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Is a geographical certification a promising production and commercialization strategy for smallholder sheep farming in Ceará, Brazil?

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Abstract

Producing a local sheep meat product under a geographical certification label may enhance market competitiveness of smallholder farmers. This study focused on sheep farms in Ceará (Northeast Brazil); we explored their potential for adopting such a strategy, described the production chain of the salted, dried sheep meat product, and evaluated its potential certification. The study built on an existing unpublished dataset about the socio-economic conditions, production techniques, and commercialization characteristics of 129 sheep producers in the Tauá municipality. Multiple correspondence analysis followed by a nonhierarchical cluster analysis resulted in five farm clusters. In-depth interviews about socio-economic and production characteristics were conducted with a subsample of 23 farmers. The production chain was evaluated by applying methodological and data triangulation. The dried mutton product showed potential for geographical certification. However, essential preconditions for establishing a successful and sustainable geographic certification system were currently lacking.

Keywords

Brazil, farming systems, food value chain, geographical indication (GI), sheep

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Introduction

The farming systems in Brazil's Northeast region are diversified, favoring flexible responses to unpredictable and semi-arid conditions. Farm management of and decision-making for agricultural activities are based on the availability of resources (Holanda Júnior, 2004). The primary objective of smallholder farms in rearing small ruminants is to meet short-term socio-economic needs, thereby ensuring sustenance of the family (Guimarães Filho, Souares, & Araújo, 2000). As reported in other parts of the world (Ayalew, King, Bruns, & Rischkowsky, 2003), small-scale farmers rarely rear livestock solely for market.

The majority of the farmers in the study region regularly sell live animals to retailers. However, neither production nor processing standards for sheep and sheep meat exist in Brazil, and the commercial channels for sheep meat are generally short and focused on local markets (Holanda Júnior, 2006). Problems identified with commercialization include the costs of animal collection, missing product and sanitary standards (Guimarães Filho, Borges, & Nogueira, 2006); the low price of imported sheep meat; and the heterogeneous, nonstandardized butchering of sheep carcasses (Maia, 2007).

In the early 2000s, the Brazilian Ministry for Agriculture, Animal Husbandry and Supply (MAPA) identified a dried and salted sheep meat product, locally produced in the semi-arid area of Ceará, as showing high potential to receive a geographical certification. The proposed certification label for the product, called "Manta de Carneiro de Tauá" (Manta), was considered as a strategy to improve the livelihoods of smallholder sheep farmers.

According to article 22 of the TRIPS agreement (Agreement on Trade Related Aspects of Intellectual Property Rights; World Trade Organization [WTO], 1994), geographical indications (GIs) are "indications which identify a good as originating in the territory of a Member, or a region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographical origin." The value attached to a typical product can be seen as a competitive advantage over similar products produced outside the certified geographical area (Muchnik, Biénabe, & Cerdan, 2005), and a label signifies both qualitative and spatial product differentiation. Economic, financial, and administrative consequences of implementation differ among countries (Addor & Grazioli, 2002), as each is allowed to determine country-specific rules and regulations.

The introduction of GIs may bring benefits through improved market access and protection against prices of competing products (Porto, 2007; Scintu & Piredda, 2007). While GIs can strengthen community development (Pérez Centeno et al., 2007; Sautier, 2006), and support the valorization of traditional knowledge and the conservation of natural resources (Sylvander et al., 2006), they may affect biodiversity positively or negatively (Thévenod-Mottet, 2010). Indirect benefits also can be reaped; for instance, in Europe only the formalized GI labels are exempted from the prohibition of promoting products with state aid (Becker & Staus, 2008).

Developing countries, however, face major challenges concerning the introduction of a GI due to generally weak institutional environments (Larson, 2007). They may struggle to develop specific legal systems for the protection of GIs, and seldom have the means to control and sustain them (Belletti & Marescotti, 2006). As a result, the economic benefit and power allocation within the production chain can be unequally distributed, and the production for market niches may exclude producers as well as consumers (Larson, 2007). Further exclusion effects may occur due to required compliance with international rules, such as food safety or sanitary product requirements (Belletti & Marescotti, 2006), which exclude countries that do not possess the required structure and knowledge. For example, there were 706 origin-labeled products registered in European countries in 2007, with around 900 projected for 2010 (Becker & Staus, 2008). In contrast, there were only six GIs in Brazil in 2010, two of which were animal-source products: beef and leather produced in southern Brazil. A third

GI for a honey from the Northeast region was under development in 2010 (Diário do Nordeste, 2010).

We hypothesized that a certification concept can improve the livelihood of farmers under particular internal and external frame conditions. Thus this study aimed at determining the conditions and factors under which GI certification of a traditional, processed meat product is economically promising and advantageous, or disadvantageous, for farmers in the study region.

Material and Methods

Study Area and Regional Environment of the Proposed GI Product

The municipality of Tauá (latitude 6°00' S, longitude 40°18' W) is located in the microregion of Sertão do Inhamuns in the state of Ceará in the Brazilian northeast. The municipality is subdivided into eight districts and occupies an area of 4,018 km² (1,551 mi²). In 2006, Tauá had 54,273 inhabitants (IPECE, 2007), with a population density of 13 inhabitants per km² (34 inhabitants per mile²) (IPECE, 2008). The distance between the town of Tauá and the state capital, Fortaleza, is 337 km (209 miles) (Tauá, 2008).

