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Original

Agro-food Chain with a Local Development Approach: A Goat Milk Case in Jimaguayu

Osvaldo Nápoles Abreu *, Lourdes Crespo Zafra *, Rosa González Zambrano **, Néstor Loredo Carballo *, Luisa Matos Mosqueda *

*The Ignacio Agramonte University of Camaguey. Camagüey, Cuba.
**Higher Technical University of Manabi. Ecuador.
Correspondence: osvaldo.napoles@reduc.edu.cu

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ABSTRACT

Background: Internationally, the determining role of goat dairy production to cope with economic, social, and environmental challenges involves the world population, mainly in developing countries. In Cuba, the benefits from these productions are not being taken advantage of. **Aim.** To characterize the agro-food chain entailing goat milk in the municipality of Jimaguayu and its contribution to local development, based on the local potential. **Materials and methods:** This is a descriptive-explicative study. The study evidenced that goat milk has the potential to positively impact the social, economic, and environmental dimensions for local development in Jimaguayu, which demands a chain-based approach using a method adjusted to the Cuban context. **Results:** The world's dairy goats recorded in 2019 was 215 316 93 animals with a milk production equivalent to 19 910 379 tons a year. In Asia, covering 50.82% of the world stocks of dairy goats contributed to the greatest milk production (58.67%). **Conclusions:** They offer information to contribute to decision-making based on reasonable grounds. The organization of production with a local approach and optimization of the municipal strategic diagnostic was a base moment for municipal strategic planning.

Keywords: goat milk, agro-food chain, local nutritional development (*Source: AGROVOC*)

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INTRODUCTION

Goats (*Capra hircus*) have been part of the living means of rural populations for centuries, and demonstrated their value as an important resource for economic growth and social improvements in communities with few resources, particularly in developing countries.

In the face of market competitiveness, the goat milk market has evolved into specialization and present-day trends for goods manufacturing with high value added, using prebiotic substances and probiotic bacteria that benefit consumer health (Sepe and Argüello, 2019).

International recognition of goat production as an effective strategy to dynamize local economies has been supported by proposals to design policies and the promotion of and funding for development projects of goat agro-food chains, implemented by international bodies (FAO, 2021; Rota and Urbani, 2021).

Although goat raising has been part of Cuban rural life since colonial times, studies have revealed it has not taken a relevant position as a productive activity within the agricultural economic structure of the nation (La O *et al*., 2018). National research results agree on the conditions of goat production, referring to a system of rustic breeding, deficient breeding, nutrition, and health management, and little resources and investment (Matos *et al*., 2017; Gispert *et al*., 2019; Arencibia and Corrales, 2021). Velázquez (2019) noted that among the causes that limit the development of these productions in the country is the lack of a value chain approach to manage these productions.

The aim of this paper is to characterize the agro-food chain entailing goat milk in the municipality of Jimaguayu and its contribution to local development, based on the local potential.

MATERIALS AND METHODS

This descriptive-explanatory research was based on a case study emphasizing the agro-food chain comprising goat milk in the municipality of Jimaguayu, Camaguey province. A combination of empirical and theoretical research methods was used, such as analysis-synthesis, induction-deduction, participatory observation, and survey, to make inferences based on the information gathered, and to better understand the phenomenon studied. This study comprised four stages, as follows:

Stage 1. Analysis of the agro-food chain involving goat milk in the international context

It aimed to access information about the international experience in goat-raising systems to design strategies for the chain in the municipality of Jimaguayu, in keeping with current trends and future scenarios. A bibliographic search was conducted through databases Scopus, Science

Direct, and Scielo, to compile relevant scientific papers in English and Spanish. Keywords like goat milk, goat production system, goat dairy products, and local development, were included.

Stage 2. Analysis of agro-food chain environment involving goat milk in Jimaguayu

In this stage, a map of the agro-food chain involving goat milk in Jimaguayu, was laid out to have a structural representation of links, actors, and relationships.

