert positive or negative pressure on the agent's intention to regularize cheese production. Lastly, PBC represents the agent's perception of their own skills and knowledge to perform a certain behavior (ICEK AJZEN, 1991). We will use the PBC construct to assess whether farmers believe they possess the capacity (e.g., knowledge, financial resources, and information) to regularize their cheese production. Next, as defined by the TPB, we will analyze construct reliability using a measurement model and the relationships between constructs using a structural model. The results of the measurement and structural models will be discussed based on the TPB and the institutional and market characteristics of the Brazilian dairy sector since the 1990s.

Study Site

The study was conducted in Minas Gerais and Paraná, Brazil, which are the first and second largest producers of milk in the country, respectively. Minas Gerais contributes to approximately 28% of the national milk production and Paraná to 13% (IBGE, 2024). In these states (Figure 2), dairy farms are predominantly characterized by family labor, low yields, and small production scales (IBGE, 2018).

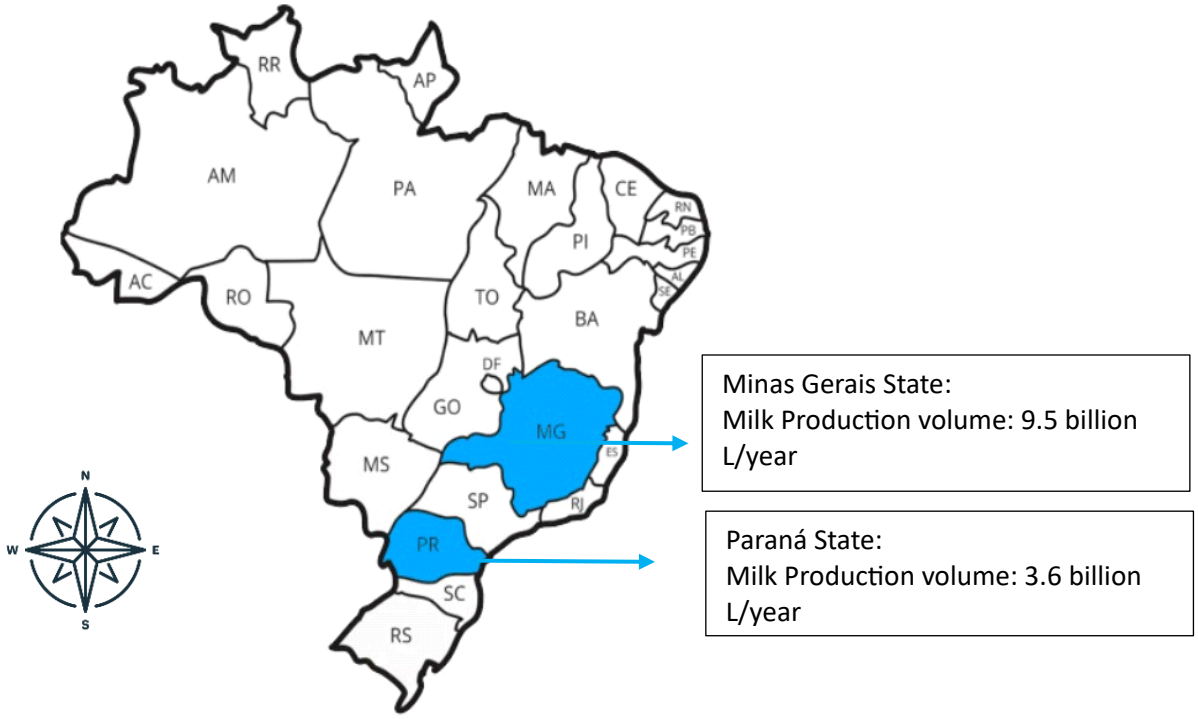

Figure 2. Map of Brazil showing the location of Paraná and Minas Gerais States and the 2023 milk production volume in liters. Source: adapted from EMBRAPA (2024).

Minas Gerais has 41,600 dairy farms producing approximately 78,200 t of cheese per year, of which 70% is produced in family systems. In Paraná, it is estimated that 9,700 dairy farms produce 9,100 t of cheese per year. Family farms are responsible for about 76% of the volume of cheese produced in Paraná (IBGE, 2018). Unlicensed cheese production is mostly carried out by dairy producers seeking an alternative source of income (BÁNKUTI et al., 2023).