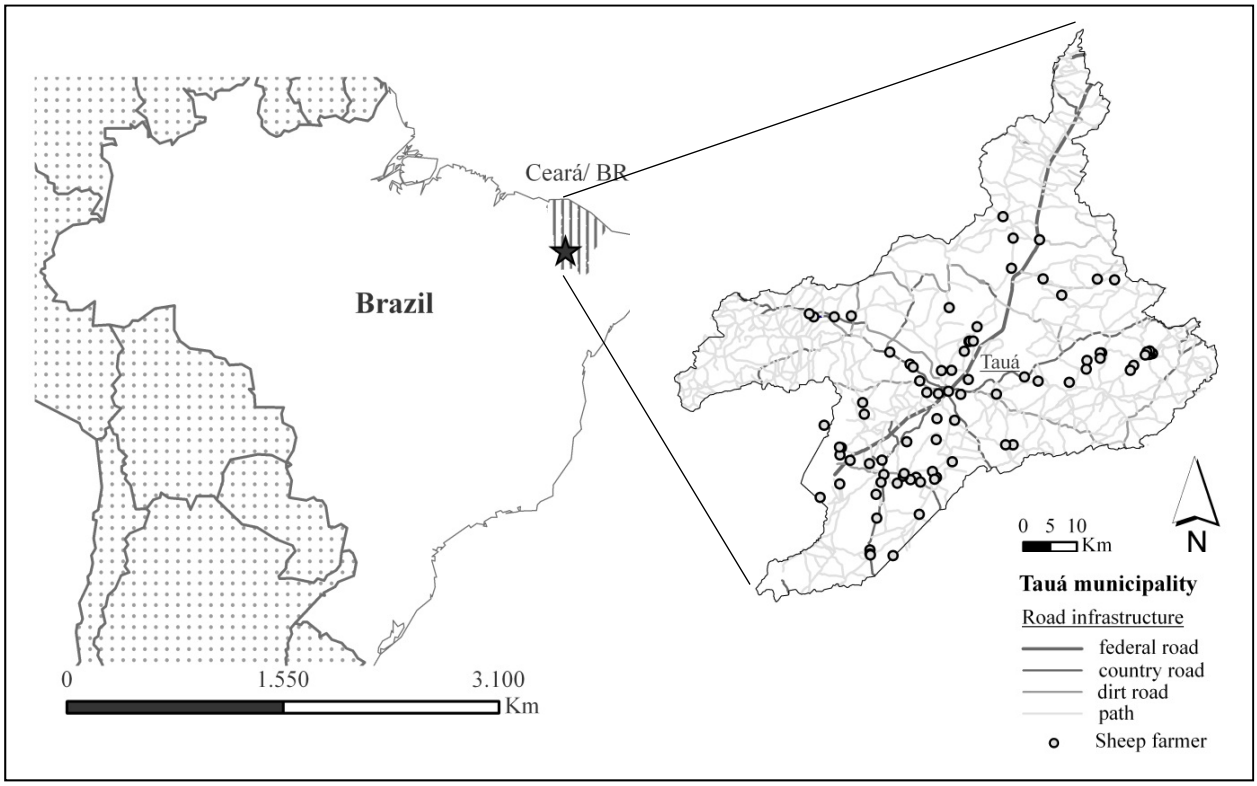
The climate is semi-arid, and can be described as a dry savannah zone (Gerstengarbe et al., 2000). Average annual rainfall is 600 mm, ranging between 155 to 1474 mm (6.1 to 58.0 inches); the average temperature the year round is 26°C (78.8°F); the altitude ranges between 400 and 800 m (1,312 to 2,625 feet) (Herfort et al., 2003). The rainy season lasts from February until the end of May, and the annual estimated evaporation rate is about 2000 mm (79 inches) (Frischkorn, Araújo, & Santiago, 2003). The Caatinga biome is divided into the arboreal, shrubby, and open Caatinga range vegetation. The typical vegetation protects and conserves soil and water resources and is characterized by a high heterogeneity, decreasing the vulnerability of the system (Maia, 2004). The available dry matter biomass varies seasonally between 1.2 and 2.3 Mg/ha (0.5 and 1.0 ton/acre); sheep browse on 62% of the tree and shrub species (Araújo Filho, Leite, & Silva, 1995). The combined effects of probable changes in land use and climate may alter groundwater recharge and lead to higher biomass variability in the future (Montenegro & Ragab, 2010).

Studies from 2008 indicate that 56% of Brazil's ovine flock was reared in the Northeast region, 22% percent was reared in the state of Ceará, and 7% were reared in the Tauá municipality (Instituto Brasileiro de Geografia e Estatística [IBGE], 2009). In 2006, the average flock size in Ceará was 27 head per household and 53 head per household in Tauá (IBGE, 2007). The sheep are mainly the hair type; they are reared primarily for mutton, and secondarily for sheepskin products. In Ceará, 90% of the farms are considered family farms (IBGE, 2007). Family farms are defined as having up to four fiscal modules of land (one module in Tauá is 90 ha or 222 acres) run by the family using mainly family labor and deriving income mainly from farm activities (Presidência da República, 2006).

Application of Existing Data Sources

This study was based on data of an unpublished 2006 project on integrated sheep production. One hundred twenty-nine Tauá sheep farmers (figure 1) were interviewed by the Embrapa Caprinos e Ovinos (Embrapa), the Sheep and Goats division of the Brazilian National Corporation for Research on Plant and Livestock Husbandry, in cooperation with local organizations. The farmers were randomly sampled from three groups of farmers that had already participated in different governmental programs. These included a breeding program, the National Project for the Fortification of Family Agriculture (PRONAF) project, and the APRISCO project, which promoted "integrated and sustainable sheep and goat husbandry." A fourth group consisted of randomly sampled farmers who had not received technical assistance or credit. Standardized questionnaires containing open- and closed-ended questions were pre-tested, adapted, and applied to collect data on socio-economic conditions, production techniques, and commercialization.

Figure 1. Study Area and Locations of Sampled Sheep Farmers



Based on 102 complete data sets of farmer interviews, multivariate data analysis was employed (using SAS, versions 8 and 9) to detect farming system structures. A multiple correspondence analysis (MCA) was used to establish all possible correlations between the observations (farmers) and the variables. Sixteen variables were selected to characterize each farm regarding land, labor, animal stocks and infrastructure, the fate of the sheep, volume of crop production, and off-farm income generation (table 1). Results then were entered in an agglomerative hierarchical cluster analysis applying Ward's minimum-variance linking method, forming five clusters. The proportion of variance accounted for by the clusters (squared multiple correlations) was 88%. Subsequently, the dataset was subjected to k-means clustering. The k-means method is a nonhierarchical clustering method identifying cluster nuclei predicted on least squares estimation. Since the variables were not normally distributed, significant differences between the clusters were tested using the chi-square test for the qualitative variables and the Kruskal-Wallis test for the quantitative variables.

Data Collection in 2008: Farmers and Other Key Persons in the Value Chain

Twenty-five percent of the farmers in each cluster were randomly sampled, and 23 farmers finally participated in in-depth interviews conducted in May and June 2008. The semistructured questionnaire addressed family size, labor force participation, living standard, crop and forage production, sheep production, and the classification of income sources. The geographic coordinates of the farms recorded in 2006 were measured using a GPS device (Garmin GPS 12). The distance from Tauá town to individual farms ranged between 4 and 46 kilometers (2.5 and 28.6 miles).

We conducted interviews with six key people, including a federal inspection service (SIF) staff member, two veterinarians from the Embrapa, and one staff member of the local health inspection

Table 1. Variables Used in the Multiple Correspondence Analysis

Section	Variable (units or levels)
1. Land and labor rights	Total land area of farm (ha)
	Legal condition of farmer (owner, leaseholder, tenant, homestead)
	Number of employees (headcount)
2. Farm infrastructure	Quantity of motor pumps (number)
	Quantity of telephones (number)
	Quantity of reservoirs (number)
	Quantity of wells (number)
	Quantity of forage silos (number)
3. Animal stocks and crop production	Sheep flock size (annualized number of adult head)
	Goat flock size (annualized number of adult head)
	Cattle herd size (annualized number of adult head)
	Crop production (kg/year)
4. Fate of sheep	Destination of sheep sales (no sales, middlemen, retailer, trader, consumer)
	Sheep consumed in the household (head/year)
5. Off-farm income	Total family revenue without revenue of product sales (R$/year)
	Revenue through retirement (R$/year)

agency. They were interviewed about national regulations and their enforcement, the existence of production standards, the regional sheep meat value chain, and sanitary control of local slaughterhouses and butcheries. The questionnaires used with the different key persons contained similar open-ended questions that also were complemented by additional questions related to the person's specific area of expertise. We interviewed a local and reputable historian in order to investigate the tradition and reputation related to the product. For cross-checking purposes on historical information, we also consulted the local Tauá library and the Embrapa library at Sobral. We conducted a further interview with the president of a cooperative founded in 2008 to support the production and commercialization of Tauá sheep and goat products (COOMANTA), which focused on the aims, objectives, and structure of the cooperative. Finally, we sampled processors, retailers and butchery owners according to their frequencies of nomination by the 23 farmers. In these semistructured interviews we explored the purchase and sale of sheep and carcasses, slaughtering and processing procedures, and demand and supply for sheep and carcasses.