The shortcomings of each link of the chain were identified through participatory observation and direct measurements, and based on interviews of key participants and documentary reviews. Outstanding goat farmers in Jimaguayu, scholars, and major political and government authorities of the province took part (Halles and Durán, 2019). The resulting information was triangulated through field visits (participatory observation), and interviews of executives, specialists, and goat farmers directly involved in production.

Stage 3. Analysis of the goat dairy market in Jimaguayu

It consisted of an exploratory study aimed at purchasing dairy products from goats, based on consumer perceptions to guide the development of the goat milk agro-food chain following the wishes and specific needs of the market in Jimaguayu.

Data were collected from a survey, according to recommendations from previous studies that demonstrated their effectiveness (Chacón-Villalobos *et al*., 2008; Kamarubahrin, 2019). It included closed questions about age, gender, goat milk, and by-product consumption. Besides, it featured open questions about the causes of the lack of consumption, access, knowledge, and intentions to consume goat milk.

The population was from the Community of Jimaguayu, comprising 2542 inhabitants. A randomized simple probabilistic sample design was used. The sample size was calculated for a 99% confidence level and 10% error margin. A total of 296 subjects were surveyed.

The data were statistically processed using Statgraphics Centurion XVIII. The Pearson Correlation Coefficient (r) was calculated to determine the intensity of relationships among the variables studied, considering that these variables were numerical and followed a normal distribution. The statistical difference among the means of variable knowledge about goat milk, through a T-student test. Probability values $p<0.05$ were defined as statistically significant, for 95% confidence.

Stage 4. Analysis of link goat milk production-local development

This stage identified the potential of goat milk production in Jimaguayu, based on internal and external elements that may favor its development. This analysis included the integration of local

development components: social, cultural, environmental, and political, as established by the Decree for Strategic Management of Local Development in Cuba (Decree No.33, 2021).

RESULTS AND DISCUSSION

Analysis of the agro-food chain involving goat milk in the international context

The world's dairy goats recorded in 2019 was 215 316 93 animals with a milk production equivalent to 19 910 379 tons a year. Asia, covering 50.82% of the world stocks of dairy goats, contributed with the greatest milk production (58.67%).

Agroecological goat raising is advantageous in that milk derivatives are labeled as organic, which is increasingly attractive to consumers concerned about the impact of high volumes of fertilizers, synthetic pesticides, antibiotics, and hormones, as well as farm animal well-being, and the effect of agriculture on climate change and the environment (Sepe and Argüello, 2019).

Analysis of domestic goat milk production

In Cuba, the Company for Minor Livestock (EGAME), from the Ministry of Agriculture (MINAG), is the organization in charge of fostering production and marketing of sheep, goats, and rabbits.

As part of the guidelines of the Cuban State in the ruling documents of the country's policies, such as the Bases for the National Plan of Economic and Social Development to 2030, and Guidelines (123, 128, 130, 131) of the economic and social politics of the Party and the Revolution for the 2021-2026 period, which favors a high priority to food production under the principle of productive chains (PCC, 2021).

Hence, the application of the agro-food chain approach as an analytical and managing tool for goat milk production according to the particular conditions of the Cuban context is highly significant. The authors of this paper coincide with Antúnez and Ferrer (2021), in that the agro-food chain approach in Cuba may be supported by a systemic approach, a prospective vision, planning, and market, along with a social and political approach as pillars of social relations among different actors (p. 45).

Nationally, goat milk production increased in the last decade (2010-2019) recorded, with the highest value (5300 t) in 2019 (FAOSTAT, 2021). The province of Camaguey, known for its livestock traditions, showed the highest figures for goat milk in the 2012-2017 period (Mustelier-Casola *et al*., 2021). The municipality of Jimaguayu produces the highest amounts of milk nationally, with a special mention of goat milk (Halles and Durán, 2019). The municipality boasts a relevant farming potential for the advancement of this economic sector, according to the results of the diagnostic conducted for the Environmental Ordering Model. However, several