Identification of Cheese Producers and Data Collection

Cheese producers were identified from a contact list made available by technical assistance and rural extension agencies of Paraná and Minas Gerais States, Brazil. A single criterion was adopted for participant selection, namely, to be a cheese producer who is not registered with Brazilian official bodies, meaning they are unlicensed.

At first contact, cheese producers were asked whether they wished to participate in the study. The team explained the objectives of the research, the interview method, and the anonymization of answers. The project and data collection form were approved by the Standing Committee on Human Research Ethics (COPEP) (CAAE No. 50176121.3.0000.0104).

Data collection was performed on-site, in 286 milk production systems located in Paraná and Minas Gerais States, Brazil. A semi-structured interview was conducted with farmers. The first part of the interview referred to farm characteristics, encompassing structural and production variables, as well as the social characteristics of farmers. For this, closed-ended questions were used, with metric, ordinal, or nominal options. These data were used to characterize the sample and assess correlations with farmers' intention to regularize cheese production.

In the second part of the interview, we sought to analyze farmers' intentions using TPB constructs (Table 1). Questions were rated on a 5-point Linkert scale (LIKERT, 1932), ranging from 1 (most negative response) to 5 (most positive response), according to the method proposed by (ICEK AJZEN, 1991). A total of 16 questions were used to evaluate TPB constructs: 4 referred to the INT construct, 4 to the ATT construct, 3 to the SN construct, and 5 to the PBC construct (Table 1).

Table 1. Items and response options of the questionnaire used to measure constructs of the theory of planned behavior.

Construct	Item	Response options (1–5)
INT1	Do you intend to obtain the inspection seal in the future?	Definitely not (1) Definitely yes (5)
INT2	How strong is your intention to obtain the inspection seal in the future?	Definitely not (1) Definitely yes (5)
INT3	Are you likely to obtain the inspection seal in the future?	Definitely not (1) Definitely yes (5)
INT4	Do you plan to obtain the sanitary inspection seal in the future?	Definitely not (1) Definitely yes (5)
ATT1	How important would it be for you to obtain the sanitary inspection seal in the future?	Very unimportant (1) Very important (5)
ATT2	How advantageous would it be for you to obtain the sanitary inspection seal in the future?	Very unimportant (1) Very important (5)
ATT3	How necessary is it for you to obtain the sanitary inspection seal in the future?	Very unimportant (1) Very important (5)
ATT4	How important is it for you to obtain the sanitary inspection seal in the future?	Very unimportant (1) Very important (5)
SN1	Do most people who are important to you think you should regularize cheese production on your farm?	Very unlikely (1) Very likely (5)
SN2	Would most people whose opinion you value approve if you regularized cheese production on your farm?	Very unlikely (1) Very likely (5)
SN3	Would most cheese producers who are like you approve if you regularized cheese production on your farm?	Very unlikely (1) Very likely (5)
SN4	Would people involved in the cheese production chain approve if you regularized cheese production on your farm?	Very unlikely (1) Very likely (5)
PBC1	If you want to obtain the sanitary inspection seal in the future, do you believe you have sufficient knowledge to do so?	Definitely not (1) Definitely yes (5)
PBC2	If you want to obtain the sanitary inspection seal in the future, do you believe you have sufficient resources to do so?	Definitely not (1) Definitely yes (5)
PBC3	How confident are you in overcoming the barriers that prevent you from obtaining the sanitary inspection seal in the future?	Definitely not (1) Definitely yes (5)

PBC4	Does obtaining the sanitary inspection seal in the future depend solely on you?	Definitely not (1) Definitely yes (5)
PBC5	Is obtaining the sanitary inspection seal in the future under your control?	Definitely not (1) Definitely yes (5)

INT, intention; ATT, attitude; PBC, perceived behavioral control; SN, subjective norms.