The majority of those interviewed in 2008 (23 farmers, six key persons, six retailers, seven retailer-processors, four processors, and four butchery owners) were identified in pre-studies conducted by the Embrapa. We employed methodological and data triangulation (Denzin, 1970) to validate data concerning the actors in the production and marketing chain, and to address their functions and the linkages between them. Questions on sale and purchase prices and demand patterns (increasing or decreasing) were included in all interviews. Two sheep markets in Tauá and Fortaleza and the local slaughterhouse were visited to enhance and validate interview-derived information.

We compared geographical certification requirements according to the Brazilian National Institute of Industrial Property (INPI) to the current status of GI development in Tauá. The structural and motivational preconditions and the quality of cooperation necessary for successful implementation of a GI-product (Belletti & Marescotti, 2006; Larson, 2007; Marescotti, Belletti, Tregear, & Arfini, 2008) were contrasted with the existing situation in Tauá (based on this study's results).

Results

The Product — "Manta de Carneiro de Tauá"— and its Processors

Fifty years ago the "Manta de Carneiro de Tauá" had not yet been commercialized. It remains unclear when it emerged for the first time, though it was probably developed by travelers searching for an effective meat conservation method for long journeys through the dry hinterland of Northeast Brazil. The term "manta" relates to the shape and size of the product, which brings to mind a blanket. "Carneiro" refers to wethers and rams, the sheep categories preferred for the product.

Interviews indicated that animals selected to produce Manta should exhibit visual healthiness, be vaccinated and dewormed, and show good body condition. The selected sheep were generally males with an average age of 18 months (range: 5 to 48 months); castrated animals were preferred, although female adult sheep and lambs were also used. The sheep's breed was not a consideration for Manta producers. Six of eight processors and retailers stated friendship and confidence with the farmer as reasons for buying from him or her. The others considered the locality where the animal was raised and the purchase price. At the time of data collection, laboratory analyses highlighting particularities of the Manta were nonexistent.

The processing was generally done in the processors' backyards. First the animal was stunned using any means at hand, hung up by the hind legs, and then the carotid and jugular veins were severed to ensure complete bleeding. The animal was skinned, eviscerated, and the feet and head were removed. Then the pelvis bones were removed and the heads of the ribs were dissected from the vertebral column before the same was removed (lumbar vertebrae then the thoracic vertebrae, and finally the cervical vertebrae with the axis and the atlas), making the carcass relatively flat. The opened carcass was laid down on a wooden table in dorsal-ventral position and, using a meat chopper, the ribs were slashed three times laterally, followed by linear cuts in the breast musculature without slicing completely through the meat. The carcass then was turned around into ventral-dorsal position, and the femurs were exposed and separated from the tibiae by making cuts through all the muscles of the pelvic limb. Following this, linear cuts were made in the lumbar and abdominal muscles. To begin the curing, the processor dispersed fine salt over the carcass. The carcass was folded together and left to rest for 20 to 30 minutes before it was hung up for drying (figure 2). Three out of seven processors left it for an average of 2.25 hours in the sun and afterwards for an average of 5.4 hours in the shade. Others dried it in the shade only. On average, a 35 kg (77 lb.) live sheep yielded 11 kg (24 lb.) dried Manta. The Manta was sold directly or stored in the freezer as a whole or in parts.

All of the interviewed Manta processors were male; ages ranged between 28 and 75 years old and processing experience between 2 to 55 years. They further differed in the time needed for processing one carcass (20 to 40 minutes) and the commercial

Figure 2. Drying Manta

scale of production. For the majority of the interviewed processors, Manta processing represented a secondary economic activity and was described as a sound source of income.

Social and Economic Indicators of Farming Families and Their Farms

In the 2006 survey, the 129 farmers ranged from 21 to 89 years old (average 50 years). Most farmers were landowners; otherwise, contracted families, *moradores,* share-cropped the farm. In general, the *moradores* earned every fifth animal and were allowed to use a plot for their own cropping. A few were *assentados,* beneficiaries of a governmental settling program. As far as educational attainment, only 4% of the interviewed household heads were illiterate, 14% did not complete the first degree (9 years), 39% did complete it, 6% completed the second degree (12 years), and 8% had higher education. More than 90% of the households had radios, gas stoves, and televisions. Eighty-six percent owned at least one refrigerator, and 52% had at least one cell phone or landline phone. The average total labor force per farm was 5.4 persons (n=97), including 3.3 family members and 2.1 wage laborers.

Complementary information on the farm households, collected in 2008 on a sub-sample, revealed that 22 of 23 households used public electricity, employed a cesspit as a sanitary system, and had concrete flooring. Gas and collected firewood were used by 72% of the families as fuel, 6% cooked with purchased firewood and gas, and 22% used only collected firewood. The majority of the farms (83%) used their own cisterns as sources of drinking water; the others fetched water from canals and wells. None of the interviewed farming families said that they suffered from food insecurity.

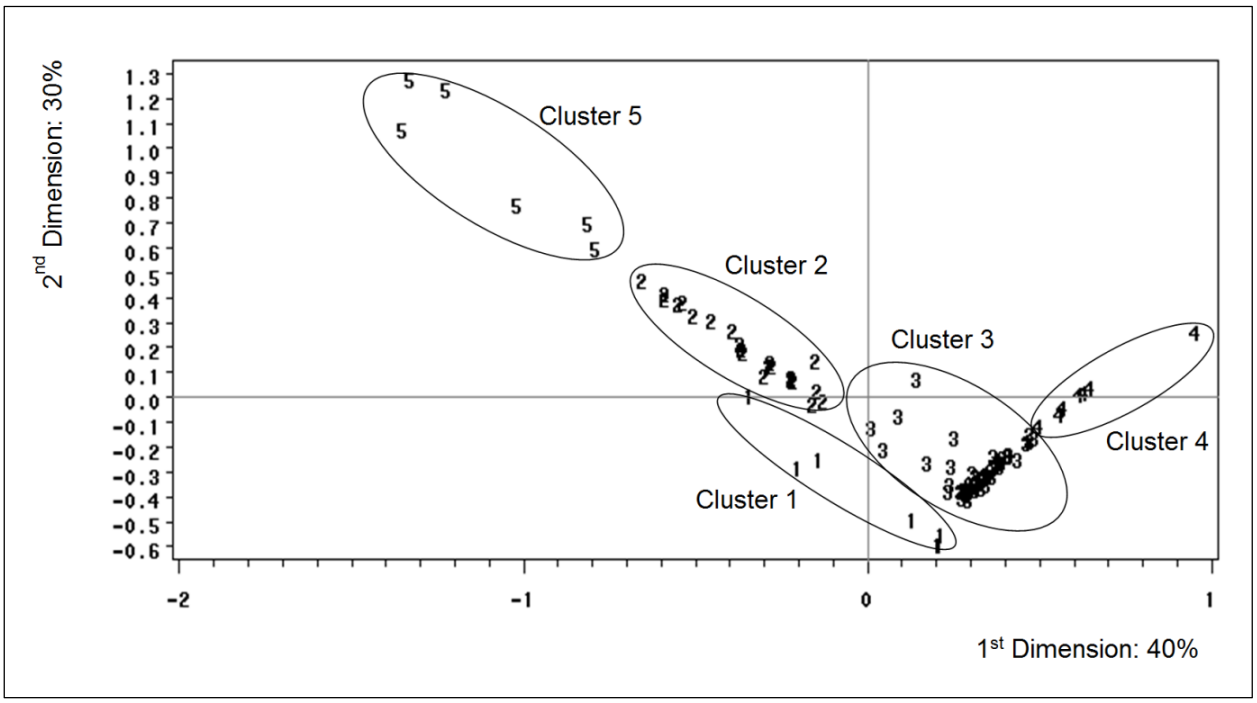
The farms (with an average size of 206 ha, or 509 acres) were usually divided into two to three plots. One was used for cropping and forage production, and the second, mainly managed Caatinga, was used for grazing sheep, goats, and cattle. The third was a reserve of Caatinga range to comply with a law that a minimum of 20% of the farm area has to be conserved. The average sheep grazing area accounted for 57% (n=22) of the total farm area, while cropping and forage production were an additional 15%. Grazing density averaged 1.7 sheep per hectare (0.7 sheep per acre). Temporary workers were employed during labor peaks (harvest or silage preparation). Wage laborers were paid 14–15 R$ per day (approximately USD8 in 2007–2008). After concluding school at age 16, farmers' children often continued helping on the farms. The sons were usually involved in animal and crop production, and the daughters in taking care of the house gardens, milk processing, and housekeeping. Sixty-one percent of male farmers worked predominantly on their own farm, 22% combined agriculture with part-time government employment, and 17% had a trade activity along with their farm. Twenty-nine percent of the women did household and farm work (taking care of chickens and the house garden, and processing milk into cheese, cream, and sweets), 33% worked full time in the household, and the remaining 38% had part-time jobs as teachers, school assistants, or vendors along with their home chores.

