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Description of smallholder pig farming in the Metropolitan Region of Curitiba, Paraná, Brazil

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Abstract: Several smallholder pig farms exist in Brazil in parallel with industrial pig farming, which is carried out on large-scale farms. This study aimed to describe the smallholder pig production systems in the Metropolitan Area of Curitiba. For this, a questionnaire was applied *in loco* by interviewing 362 farmers. The labor force was exclusively family-oriented (93.4%), 50% of the farms had between 1.1 and 10 acres, 98.3% raised other animal species (i.e., poultry), and in 80.9% of the properties they cultivated mainly corn. Farrow-to-finish operations were developed in 57.2% of the farms, the swine were kept in a confined system in 62.5%, and the swine were kept outdoors in 20.7%. Of the farrow-to-finish operations, 40.1% had between 11 and 20 pigs, while in the fattening farms, 88.4% had up to 5 pigs. Most of the visited properties (79.6%) had pigs with undefined breeds. In terms of feeding practices, corn, and locally available vegetables were the most commonly used. In addition, 38.1% of farmers used commercial concentrate, usually with other feed. Reproduction was exclusively by natural mating, and the most frequently weaning age (46.9%) was two months. All the interviewees raised swine primarily for their consumption, with 78.7% also selling the animals. In the studied region, farmers obtained their family income by combining farming with other activities and stated that pig production contributed little to this income, and was developed mainly as a family tradition.
Keywords: family farming; pig farming; subsistence.

1. Introduction

There are various forms of family farming in Brazil, which can be characterized according to the technology used, the production factors, the combination of agricultural and non-agricultural activities, and the different strategies for market engagement (Breitenbach, 2018). Thus, Brazilian pig farming is characterized by heterogeneity, both in the main production regions and in agricultural establishments in the same region. Large-scale farms — mainly located in the Southern region of Brazil — are responsible for the majority of the inspected slaughter and all exports. However, there is also a significant number of small farms that raise pigs marginally for other agricultural activities, mostly in the northeast and south of Brazil (Miele *et al.*, 2014). According to the 2017 Agricultural Census (IBGE, 2018), 79.6% (1,171,715) of the establishments that raised pigs had up to ten animals.

In smallholder farms, pig farming functions as both a source of food and income, usually playing a secondary role to other activities (Nantima *et al.*, 2016). These farms have low investment in infrastructure and technology, the farmers have no technical assistance and the work is carried out by family labor (Rocha *et al.*, 2016). Depending on the farm's type of orientation — production for trade or subsistence — producers may only sell surpluses sporadically, or continuously sell a few animals or their products (FAO, 2019). These small producers have no connection with companies, cooperatives, or associations, thus they sell their products locally and informally (Gomes *et al.*, 2018).

Related studies have been carried out in African and Asian countries (Kambashi *et al.*, 2014; Riedel *et al.*, 2014; Leslie *et al.*, 2015; Motsa'a *et al.*, 2018; Gomes and Code, 2020; Hirwa *et al.*, 2022); in Brazil, the literature mainly describes breeders in the Northeast region (Silva Filha *et al.*, 2008; Souza *et al.*, 2010; Gomes *et al.*, 2018). In these places, pig farming is described as an attractive activity for small farmers due to its easy implementation, the pig's capacity to convert agro-industrial by-products and domestic waste into quality animal protein, high prolificacy, short production cycle, and fast growth (Chah *et al.*, 2014; Nantima *et al.*, 2016; Rocha *et al.*, 2016). Besides a previous study carried out by the authors of this very article (Horwat *et al.*, 2019), there are no academic papers in the literature dealing with smallholder pig farming in the southern region of Brazil, indicating that this research is relevant to understanding the particularities of this production system in different regions.

Previous research, other than describing the cultural and socioeconomic importance of smallholder pig farming, also reports a series of challenges faced by the farmers, such as restricted access to markets and services, and omission by government sectors (Leslie *et al.*, 2015; Gomes *et al.*, 2018; FAO, 2019). In addition, the low levels of biosecurity found in these farms (Nantima *et al.*, 2016; Leslie *et al.*, 2015), associated with farmers' limited knowledge of pig health, may present a risk for disease spreading (Leslie *et al.*, 2015; FAO, 2019).

Given these, it is essential to analyze and become acquainted with the aspects of local pig farming to help professionals in the field provide subsidies to develop appropriate strategies. A good diagnosis of the farms' conditions, with greater detail of some farmers' particularities, will help in the effective planning and targeting of future actions (Gomes *et al.*, 2018). Therefore, this study aimed to describe the smallholder pig production system in the Metropolitan Region of Curitiba (Paraná, Brazil).

2. Materials e Methods

The study was developed in the Metropolitan Region of Curitiba — which has 29 municipalities — and is 16,581,21 km long, extending from the border with the state of São Paulo (North) to Santa Catarina (South) (COMEC, 2017). According to the latest Agricultural Census, the swine herd in Paraná in 2017 consisted of 72,863 individuals distributed over 6,886 establishments (IBGE, 2018). The population evaluated in the present study consisted of swine farms in the region, and the participating farmers were

randomly selected from a database provided by the Paraná Agribusiness Defense Agency, granted solely for research purposes. Two municipalities — Adrianópolis and Doutor Ulysses — were not included in the evaluation due to their great distance from Curitiba (144 and 149 km, respectively).