restrictions hampering the development of the livestock sector were identified, such as natural risks: floods, severe droughts, slopes greater than 20 degrees, and rural fires. Besides, 42% of the municipal land is idle, mostly infested by sickle bush (Acosta *et al*., 2017). In Jimaguayu, goat raising is mainly in the hands of the private sector. In 2019, the municipality totaled 7048 animals, roughly 94.42% from private owners. Their production systems are the family type, more oriented to meat and milk production. In the local goat milk agro-food chain several actors offer their services, either in transforming or selling goods, logistics, financing, training, or technical assistance, as well as the regulation of certain processes (Figure 1). This chain operates among different municipalities, considering the industrial transformation activities performed in the municipality of Camaguey.

The cross-analysis of information resulting from the previously mentioned application of capture tools helped unravel the main breaches limiting the performance of these productions (Table 1). Interactive dialogue was the main source of information for this study, contributing a large amount of data, and a more serious analysis of the situation of the chain.

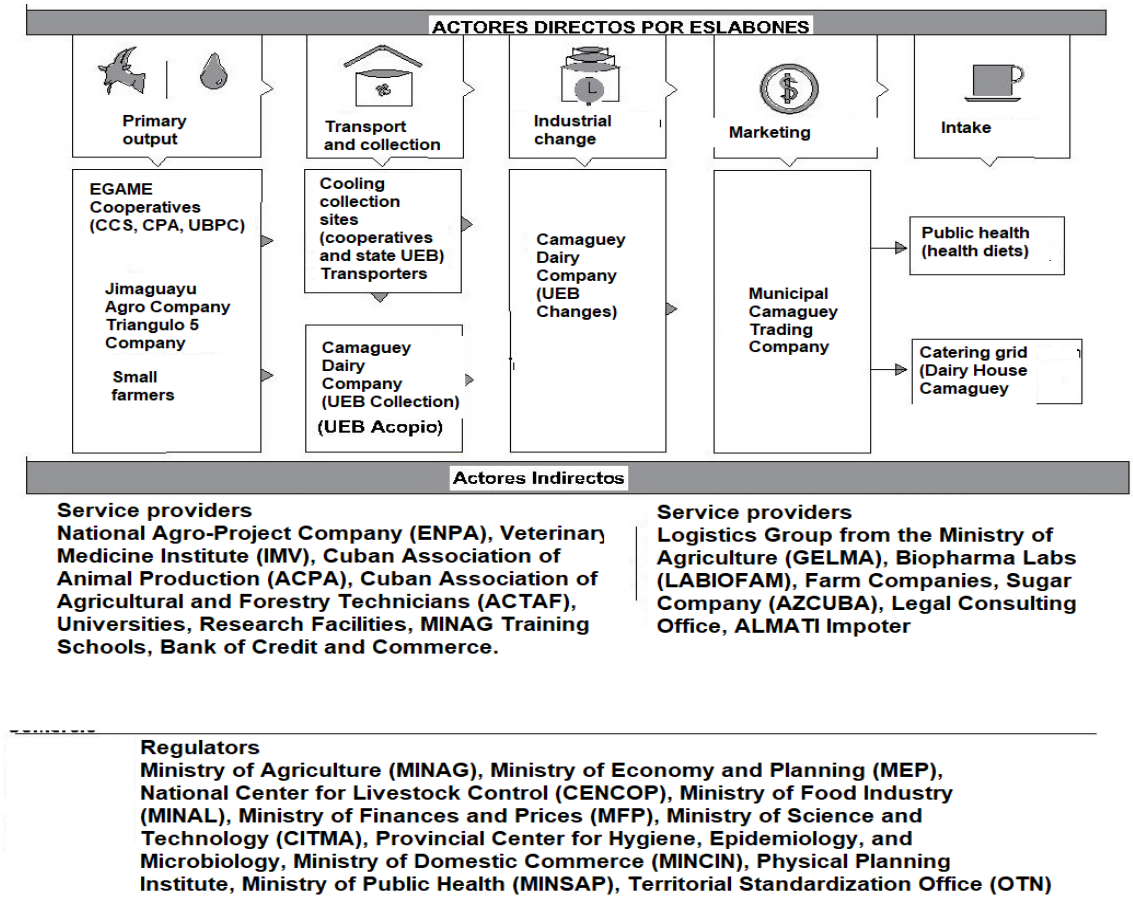

Figure 1: Map of goat milk agro-food chain in Jimaguayu
Source: Made by the authors, 2021