Characterization of Sheep Farming Clusters

Multivariate analyses were performed to detect structures in the sample. The first three dimensions of the multiple correspondence analysis (MCA) explained 92% of the total variance, and therefore were preferred over the two-dimension solution, which explained only 70%. Figure 3 shows the location of the farms after clustering in dimensions one and two of the MCA. Although clusters could be distinguished, they were generally not very distinct from each other.

Farms from clusters 1, 2, and 5 were rain-fed, mixed-farming systems (classified according to Steinfeld & Mäki-Hokkonen, 1996). Clusters 3 and 4 were livestock-production systems, though a small crop sector existed in cluster 3. Although some means of irrigation was present in roughly half the farms, the estimated contribution to total crop value was low. The number of farms per group was uneven, ranging from 6 to 56 (table 2). The five clusters were characterized as follows:

Figure 3. Distribution of the 102 Study Farms by Cluster, Presented Visually According to the Two First Dimensions of the Multiple Correspondence Analysis



Cluster 1: Pensioners still active in mixed farming system (n=7). The average farmer age was 66 years, and 86% of the owners lived on their farms. Over 50% of the farms were managed by family labor. Revenues realized from crops, small ruminants, and cattle were comparable; 67% of product sales were derived from livestock activities. The total revenue from product sales (TRPS) was 13,791 R$. This corresponds to 3.3 minimum salaries of 350 R$ per month in 2006. In contrast to other clusters, a large share of the total household revenue (34%) was generated from old-age pensions.

Cluster 2: Mixed farming system with focus on cow milk processing (n=23). A quarter of the farms were grouped into this cluster. Milk production and processing activities were relatively high in this cluster. Despite the lowest average number of sheep sold, sheep product sales contributed 25% to the total income; livestock in this cluster provided 44% of the TRPS, which accounted to 12,933 R$.

Cluster 3: Diversified livestock-farming system with intensive sheep production (n=59). This cluster included approximately half of the farms in the sample, had the largest average sheep flocks (148 head/household) and highest total revenue from sheep sales (4,309 R$). However, revenue from cattle production (including milk and derivates) equaled the sheep revenue, and secondary goat production was highest among the clusters. Livestock provided 95% of TRPS, which was 12,935 R$.

Cluster 4: Extensive sheep farming system (n=7). This cluster was characterized by extensive animal production. More than half of the farms (57%) were managed by sharecroppers who were practicing subsistence cropping and value their sheep as liquid assets. The TRPS was substantially the lowest (947 R$), 85% of which was from sheep. Secondary income sources of off-farm owners could not be identified, nor were the animal and crop production volumes and revenues recorded by the sharecroppers.

Table 2: Comparison of Sheep Farming Clusters Regarding Farm Labor, Household Characteristics, Livestock, Annual Production and Income

		Clusters					
		1	2	3	4	5	
Observations (n)		7	23	59	7	6	Signifi-
Variables	Unit	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)	cance
Labor endowment and household characteristics							
Family labor force	Number	5.1 (0.8)	2.6 (0.3)	2.9 (0.3)	3.1 (1.5)	2.7 (0.9)	n.s.
Wage labor force	Number	0.6 (0.3)	1.5 (0.3)	1.4 (0.3)	2.4 (1.3)	4.5 (2.1)	n.s.
Age of the farm owner	Years	66 (5)	42 (2)	52 (2)	46 (5)	40 (7)	**
Owners that live on the farm	%	86	59	75	43	83	n.s.
Annual production and stocks							
Sheep, average flock size	Head	120 (27)	97 (9)	148 (14)	103 (20)	107 (25)	n.s.
Goat, average flock size	Head	17 (10)	26 (6)	72 (12)	42 (42)	39 (31)	n.s.
Cattle, average herd size	Head	28 (7)	21 (4)	23 (3)	33 (29)	36 (28)	n.s.
Cow milk solda	Liters	385 (250)	1,317 (571)	1,005 (594)	0 (0)	9,600 (6,350)	**
Cow milk derivates sold	kg	301 (195)	498 (99)	368 (100)	0 (0)	0 (0)	**
Crops sold	kg	2,047 (650)	3,579 (685)	195 (85)	0 (0)	6,077 (3,248)	***
Crops consumed on farm	kg	1,300 (639)	2,757 (418)	74 (32)	0 (0)	9,407 (4,177)	***
Annual revenues and pension							
Total product sales	R$[d]	13,791 (3,153)	12,403 (971)	11,197 (1,323)	947 (230)	11,801 (3,541)	***
Sheep	R$	3,700 (668)	3,071 (288)	4,309 (662)	807 (239)	2,033 (933)	**
Goat	R$	714 (520)	472 (141)	1,627 (350)	0 (0)	0 (0)	**
Cattle	R$	2,143 (609)	2,259 (475)	1,715 (313)	121 (121)	792 (526)	*
Milk[a]	R$	263 (171)	950 (404)	667 (378)	0 (0)	6,554 (4,335)	**
Milk derivates	R$	1,353 (857)	2,200 (449)	1,920 (501)	0 (0)	0 (0)	**
Other from animals[b]	R$	1,016 (522)	290 (152)	288 (101)	19 (11)	995 (669)	*
Crop and fruit	R$	4,601 (2,696)	3,161 (335)	583 (168)	0 (0)	1,427 (841)	***
Old-age pension	R$	7,329 (941)	98 (55)	131 (34)	0 (0)	127 (127)	***
Total household revenue[c]	R$	21,257 (3,825)	12,933 (1,013)	12,935 (1,585)	1,539 (733)	12,116 (8,704)	***

Note: Sample size = 102 farms; labor force n = 101; owners that live on the farm n = 98; SE = standard error of the mean; significance levels: *** $p<0.001$, ** $p<0.01$, * $p<0.05$ according to Kruskal-Wallis or chi-square test.