Data Analysis

Initially, the data were analyzed using descriptive statistics (mean, standard deviation, maximum, and minimum) for characterization of dairy farms and farm operators. The correlations between farmers' intention to regularize cheese production and farm/farmer characteristics were assessed using the INT construct (INT1 to INT4) (Table 1). This construct was generated using confirmatory factor analysis. Construct validity was assessed by analyzing factor loadings of variables/items, which should be greater than |0.5|, and Cronbach's alpha, which should be greater than 0.7 (HAIR et al., 2009). Having defined the INT construct, we used Spearman correlation analysis to evaluate relationships between the construct and farm/farmers variables.

Analysis of TPB Models

According to TPB assumptions, the analysis should begin with the definition of the measurement model. This model is used to verify whether the chosen variables adequately represent the constructs proposed by the theory (ICEK AJZEN, 1991). The measurement model was assessed using confirmatory factor analysis and reliability indices. The following reliability indices were determined: average variance extracted (AVE), which must be greater than 50%; construct reliability, which must be greater than 0.7; and Cronbach's alpha, which must be greater than 0.7 (FIELD, 2009; HAIR et al., 2009). The fit of the measurement model was assessed by determining the root mean square error of approximation (RMSEA) at the 95% confidence level, comparative fit index (CFI),

Tucker–Lewis index (TLI), and standardized root mean square residual (SRMR). RMSEA and SRMR must be lower than 0.08, whereas CFI and TLI must be greater than 0.95 (HAIR et al., 2009).

In the second stage, as established by the TPB, the structural model was generated. The structural model uses multiple regressions to test relationships between constructs generated in the previous model (the measurement model) (HAIR et al., 2009). With this procedure, we can assess the strength of the relationships between the dependent construct (INT) and independent constructs (ATT, PBC, and SN) based on the estimated values of coefficients. Additionally, the structural model allows us to examine the research hypotheses through *p*-values and analyze the predictive/explanatory capacity of the model based on the coefficient of determination (R^2). In this research, the coefficient of determination represents the explanatory power of the model regarding producers' intention to regularize cheese production.

In this model, the strength of relationships between constructs was evaluated using multiple regression analysis. The coefficient of determination (R^2) and β values of the structural model were defined. The acceptability of hypotheses was determined at $p < 0.05$ (HAIR et al., 2009; MORAIS; BINOTTO; BORGES, 2017).

RESULTS

Sample Characterization

The sampled cheese producers were from Paraná State (39.9%) and Minas Gerais State (60.1%). Cheese production was the main source of income of cheese producers. The mean age and experience in the activity were 55 ± 11.75 years and 8.05 ± 6.37 years, respectively. Some farm operators (61.90%) participated in cooperatives or associations of milk and cheese producers (Table 2).

Analysis of farm characteristics showed that the mean farm area was 18.24 ± 17.59 ha, and the mean production area (encompassing areas for grazing, feed grain crops, animal management, and cheese production) was 7.19 ± 8.51 ha (Table 2). Farms had a mean daily milk production of 216.41 ± 233.60 L. The predominant milking method was machine milking with bucket milkers (57.3%), followed by manual milking (35.3%) and pipeline milking (7.3%) (Table 2).

Table 2. Social and structural characteristics of dairy farms included in the study.

Variable		***n***	**%**
State	Paraná	114	39.9
	Minas Gerais	172	60.1
Is cheese production your main source of income?	Yes	105	36.7
	No	181	63.3
Sex	Male	169	59.1
	Female	117	40.9
Milking system	Manual	101	35.3
	Mechanized	164	57.3
	Pipeline system	21	7.3
Do you participate in collective organizations?	Yes	177	61.9
	No	109	38.1

Variable	**Mean**	**SD**	**Min**	**Max**
Age (years)	55.59	11.75	28.00	92.00
Experience in dairy farming (years)	8.05	6.37	1.00	35.00
Farm size (ha)	18.24	17.59	0.25	111.00
Milk/cheese production area (ha)*	7.19	8.51	0.25	44.00
Milk production (L/day)	216.41	233.60	20.00	1.800.00

SD, standard deviation.

* Includes areas used for pasture, silage, feed grain crops, animal management, and cheese production.