Table 1. Main flaws and related causes of goat agro-food chain in Jimaguayu

Links	Main breaches	Main causes
Primary production	Low feed availability for herds	-Little use of high nutritional grass and forages -Difficulty in acquiring materials and nutritional complements -Lack of tools and supplies for grass enclosures. -Poor use of the existing potential of by-products and stalks (sugar, citrus wastes, and crops)
	Inappropriate herd structure	No control of animal reproductive behavior, nonexistent records -Lack of special attention to pregnant goats
	Low milk production yields per goat	-Absence of a breeding strategy in the herd -No application of artificial insemination
	Poor milk quality	-Inadequate conditions of milking facilities, absence of necessary infrastructure (platforms, mechanical milking) -Lack of tools, means, and supplies for proper hygiene -Lack of compliance with the procedures ruling milking
Transport and collection	Loss of milk quality caused by deficiencies in transport and collection	-Lack of transport means and containers for private transport, which does not ensure cleaning and disinfection of the means used. -Goat milk is contaminated with other milks in the refrigerated collection sites -Deteriorated transport routes.
Industrial transformation	Poor use of added value	-Lack of infrastructure for industrial processing in the municipality -No new projects have been encouraged for the creation of new rustic local start-offs to produce goat milk derivatives. -The current industrial capacity for processing cow's milk limits the chances of diversification for smaller volumes of goat milk. -The dairy products made are not based on market studies
Marketing	The goat milk requirements and its derivatives remain unmet	-Poor availability of goat dairies -The cooling system is harmed in sales facilities, limiting conservation. -The goat milk supply does not respond to the wishes and needs of consumers -The lack of quality certification and product traceability hinders sales to the tourist sector

The conditions of the agro-food chain of goat milk evidence the need for comprehensive and coordinated actions by the actors. The identification of flaws in each link of the chain is an indispensable kick-off for the mobilization of local production potential, and the detection of income sources through local strategies for addressing issues.

Analysis of the goat dairy market in Jimaguayu

A study targeting purchase intention for goat milk and derivatives in Jimaguayu used a sample of 139 women (46.96%), and 157 men (53.04%). Of them, 59.45% noted that they had consumed goat milk at least once in their lives. However, 10.47 % (31 subjects) were consuming it when this paper was done (regular consumers). These results show that most subjects (89.53%) did not drink goat milk often. Out of the regular consumers, the majority (83.87%) drank it once or twice a week, maximum, while only 5 subjects (16.13 %) consumed it three or more times a week.

The study found that age had a strong significant correlation with regular goat milk consumption r = 0.8427). Considering that the correlation was positive, it was inferred that the highest intake was associated with the elderly. In that sense, most regular consumers (88.8%) belong to adult groups (32.25%) and the elderly (56.55%). Similar results were reported by Chacón-Villalobos *et al*. (2008) in Costa Rican adults and elders.

The subjects who did not drink the goat milk (265), noted that the reasons for it were unavailability (43.40%), lack of interest or apathy for consumption (32.45 %), dislike of sensorial features (11.70%), distrust over hygiene (10.19%), and lactose intolerance (2.26%). These results coincide with other research studies reporting that the little availability of goat milk was the main barrier to its consumption (Chacón -Villalobos *et al*., 2008).

A remarkable outcome shows the benefits of goat milk to consumers, a fact unknown by most subjects (74%). The main perceptions of goat milk among the surveyed subjects who knew its benefits were as follows: a higher alternative to cow's milk for lactose intolerant people (55%), nutritional values for lactating children (22%), medicinal properties for patients suffering from gastric disorders, ulcers, and colitis (17%), anti-allergenic properties compared to cow's milk (6%).