[a] Quantities of milk sold and revenue from milk were not consistently mentioned. A few missing values were replaced by the average price of 0.68 R$/L.

[b] Other product sales from animals included sheepskins and other animals. [c] Total household revenue included total product sales, old-age pension, transfer payments from social programs and donations, pasture rented out and part-time off-farm revenue. [d] 1R$ in 2006 ≈ USD0.46 (www.oanda.com).

Cluster 5: Intensive mixed farming system with significant cow milk sales (n=6). This cluster was the youngest, with a mean age of 40 years. More than 80% lived on their farms, but permanent wage labor was dominant (on average 4.5 wage versus 2.7 family laborers). Cow milk production was substantial, and provided the main source of income (56%). The farmers practiced subsistence cropping, consuming the majority of crops at home, coupled with an intensive animal-production system in which crops were converted into silage to feed livestock. TRPS was 11,801 R$, of which 88% was derived from livestock.

Sheep Management and Production Practices
Thirty-two percent of the farmers separated their animals by sex, and 16% separated their sheep according to their age. Castration was carried out by 84% of the farmers, and was generally done between the age of 2 and 6 months. Additional breeding rams were either bought or borrowed from neighbors. Average litter size from 71 farms calculated from the recalled number of single, twin, and triplet births in 2005 was 1.56 (range 1.0–3.0). The lambing interval was 8 months and the mortality until weaning (at about 3 to 6 months) was 14% in the 2006 sample. Lamb mortality up to the age of 18 months was low (3%) in the revisited subsample of cluster 5, while it was between 10% and 15% in the other revisited subgroups. The majority of farmers (68%) did not maintain records for the flock, although some recorded births and litter sizes. The main reasons for culling ewes were giving birth less than once a year (40%), the need for money (24%), and ill health of the animal (21%).

The interviews from 2008 described production systems ranging from extensive to semi-intensive. The main breeds raised were Santa Inês (27%), crossbreeds or sheep without defined breed (26%), Somali Brasileiro (19%), and Bergamácia (18%); the remaining 10% were nominal numbers of Morada Nova, Rabo Largo, Dorper, and local wool sheep. Generally, animals grazed and browsed the Caatinga vegetation throughout the whole year. Forty percent of the farmers modified the Caatinga vegetation by selective thinning, removing shrubs and trees with low forage value. Usually, animals spent every night or every second night in an enclosure, returning to the range in the morning. A quarter of the farmers divided the range in different plots. Water was not a major constraint even in the driest of seasons. In the rainy season, the animals fed exclusively on Caatinga vegetation, whereas in the dry season additional feed was provided by 82% of the farmers. The fodder was usually maize (*Zea mays* L.), sorghum (*Sorghum bicolor* L.), and/or a mixture of different grass species. More than 50% of the farmers prepared silage for feeding in the dry season, mainly from the above mentioned feeds. Further feed sources were algarroba pods (*Prosopis juliflora* (Sw.) DC.), cotton seed cake (*Gossypium* sp.), soybean (*Glycine max* (L.) Merr.), forage cactus (*Opuntia ficus-indica* (L.) Mill.), leucaena twigs (*Leucaena leucocephala* (Lam.) de Wit), and wheat bran (*Triticum aestivum* L.). About two-thirds of the farmers provided feed only for certain animal categories — rams, lactating and lambing ewes, and very weak animals. No systematic fattening protocol was found. In the dry season 45% of the farmers irrigated pastures with water from their small farm reservoirs or open wells. Most of the farmers (90%) provided mineral salt to the sheep. All farmers provided antihelminth preparations for the sheep (averaging 3.3 applications annually), and an average of 80% of each flock was vaccinated against rabies, clostridiosis, foot-and-mouth disease, and symptomatic carbuncle, while brucellosis control was only done in cattle.

Few (6%) of the farmers sampled in 2006 specialized in producing breeding animals for specialized markets. They used defined breeds, and mating was controlled by targeted selection of the ram. Concentrated feeds were provided, including during the rainy season. The specialized breeders appeared to attach a higher value to their animals, compared to the other farmers, as indicated by following the vaccination schedule more carefully and administering helminth-controlling preparations and vaccinations 3.6 times per year. Furthermore, their animals were registered, which implies record-keeping about births, live weights, applied drugs, and mating.

The Sheep Meat Marketing Chain, Estimated Trading Volume, and Prices

At the time of this study, the sheep meat production chain in the Northeast was weak and not formally organized. The 2006 study indicated that sheep were sold with an average live weight of 30 kg or 66 lb. (range 14–40 kg or 31–88 lb.), at an average age of 11 months (range 5–24 months). Neither lamb producers selling directly after weaning nor those who fatten lambs to a target weight could be distinguished. Few sheep were sold for breeding. Some were channeled through PRONAF, a government support program for emerging sheep farmers. Others were sold at specialized animal fairs and auctions, where breeding animals fetched significantly higher prices than slaughter animals.

The farmers sold approximately 90% of live sheep to retailers at the farms, and 10% at the market in Tauá. Forty-six percent of these sheep (approximately 46,000 head annually) were collected weekly from the farms by retailers, sold in a sheep market in the state capital, and subsequently bought by butchery and restaurant owners. Local butcheries processed approximately 30% of the sheep marketed in Tauá. They fattened the animals on their own farms and in this way secured a constant meat supply for their butcheries. Some interviewed butchery owners mentioned specifically purchasing lean animals at relatively low prices from farmers who were in need of money, indicating distress sales on the part of producers. This was confirmed by farmers who claimed they were preselecting weaker or older animals before they contacted the retailer. In other cases, the retailers approached the farmers when they intended to make a purchase. Selling Manta represented a secondary commercialization channel for 12% of the retailers, who in this case sold the sheep or the carcass — some retailers also did the slaughtering — to the Manta processor. Most Manta retailers also processed it. The processed Manta was sold in local butcheries, on the local market, in restaurants and to private persons.

The prices in figure 4 represent average prices per live sheep, carcass, and Manta throughout the production chain. Transport, slaughter, processing, and transaction costs were not included in these prices. Additional revenue through the sale of byproducts (such as the sheepskin and a local dish prepared from offal) was included in the prices of the meat and Manta. The margins between purchasing price and resale price were, on average, very small. Thus the Manta processors gained only minimal, if any, added value; profit margins were higher for those who both purchased and slaughtered the sheep themselves. To make a profit on Manta, the entire Manta must be sold for a minimum of 86 R$ (a 16 kg carcass, priced at 6.50 R$ per kg[1], yielded 11 kg Manta), assuming the processor had no further costs, did not remunerate labor, and sold the byproducts for approximately 18 R$.