Correlation Between INT and Socioeconomic and Production Variables

Correlation analysis revealed positive and significant correlations between the intention of farmers to license cheese production (INT) and farmers' age (0.370, $P <$

0.001), experience in milk and cheese production (0.310, $P < 0.001$), farm production area (0.189, $P = 0.001$), and milk production volume (0.134, $P < 0.024$). These results show that older producers, those who have more experience in the activity, those with larger farm sizes, and those with higher production volumes have the greatest intention to regularize cheese production.

Measurement Model

For validation of the measurement model, we removed the items SN1, PBC1, and PBC4, given their low factor loadings (less than |0.5|). The retained items had standardized factor loadings greater than 0.56 at the 95% confidence level. The consistency of the measurement model was suitable, with an AVE greater than 0.57, construct reliability greater than 0.73, and Cronbach's alpha greater than 0.72 for all constructs (Table 3).

Table 3. Standardized factor loadings, Cronbach's alpha, average variance extracted (AVE), and construct reliability (CR) of model constructs.

	ATT		**INT**		**PBC**		**SN**	
	ATT1	0.664	INT1	0.787	PBC2	0.666	SN2	0.716
	ATT2	0.641	INT2	0.685	PBC3	0.559	SN3	0.759
	ATT3	0.931	INT3	0.635	PBC5	0.819	SN4	0.667
	ATT4	0.613	INT4	0.728				
Cronbach's alpha	0.797		0.798		0.723		0.745	
AVE	0.674		0.573		0.622		0.633	
CR	0.821		0.778		0.732		0.747	

ATT, attitude; INT, intention; PBC, perceived behavioral control; SN, subjective norms.

Structural Model

The structural model proposed by the TPB was used to evaluate the intensity of the relationships between farmers' intention to regularize cheese production (INT) and

perceived attitude (ATT), perceived behavioral control (PBC), and perceived subjective norms (SN), as well as to test the hypotheses defined in this research. The coefficients between INT and ATT, SN, and PBC were positive. The largest coefficient was that between INT and PBC (0.430), followed by SN (0.232) and ATT (0.106). Of these, INT–SN and INT–PBC interactions were significant ($P < 0.05$) (Table 4).

Table 4. Results of the structural model describing Brazilian farmers' intention to regularize on-farm cheese production.

Hypothesis	Interaction	Coefficient	SD	95% LB	95% UB	Standard β	z	P
H1	ATT→INT	0.106	0.073	−0.036	0.249	0.09	1.45	0.146
H2	SN→INT	0.232	0.079	0.075	0.388	0.202	2.91	0.004*
H3	PBC→INT	0.430	0.055	0.321	0.539	0.38	7.73	<0.001*

SD, standard deviation; LB, 95% confidence interval lower bound; UB, 95% confidence interval upper bound; ATT, attitude; INT, intention; SN, subjective norms; PBC, perceived behavioral control.
Hypothesis testing results ($P < 0.05$): H1, rejected; H2, accepted; H3, accepted.

The coefficient of the relationship between ATT and INT was positive but non-significant, resulting in the rejection of H1 (attitude has a positive influence on farmers' intention to regularize cheese production). The coefficient of the SN–INT relationship was positive and significant, confirming H2 (subjective norms have a positive influence on farmers' intention to regularize cheese production). Finally, the PBC–INT coefficient was positive and significant, confirming H3 (perceived behavioral control has a positive influence on farmers' intention to regularize cheese production) (Table 4).

The prediction capacity of the structural model (R^2) was 0.25. Albeit low, this result indicates that SN and PBC together explained 25.0% of the variance in farmers' intention to regularize cheese production.

Relationships Between TPB Constructs

For the ATT construct, the most important variables were, in the following descending order of importance, ATT3, ATT2, ATT1, and ATT4. For PBC, PBC5, PBC2, and PBC3 held the greatest importance. For SN, the variables with the greatest impact were SN3, SN4, and SN2. For INT, the most important variables were INT1, INT4, INT2, and INT3. Only positive relationships were observed between variables and the respective constructs (Figure 3).