Figure 2 shows the results observed in terms of desired weekly consumption frequency for goat dairies by age groups, in Jimaguayu.

Remarkably, 56.08% of the subjects noted their intention to consume, at least one derivative from goat once a week has a 5.35-fold increase approximately, the number of people who used to drink goat milk, compared to the current consumers.

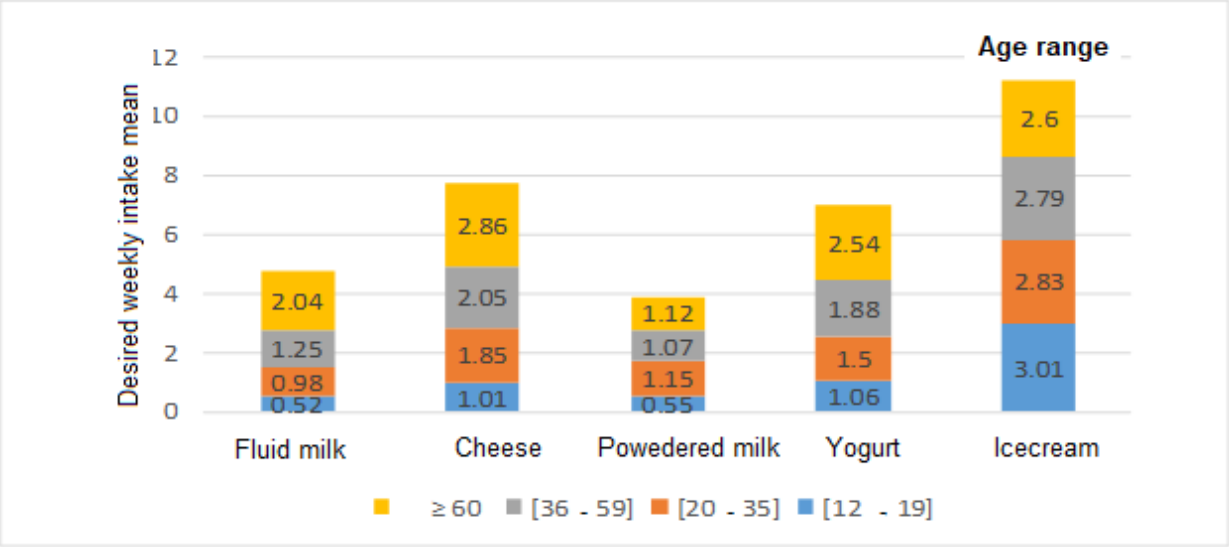

Figure 2. Consumption intention for dairy goat products in Jimaguayu

The findings show that goat milk ice cream was the most widely desired by the population in the study, followed by cheese and yogurt. As part of the national projection for goat milk derivatives (MINAG, 2021), ice-cream was not included, thus evidencing the need for projects whose design respond to the specifications of the local demands.

3.4 Analysis of link goat milk production-local development

The analysis of managing models of goat productions internationally showed common features to the local traditional and contemporary development models, according to Torres *et al*. (2020), such as,

1. An economy-like approach prevails, which is intended to connect the local community to the financial capital circuits, and the international production chains.
2. They are mainly based on small and mid-sized enterprises, restricting the role of governments to that of a simple agent of private initiatives.
3. It stresses the simple-like approach of a public administration oriented to short-term management of goods and public services, instead of one strategic management for development over participatory bases and a sustainability approach.

Consequently, there is a need to manage this agro-food chain with a context-based approach in the country, rather than the implementation of models whose theoretical and instrumental conception were conceived to meet the interests of the bourgeoisie and the reproduction of capital, which differ from the ideological principles of Cuba, a nation engaged in the construction of a socialist society.