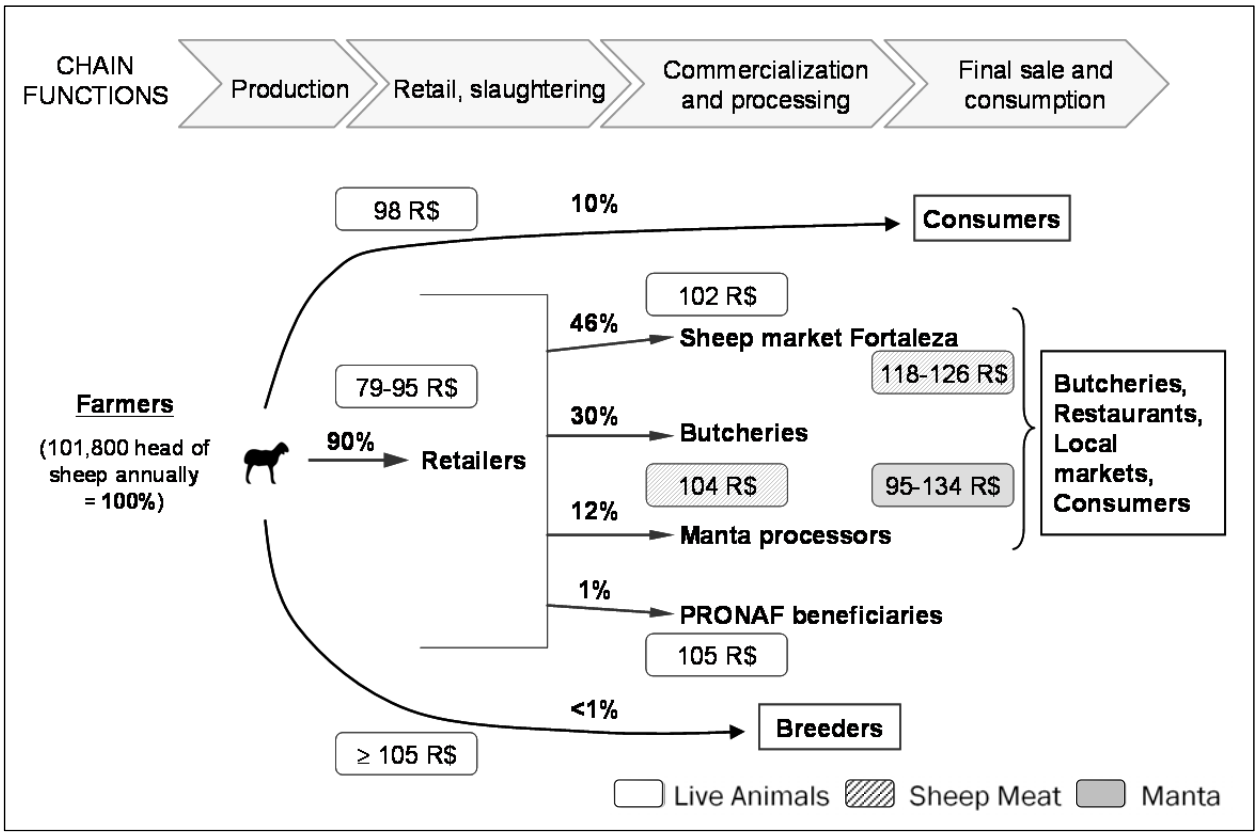
Most farmers sold animals year-round; others sold twice a year, receiving higher prices at holiday markets in July and December. In the dry season (July to December) the live weight prices generally increased by 0.10–0.40 R$ per kg due to lower supply. The interviewees generally perceived an increasing demand for sheep meat and Manta. Possible reasons for the increase that were mentioned include wider recognition of the nutritional value and taste of sheep meat, and the rising fame of Tauá sheep. Six of nine retailers did not report any difficulties in securing a constant sheep supply, while the others mentioned shortages of supply in the dry season and farmers' decreasing willingness to sell the animals due to the highly valued liquid asset function of animals.

Legal, Structural and Motivational Preconditions for Obtaining an Origin Certification

The legal preconditions in order to obtain a geographical indication label in Brazil according to the INPI resolution number 75/2000 (Instituto Nacional da Propriedade Industrial [INPI], 2000) are:

1. Evidence that Tauá has become known as a center of extraction, production, or manufacture of the "Manta de Carneiro de Tauá";

Figure 4. Estimated Relative Trade Volumes of Sheep, and the Respective Sale Prices of Live Animals, Sheep Meat, and Manta, Corrected to One Animal



Note: 1R$ in 2008 ≈ USD0.55 (www.oanda.com). The average live weight per sheep was 35 kg, with a carcass weight of 16 kg, yielding a Manta of 11 kg. PRONAF = governmental development project.

2. The establishment of a Manta production control system;

3. Proof that Manta producers are residents in the delimited geographic area (which implies that the geographic area has been defined); and

4. The need for a "description of the quality and characteristics which exist exclusively or essentially due to its geographic environment, including natural and human factors."

Apart from the legal requirements, further preconditions for successful implementation of a GI label (Belletti & Marescotti, 2006; Larson, 2007; Marescotti et al., 2008) can be summarized as:

1. Development of institutional, organizational, and infrastructural support related to the availability of and access to local and regional markets, and a demand and supply structure for the product; and

2. Motivational preconditions and a sufficient quality of cooperation, including capacity and motivation of initiators to guide the process; networking and collective action; fair and transparent attitudes among production chain members; and a personal motivation from the chain members themselves.

Feasibility of Introducing a Protected GI Label for the Manta de Carneiro de Tauá

Two challenges stand out to introducing a GI label

for Manta: Delimitation of the geographic area and differentiation from similar products. The "Manta de Carneiro de Tauá" is known as a regional specialty and the name "Tauá" is said to aggregate value to the product. In the interviewed historian's opinion, the commercialization of Manta likely began in Tauá. Knowledge of its processing spread to surrounding municipalities, where similar products are produced and sold under the same, a different, or no special name. According to study participants, Tauá sheep meat is regarded as special and unique due to specific forage plants found only there. Some interviewees mentioned an increase in demand, though at present this demand seems to be local. Demand from other states was due to migrants originating from the Northeast, and no indicators of national or international demand could be identified.

At the time of this study, neither official standards for mutton production, processing or carcass conformation nor laboratory analysis specifying meat quality traits were available, reflecting the heterogeneous production practices among the farmers and processors. According to the federal inspection service staff member, only 1% of all processed sheep in Ceará were slaughtered in formal slaughterhouses. Additionally, four of the five existing small ruminant slaughterhouses had to be closed due to irregular animal supply. Since supermarkets, butcheries, and restaurants willingly purchased meat without sanitary inspection seals, informal slaughters were common in the region. In Tauá, the physical structure of the slaughterhouse met cattle-slaughtering requirements, but not for small ruminants, which likely contributed to few locally processed sheep being slaughtered there. The health inspection agency, which supervised meat sold in Tauá's butcher shops and restaurants, did not control the origin and the visual appearance of the meats, which would be necessary for a GI protocol.

Formal commercialization structures for Manta and sheep meat in general were not present in Tauá, and the production chain was not transparent. Only economic profits realized by farmers were evaluated in this study. The Manta was marketed on a small scale along short informal channels. At the time of the survey, it was locally acknowledged that formal commercialization was almost nonexistent.