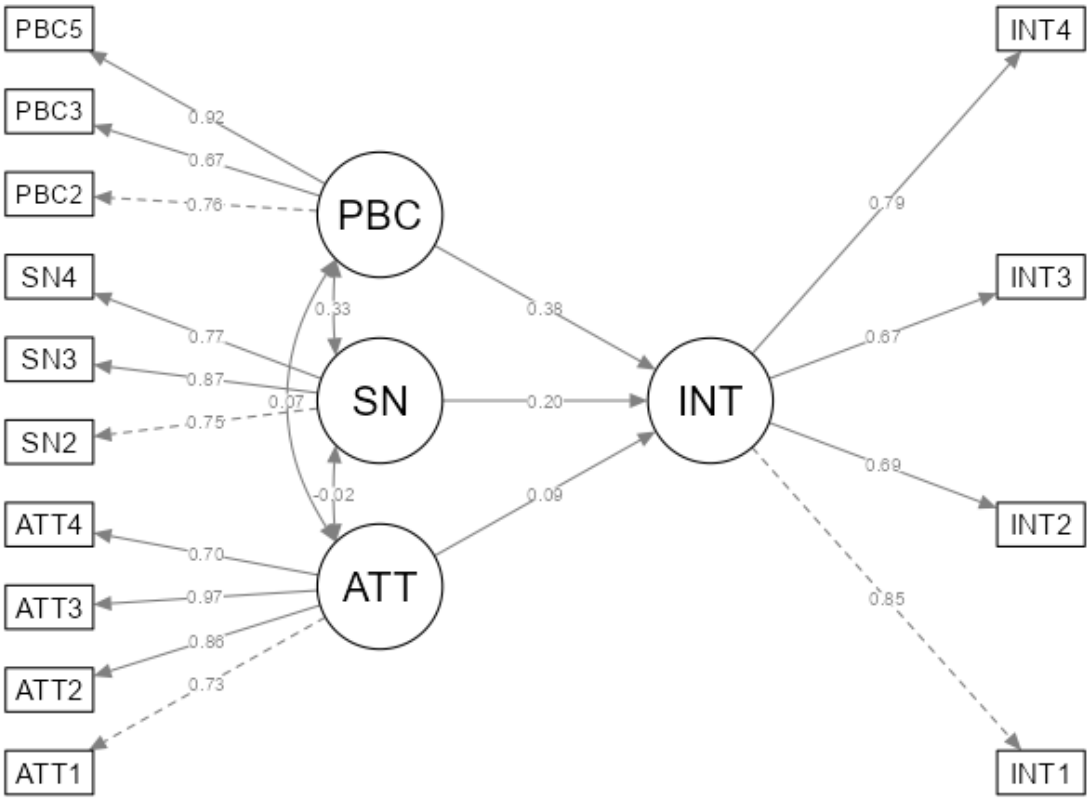

Figure 3. Diagram of measures and correlations of intention (INT), attitude (ATT), subjective norms (SN), and perceived behavioral control (PBC).

DISCUSSION

Characteristics of Farms and Cheese Producers

The social characteristics of the sampled cheese producers revealed homogeneity between men and women, with a notable prevalence of older individuals and farmers with extensive experience in milk and cheese production. If, on the one hand, maturity and experience suggest a greater ability to handle daily activities; on the other hand, these

qualities may pose challenges in adapting to current market and institutional requirements (SIQUEIRA et al., 2021). This is especially true for changes involving production methods and the adoption of new technologies that require learning (BÁNKUTI et al., 2018).

Regarding farm characteristics, we observed that the total farm area, production area, and production scale of the analyzed sample were low compared with that of other countries in South America (FAO, 2021; IBGE, 2018). Low productivity and production scale may indicate greater difficulty in selling milk to processing industries (BÁNKUTI; CALDAS, 2018a; SIMÕES et al., 2021). Added to this fact is the predominance of bucket milking and other manual methods, which may result in milk with low physicochemical and microbiological quality, as indicated in previous studies (DEFANTE et al., 2019; INGHAM; HU; ANÉ, 2011). The farm characteristics identified here suggest difficulties in meeting institutional demands regarding the physicochemical and microbiological quality of milk. Furthermore, farmers may find it difficult to achieve the large production scale required by the industrial market. These factors may encourage dairy farmers to seek alternative income through cheese production, even if unlicensed.