The SAN Plan not only refers to food production but also to integrated local food systems to local development areas in Cuban municipalities. There are several definitions of local development, but in this context, the one stated in the Policy for the Advancement of Local Development, was assumed, as,

"An essentially endogenous, participatory, innovating, process that articulates the interests of actors, territories, and scales (municipal, provincial, and sectoral/national). It rests on municipal and provincial government leadership for managing development strategies, from knowledge management and innovation, fostering new projects that generate economic, productive, and sociocultural, environmental, and institutional changes to increase life quality" (MEP, 2020, p. 3).

It poses a challenge to municipal governments in terms of effective actors and managers of development leading to municipal autonomy. It requires capacities like providing the best use for rational and creative development potential; strengthening institutions; creating jobs; guiding the

people in the construction of the desire municipality; linking events and different forms of production and services from the state and private sectors, among others.

Considering the above, the authors deem it necessary to stress the particularities that distinguish goat productions, which are coherent with the Cuban policies that favor local development, based on the specific potentials of municipalities.

Having that change of paradigm associated with the demand for foods, production must focus on goat dairies with added value. As to goat dairies, the value must be added not only to create processed foods but also to provide features that make such products suitable for the demands of several market sectors. For instance, affordability, accessibility, sensorial features, nutritional value, safety, diversity, and others.

The creation of goat dairy companies in Jimaguayu will reduce costs of transport and transaction, being located in nearby areas. The type of industrial scheme adopted will be important to develop these productions.

The challenge posed by climate change must be addressed, along with the growing food demands. The raising of dairy goats is a sustainable perspective to be considered. In light of changes in water availability, temperature, and plant biodiversity, goats are the group of animals with the greatest adaptation advantage. These animals give off less methane than other domestic ruminants (Miller and Lu, 2019). Residue management is a defying problem to the protection of the environment.

Continuous herd and related growth in industrial and developing countries evidence that this animals are a viable productive alternative to meet the demographic needs worldwide. According to several authors (Bidot-Fernández, 2017; Sonu and Basavaprabhu, 2020), goat milk is a potential food to improve the life quality of the elderly through healthy nutrition in light of policies adopted to face the accelerated aging of the Cuban population.

If, in addition to it, this milk is assumed as an alternative to children with cow milk allergies, and goat dairies, goat milk is healthy food, and sensitive to nutrition. These are necessary elements to reach a sustainable model of production as a component of food and nutritional safety, as stated by the SAN Plan.

Miller and Lu (2019) found that dairy goats could become a major tool to meet the 2030 Agenda for Sustainable Development, adopted by the UN, in 2016. In that sense, Rota and Urbani (2021) have shown the positive impact of minor livestock animals, including goats, in 12 of the 17 Goals for Sustainable Development (GSD) approved. Therefore, showing the contribution of dairy goat production to the harmonization of municipal interests with the international obligations embraced by Cuba, particularly those of the GSD.

CONCLUSION

The study evidenced that goat milk has a potential to have a positive impact on the social, economic, environmental, and political dimensions for local development in Jimaguayu, which demands an agro-food chain-based approach using a method adjusted to the Cuban context.

The shortcomings found in the goat milk agro-food chain could be overcome through its articulation with the municipal and provincial development strategy led by the local government, based on science and innovation, so that it encourages coordinated actions by its actors, with proper use of local resources and capacities.

The goat milk perception study in Jimaguayu showed the existence of a demand for goat dairy products, for which the goat agro-food chain should strengthen capacities that respond swiftly and effectively to the specific demands of consumers.

These results offer information that contribute to decision-making based on proper grounds. The organization of production with a local approach and optimization of the municipal strategic diagnostic as a base moment for municipal strategic planning.

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CONTRIBUCIÓN DE LOS AUTORES

Concepción y diseño de la investigación: ONA, LCZ, RGZ, NLC, LMM; análisis e interpretación de los datos: ONA, LCZ, RGZ, NLC, LMM; redacción del artículo: ONA, LCZ, RGZ, NLC, LMM.

CONFLICT OF INTEREST STATEMENT

The authors state there are no conflicts of interest whatsoever.