At the time of the study, several governmental and nongovernmental institutions in Tauá were willing to support GI implementation. However, integration in local policy and production seemed poor. The COOMANTA cooperative aimed to create a direct-market location for Tauá sheep and goat products and a small-ruminant slaughterhouse. A GI was not yet planned, but establishing such a slaughterhouse may facilitate the process of GI implementation. Cooperative membership implied membership in the Association of Sheep and Goat Keepers in Inhamuns (ASCOCI), which listed nearly 40% of farmers in clusters of three, four, and five as members in June 2008. Potential exists for predicting, recruiting, and tracking farmer participation through ASCOCI. However, the project had not been realized due to lack of funds and low stakeholder motivation.

Discussion

This study assessed current sheep production infrastructure and volume in the Tauá municipal as prerequisites for evaluating the farmers' and region's potential and limitations for introducing a GI label for the local sheep meat product Manta de Carneiro de Tauá. While there is some literature on GI certification of animal-source products in Europe, the present study is a rare case of a certification project for an animal-source product in a tropical country. The introduction of the proposed label faces the following series of obstacles.

Product Quality: Hazardous, Typical or Standardized

The present study confirms the statement of Holanda Júnior, Alves, Silva, and Lopes (2007) and Lousada Júnior (2007) that Manta represents a typical, traditionally processed product. From this point of view, and considering the organoleptic nature of Manta as a "quality, which exists exclusively or essentially due to its geographic environment, including natural and human factors" (INPI, 2000), it may qualify for a geographical certification label. However, the parameters distinguishing its

uniqueness will have to be proven to achieve legal approval. Furthermore, the selection and extent of standards — currently nonexistent for Manta — are crucial and complicated, as they may alter the typicality of the product. When "quality" is defined not only by sensory quality and originating from a specific place, but also by processing hygiene, food safety, and animal welfare aspects, Manta as it is currently produced does not meet certification requirements.

The primary reason for this is that production and processing conditions do not follow any standard. Observation of Manta processing confirmed that critical control points identified by Holanda Júnior et al. (2007), like hygienic measures taken to reduce the risk of contamination, e.g., changing of clothes before processing the meat, were poorly addressed. A laboratory meat quality analysis of Manta samples from Tauá to be compared with samples from a different origin was under way in 2010 (M. Suely Madrugada, personal communication, 19 September 2010). Applying microbiological tests on inspected and noninspected bovine dried meat, Costa and Silva (2001) found high levels of hazardous bacteria in both samples, and significantly high feces contamination in the noninspected sample. However, this might not be problematic, as high levels of hazardous bacterial strains in a traditional salted and dried sheep meat can be controlled due to the characteristics of the product (low water activity due to salting and drying; Bennani, Zenati, Faid, & Ettayebi, 1995). Introducing hygienic measures to prevent a suggested but not proven hazard may result in a change of the product's typical flavor (Scintu & Piredda, 2007).

Production Systems and Target Groups

Contrary to expectations, revenues were comparable among clusters, excluding pension payments and the extensive system (where owners' off-farm revenues could not be accounted for). Sheep played the most prominent role in the biggest cluster, forming a large target group for improvements in the sheep sector. In contrast to findings in Bahia (Holanda Júnior, 2004), cropping and off-farm activities were restricted and livestock-based farming systems prevailed. A small group of farmers was observed to be applying more sophisticated management practices, including commercializing breeding animals. A similar situation was described for the state of Rio Grande do Norte, where a very small number of farmers, generally with larger farms, specialized in producing ewes and rams for breeding (SEBRAE/RN, 2001). Breeding animals could fetch exceptionally high prices, yet it was a small market niche for auction enthusiasts. Producing breeding animals, however, signals a readiness for substantial adjustments in the production and commercialization process.

Sheep Management

The harsh local environment with an irregular rainfall distribution, high temperatures, and lack of feed resources in the dry season negatively affects sheeps' growth (Fernandes, Buchanan, & Selaive-Villarroel, 2001; Gertner, 2006). This is reflected in the sheeps' weight-to-age ratio. The average sheep in this study reached 30 kg (66 lb.) at an age of 11 months (all values based on recall; no recurrent on-farm measurements could be made for validation). Sheep grown in traditional systems in Rio Grande do Norte reach 27 kg (60 lb.) at an age of 12 months (Guimarães Filho et al., 2000). A technical manual (Banco do Nordeste do Brasil [BNB], 2008) states that the weight of a sheep at an age of 12 months ranges between 31–33 kg (68–73 lb.) live weight in the traditional system, and reaches 33–35 kg (73–77 lb.) in a more specialized system. Medeiros (2006) showed that Morada Nova sheep fed on the lowest level of concentrates in a station trial required over one year to reach a slaughter weight of 30 kg (66 lb.). Literature and study results suggest production of young lambs (up to 6 month old) for slaughtering is unusual in the Northeast; slaughters at one year of age or older were more typical. COOMANTA (2008) suggested the following selection criteria for Manta production: young animals before the eruption of permanent incisors (less than 12 months), with an average carcass weight of 13 kg (29 lb.), a normal to slightly fatty body condition (score 3 to 3.5 on a scale from 1 to 5), and in perfect health. The animals should be slaughtered in slaughterhouses and be inspected before being transported to the processing house.

Not all sheep sold were immediately slaughtered. Emphasizing the liquid asset function of sheep, farmers sometimes contacted the retailers themselves after preselecting old, weak, and sometimes undernourished sheep. The retailer benefitted from a low price per animal by doing the final fattening before slaughtering. This practice is confirmed by a study in the state of Bahia where 68% of the interviewed farmers preselected old cull sheep and thin animals (Holanda Júnior, 2005). In the Tauá study, the reason for sales, such as culling, need for emergency cash, and sale of finished animals, could not be determined.

The mortality rate of the lambs before weaning identified in this study (14%) was similar to the lowest technological level in the Brazilian Northeast (BNB, 2008), and similar to that identified by Girão, Medeiros, and Girão (1997) for lambs from single births (15%). Guimarães Filho et al. (2000) identified higher levels (15%–25%) in the traditional husbandry system.

The feed and forage composition described by the farmers in this study is, according to Campos (2003), typical for the region. Additional nutritional feed resources would be needed to reduce slaughter age and thereby increase turnover or marketability for lamb or premium lamb markets. Substantial changes in the feeding basis, however, would not comply with the GI-certified product concept, since browsing was one criterion for its uniqueness. Additionally, sanitary measures have to be applied properly and appropriate breeds must be chosen. Any potential advantages accruing from management changes must also be contrasted with increased costs and labor demand. The sheep production systems in this study were all at a low to medium technological level. However, the existence some advanced techniques, like silage-making and preventative health management, hints at an openness toward system changes on the part of at least some of the farmers.

Marketing of Sheep Meat

Almost half the sheep were sold to retailers at the farm gate, heading for markets in the state capital. The other half, which was consumed locally, reached the consumer via retailers or direct farm sales. Tauá has the tenth largest total sheep stock out of 5,564 municipals in Brazil and the biggest in the Northeast (IBGE, 2009), highlighting its regional importance. Nevertheless, in the prevailing traditional trade procedure the animals are not weighed or health-inspected; they are only classified visually according to their body condition (Holanda Júnior, 2005). Thus the sheep markets in the Northeast are informal and use low levels of technologies (Fernandes, Selaive Villarroel, & Osório, 2007). Moreover, they lack infrastructure and show low organizational levels throughout the market chain (Brisola and Santos, 2003, as cited by Fernandes et al., 2007). According to Benitez-Ojeda (2002), this leads to a product without quality control, as confirmed by the present study.