Regarding the organizational aspect of production, the participation of the study sample in collective arrangements is a good result. It suggests that some farmers have sought technical and market support to produce milk and cheese. Participation in farmers' collectives offers several advantages, such as increased bargaining power in market relations, either through reduced costs when purchasing inputs on a larger scale or by securing better prices per liter of milk with the industry (BEBER; LAKNER; SKEVAS, 2021; BRITO et al., 2015; MARTINELLI et al., 2022a).

Structural Model

Analysis of the structural model indicated that the PBC construct held the greatest importance in determining farmers' intention to regularize cheese production (Table 4). With this, H3 was accepted. However, the findings for PBC demonstrate that farmers believe they have sufficient capacity to regularize cheese production, particularly in relation to their autonomy (PBC5, β = 0.92), resources (PBC2, β = 0.76), and self-confidence (PBC3, β = 0.67) (Figure 2).

Although farmer's self-perception of their capacity to regularize cheese production is a positive result, some may lack information and knowledge about the bureaucratic procedures, costs associated with fees and hiring specialized professionals, modifications to physical facilities required for cheese production, and other pertinent factors, as discussed in previous studies (ANDRETTA et al., 2019a; KAMIMURA et al., 2019a). Furthermore, a perceived capacity to become licensed may not necessarily translate into a decision to pursue licensing. As supported by the TPB, an agent's decision is also influenced by ATT and SN constructs (ICEK AJZEN, 1991).

The SN construct had the second greatest weight in farmers' intention to regularize cheese production (Table 4). With this, H2 was accepted. The results indicated that the groups of individuals close to farmers supported the licensing of cheese production. Analysis of β values indicated that the groups that exerted the strongest influence on farmers to pursue licensing were other cheese producers (SN3, β = 0.87), other agents of the cheese production chain (SN4, β = 0.77), and close individuals (SN2, β = 0.75) (Figure 2).

The pressure exerted by these agents to regularize cheese production may be due to a series of factors, such as the perception of non-compliance with sanitary requirements that could result in unsafe products. Previous studies reported that, in Brazil, unlicensed dairy products that do not meet the sanitary requirements established by Brazilian

legislation are often affected by microbiological contamination (ALLAION; BARRIONUEVO; FRANCO, 2021a; ANDRETTA et al., 2019a). Kousta et al. (2010), in a comprehensive review of articles from various regions of the world, demonstrated the risks and public health problems related to the consumption of milk and cheese that do not adhere to sanitary standards set by regulatory bodies.

The pressure exerted by peers and close individuals may also stem from the perception of increased difficulty to expand unlicensed activity, being restricted to small sales channels, such as free markets, small retail markets, and direct sales to consumers. Furthermore, such farmers may be more vulnerable to unfair competition with licensed companies, as observed by Bánkuti et al., (2023). Analysis of the SN construct indicated that, although cheese producers feel pressure from other agents to pursue licensing, this pressure is insufficient to transform their intentions into a change in behavior toward regularization.

The ATT construct was not important for determining farmers' intention to regularize cheese production (Table 4). Thus, H1 was rejected. The non-interaction of ATT with farmers' intention indicates the absence of perceived incentives for the regularization of cheese production. This condition can be attributed to the costs of regularizing cheese production, hiring qualified professionals to assist in the agroindustry, adapting facilities for compliance with cheese production regulations, purchasing equipment, and paying government fees. Such costs may be burdensome for small-scale farmers (PINEDA et al., 2021). Even though farmers reported having the capacity to license cheese production (PBC construct), the results of the ATT construct indicate that they are not willing to invest their financial resources in this matter. Furthermore, farmers probably perceive a low risk of facing legal sanctions for producing unlicensed cheese. This fact may be due to the low effectiveness of inspection bodies in enforcing compliance with sanitary

standards for cheese production (Bánkuti et al., 2023a); furthermore, the perception may also stem from farmers' lack of information or awareness of the importance of compliance with sanitary regulation and the impact of non-conformities on product quality and safety, as reported in previous studies (BÁNKUTI et al., 2023; DE MEDEIROS CARVALHO et al., 2019b; KAMIMURA et al., 2019b).

In our study, the two constructs retained in the TPB model (PBC and SN) explained 24.9% (R^2 = 24.9) of farmers' intention to regularize cheese production. This result indicates that the model was able to predict by 25% the intention of farmers analyzed in this study to regularize cheese production. The analysis of coefficients of determination must be conducted considering the characteristics of the research, the complexity of the model, and sample size, among other peculiarities, as recommended by Hair et al. (2009). Therefore, in exploratory research, there is no clear indication of ideal values for the coefficient of determination.

Here, the coefficient of determination was deemed adequate. This can be attributed to two primary characteristics of this research. First, it involves the analysis of a topic sensitive to farmers—the intention to regularize cheese production. Some farmers may have experienced fear or hesitation in providing precise responses regarding their intention to regularize cheese production, given that licensing is mandated by Brazilian legislation and was not currently being met. The second aspect may be related to the heterogeneity of the sample, which comprised farmers from two states, namely Paraná and Minas Gerais. Thus, farmers may have different perceptions about the regularization of cheese production, increasing the variability of responses. These characteristics, added to the possibility of problems in formulating the questions or farmers' difficulties in interpreting the questions, represent some of the limitations of this research. Another limitation is the impossibility of extrapolating the results. Although the results provide a

good representation of the analyzed sample, they cannot be extrapolated. The limitations of this research are common to studies that use similar approaches, as mentioned by other authors (Indrawan et al., 2020; Simões et al., 2021; Tonet et al., 2023).

In view of the above, we suggest that actions of guidance, information, and training aimed at regularization be taken with farmers, their peers, and other agents of the production chain. Such actions can be carried out in collaboration with farmers' associations, cooperatives, and technical assistance institutions. Several studies demonstrated the importance of associations and cooperatives in improving production conditions and yield of farmers (BRITO et al., 2015; CHAGWIZA; MURADIAN; RUBEN, 2016; KUMAR et al., 2018). Furthermore, similar initiatives can be undertaken by the dairy industry and government agencies for technical assistance in agriculture. It is understood that these agents have a direct interest in reducing problems associated with unlicensed cheese production or concerns about public health. Regardless of whether the competent bodies supervise and sanction unlicensed farmers, we suggest developing awareness-raising initiatives among producers about the importance of regularizing their activities. Additionally, these actions should emphasize the benefits of regularization, such as gaining access to new markets and increasing opportunities for growth and profit.

CONCLUSIONS

The results indicated that the analyzed dairy farmers have the intention to regularize cheese production. Among TPB constructs, farmers' intention was mainly determined by PBC, followed by SN. These findings show that farmers perceive themselves as having the capacity to regularize cheese production and that people close to them exert positive pressure to pursue licensing. The ATT construct did not influence farmers' intention to regularize cheese production.

Acknowledgements

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1. FINAL CONSIDERATIONS

The research showed that producers intend to license cheese production and, studies like this one, are important due to the expressiveness of cheese production in Brazil. The use of TPB explained that part of the producers' intention was influenced by the construct - perceived behavioral control and by the construct - subjective norms. (H2 and H3 acepted). The construct, attitude was not important to explain the intention of producers to license the production of cheeses (H1 rejected).

The application of the theoretical model of TPB indicated that the intention of the producers seems to be influenced by the theme of the research, by the diversity of the sample and by factors not contemplated in the model. In this research, the heterogeneity of the sample, composed of producers from two Brazilian states, demonstrated different perceptions about the intention to license cheese production.

Despite following good production practices, many producers resist licensing cheeses due to financial and family issues and lack of awareness, trusting in the relationship with consumers. Awareness policies are needed to highlight the importance of registration for public health and product quality. Financial and technological incentives can support smallholders, while government oversight of food production should be encouraged to improve existing production and create in farmers the desire to produce cheese in accordance with health standards.

VI. APPENDIX

Decision Letter (JDS.2024-25672.R1)

From: hein0106@umn.edu

To: fibankuti@uem.br, ferencistvan@gmail.com, anaplefh@gmail.com, JCDAMASCENO@uem.br, gtsantos@uem.br

CC:

Subject: Journal of Dairy Science - Decision on Manuscript ID JDS.2024-25672.R1

Body: 27-Jan-2025

Dear Prof. Ferenc Bankuti:

Manuscript ID: JDS.2024-25672.R1
Title: Sociopsychological factors influencing Brazilian farmers' intention to regularize their cheese production

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Sincerely,

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Section Editor, Journal of Dairy Science

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