Existing slaughterhouses had to close in the region as sheep supply was short, although the number of sheep kept was reportedly high. Informal slaughters turned out to be a common practice in the Tauá region. This was similar in Bahia, where the majority of the sheep (97%) were slaughtered informally without inspection, thus preventing the marketing of sheep products to distant — and formal — markets (Holanda Júnior, 2005). Gertner (2006) further identified informal slaughters as the major obstacle for the development of the sheep and goat meat value chain in Bahia.

Demand for Manta de Carneiro de Tauá

In this study, an increasing demand for Tauá sheep in general, and for Manta de Carneiro de Tauá in particular, was suggested but could not be quantified. Lousada Júnior (2007) and Fernandes et al. (2007) similarly stated that for many years the supply has not been able to meet the increasing demand for sheep meat in the cities of the Brazilian Northeast region. Cerdan and Sautier (2003) indicated that consumers search for products that represent a link to their cultural background and values. Our findings support this, as consumers demanding Manta in Ceará and throughout Brazil seem to be almost exclusively people originating from Tauá or the states of the Northeast. A rough estimate of the current production volume of the Manta in Tauá is up to 12,800 carcasses processed

into Manta annually (approximately 250 Mantas weekly). This number corresponds with a total of 800 animals being processed into Manta weekly in Tauá and the nearby municipalities of Independência, Crateús, and Parambu, 90% of which are consumed locally (França, 2006). It was furthermore estimated that only 12% of the sheep were currently used for Manta preparation; the majority entered other marketing channels. Even if the demand for Manta was increasing, farmers still receive the same prices for their live sheep, regardless of the intended final product. The current production systems seemed not to assign specific production goals for lambs. Manta production reinforced this nondifferentiation, as a fixed sex, age, or weight of the animal was not demanded, nor a specific breed. Therefore currently there is no incentive for farmers to produce more sheep for Manta, since they have various alternatives to sell their sheep.

Potential of Sheep Production for Manta

A higher profit through sheep sales could benefit farmers, especially those with a high share of income from sheep sales. In particular, the farms in cluster 3 generated a large share and absolute amount of their total revenue via sheep sales. The Brazilian agricultural ministry suggested that the production of sheep for Manta could increase farm profits. Under the current extensive to semi-intensive production conditions, the present study could not confirm this. The certification of Manta would involve changes and investments that bear price and commercialization risks for the farmers. The animals used for Manta preparation do not meet a specified standard, apart from the preferences of each processor. Formulating uniform production standards and carcass characteristics is a prerequisite for successfully increasing sheep production for Manta, since the product may enter new markets with specific expectations. The standards have to be communicated explicitly and transparently in order to assign a unique product identity to Manta that is substantially different from a Manta without a label. This will be crucial for local consumers, who would have a choice between products with and without the label.

The technical regulations for Carne do Pampa Gaucho da Campanha Meridional, a beef produced under a GI in the south of Brazil, clearly defined the animal breeds, a specific feeding regime, and minimal weights accepted at a certain age, and delimited the geographic area (APROPAMPA, 2010). The delimitated area can be extended beyond current administrative borders if a produce qualifies. This could reduce the exclusion of farmers producing sheep for Manta outside Tauá. Accepting only specific local breeds would ease process control (as well as assist the conservation of local breeds). Capping flock sizes could protect smallholders' stakes.

Incentives for a farmer to produce sheep for Manta would include receiving a premium price for the respective sheep or participating fully in the production chain until final sale. An analysis would necessarily build on a comprehensive standard of good practices. Whether the benefits of the Manta GI would outweigh its implementation and maintenance costs was not estimated in the present study, although an investment analysis for a tentative GI of a Costa Rican cheese suggested a positive return in the third year (Granados & Álvarez, 2007). This is a crucial point, since no clear evidence supports the general assumption that GI benefits reach farmers in developing countries and improve their livelihoods (Jena & Grote, 2010). The possible negative externalities or risks accruing from a GI also need to be evaluated, such as those that may emerge from unequal development of standardization or organizational modifications (Roussel & Verdeaux, 2007).

A recent Brazilian policy supports the implementation of research results aimed at organizational and technical innovations that improve the livelihoods of rural people (Farias & Mendes, 2009). Since the conclusion of our study, the proposed processing house was built in Tauá with funds from Brazilian Services for the Support of Small Enterprises (SEBRAE) and promotion by Embrapa. COOMANTA does not focus on Manta alone; its mission is to add value by developing a range of products from sheep and goats, inspired by the more differentiated beef-processing sector.

However, neither the generally superior sheepskin quality of hair sheep over wool sheep (Fernandes et al., 2007), nor promoting a targeted production of lambs for a premium market, is currently included in product development plans. Emphasizing a value chain, which is linear by definition, masks the web character of livestock-keeping and associated products and services (Otte, 2010). The potential of alternative or parallel production and commercialization strategies for Tauá farmers should be investigated.

A multiple-product approach may be helpful, as it is not evident currently if a geographical certification would have a value-adding function for the product, nor if farmers would benefit economically from its implementation. Investing into a more standardized Manta production may be a useful pathway for some, but perhaps not all, farms. COOMANTA (2008) even suggested that only farmers participating in one of the various programs of technical assistance in the Tauá region should be allowed to deliver sheep for Manta production. In this way, controlled implementation of production standards could be more easily managed. A detailed and consistent farm monitoring program, including following performance and development of individual animals, is needed as a reference for planning. A stakeholder analysis should clarify the roles and interests of the different and increasing number of production chain members in Tauá, along with estimating their economic benefits and risks. Further research remains to approximate the likelihood of meeting the legal, organizational, structural, and functional criteria that are essential for successful implementation. The availability of marketing options for farmers needs to be assessed, as well as the desired level of involvement of various institutions. Effective technical assistance should be secured in order to jointly adapt best practices of production to local conditions. As soon as the quality of production, processing of the meat, and distribution reaches a certain standard, then the (processed) meat may enter the market at higher prices without GI status (Larson, 2007). Officially approved standards could facilitate the certification process. The presence of officially certified products, however, appears to indicate a certain level of development and therefore more a result than a means to trigger it (Marescotti, 2003).

The question emerges whether farmers will be sufficiently better off, and more competitive, by intensifying their systems consistently according to general standards. If so, they may opt to avoid the tedious process of label introduction and maintenance. An answer to these questions requires estimates of future livelihood and market dynamics. Ultimately, it will be complex to merge current local skills with scientific knowledge and regulations without losing the product's identity (Bouche & Moity-Maïzi, 2009).

In conclusion, this study showed that the introduction of a certification concept for Manta de Carneiro de Tauá is not an immediate solution to improving the livelihoods of farmers in the study region. On the one hand, the profitability of the product at the farmer level is not clear, and on the other, a range of preconditions need to be met that are currently far from being fulfilled. Farm types with a higher dependence or focus on sheep sales are more likely to profit from such changes. Yet farm profitability and the feasibility of the related structural and functional changes of the chain could not yet be assessed satisfactorily.

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