We used a non-probabilistic sample since the database did not include all the pig farmers in the region. We determined a sample size of 362 properties, based on the number of establishments surveyed by the Brazilian Institute of Geography and Statistics (IBGE) in 2017 with a confidence level of 95% and a margin of error of 5%.

We collected data by visiting the properties, where we observed the production methods and applied a structured questionnaire by interviewing the farmers, which was always carried out by the same researcher. The questionnaire used in the research was validated by two specialists and a pilot test was conducted on two farms, which were not incorporated into the results. The questionnaire consisted of eight main sections, including the farmers' socioeconomic data, information about the property and its activities, information about the pig herd and the type of housing, feeding, reproductive management, health data, productivity parameters, and perceptions about the activity. In the section on productivity parameters, we asked interviewees about the average number of piglets born per farrowing, age, and weight of the pigs at slaughter, and the answers were used to calculate the averages presented in the results. We did not carry out any type of monitoring, counting, or weighing.

The data obtained were tabulated in Microsoft Excel 2019 spreadsheets and evaluated using descriptive statistics, and absolute and relative frequency distribution. This study was approved by the Research Ethics Committee of the Health Sciences Sector of the Federal University of Paraná (UFPR) under register no. 5.617.247 and by the Ethics Committee for the Use of Animals of the Agrarian Sciences Sector of the UFPR under letter 048/2019.

3. Results

The socioeconomic data of the interviewees are presented in Table 1. Two farms were not included in the socioeconomic analysis because they were an agricultural school and an association of nuns. The section on socioeconomic data also delves into the timeframe of the farmers' participation in the activity, revealing that most of them had many years of experience. According to their estimate: 13.6% (49) had been involved in pig production for more than 50 years; 35.3% (127) for more than 30 years; 25.6% (92) between 11 and 30 years; 21.4% (77) between one and ten years; and 4.2% (15) had been involved for one year or less.

The general characteristics of the properties and the activities carried out in the farms are described in Table 2. Data regarding the swineherd and types of housing are shown in Table 3; according to this table, one of the forms of housing is loose housing: in this system, males, empty females, and pregnant females are kept in paddocks, while lactating females with piglets and animals in the fattening phase are confined.

Variable	Percentage	Number
Gender		
Male	71.4%	257
Female	28.6%	103
Age		
30 years old or less	4.4%	16
31 to 50 years old	32.8%	118
51 to 70 years old	53%	189
Over 70 years old	10.3%	37
Education		
Never studied	7.2%	26
Incomplete primary education	52.2%	188
Complete primary education	16.4%	59
High school	20.3%	73
Higher education	3.9%	14
Number of people on the property		
One or two	32.8%	118
Three of four	52.5%	189
Over four	14.7%	53
Household income		
Up to one minimum wage	10.6%	38
One to two minimum wages	34.2%	123
Two to four minimum wages	19.4%	70
Over four minimum wages	8.3%	30
Did not know or did not want to answer	27.5%	99
Main source of income		
Salary or company	36.1%	130
Agriculture	33.9%	122
Retirement	24.4%	88
Livestock	2.8%	10
Agriculture and retirement	2.2%	8
Other	0.6%	2

Table 1 – Socioeconomic data of pig farmers in the Metropolitan Region of Curitiba (n=360).

Variable	Percentage	Number
Property size		
One acre or less	5.2%	19
1.1 to 5 acres	29%	105
5.1 to 10 acres	21%	76
10.1 to 20 acres	15.7%	57
Over 20 acres	12.2%	44
Unable to respond	16.9%	61
Labor		
Exclusively family	93.4%	338
Employees	6.6%	24
Production of other species		
Yes	98.3%	356
No	1.7%	6
Other species produced (n=356)		
Chickens	94.4%	336
Cattle	66.6%	237
Goats	11.2%	40
Fish	3.1%	11
Sheep	2.8%	10
Buffalo	0.3%	1
Rabbits	0.3%	1
Agricultural production		
Yes	80.9%	293
No	19.1%	69
Crop species produced (n=293)		
Corn	91.8%	269
Vegetables	36.5%	107
Bean	30.7%	90
Soy	29%	85
Tobacco	6.8%	20
Wheat	1.7%	5
Uses pesticides (n=293)		
Yes	84.3%	247
No	15.7%	46

Table 2 – General characteristics of pig farms in the Metropolitan Region of Curitiba (n=362).

Variable	Percentage	Number
Acquisition of replacement pigs		
Neighbors	40.3%	146
Friends or family	27.9%	101
By themselves	27.1%	98
Companies or institutions	4.7%	17
Housing		
Confined in concrete pens	42.3%	153
Confined in wooden structures	20.2%	73
Loose housing	16.9%	61
Paddocks	14.9%	54
Free range	5.8%	21
Production system		
Farrow-to-finish	57.2%	207
Fattening	42.8%	155
Number of farrow-to-finish pigs (n=207)		
1 to 5	15.5%	32
6 to 10	35.7%	74
11 to 20	40.1%	83
21 to 50	8.7%	18
Number of fattening pigs (n=155)		
1 to 5	88.4%	137
6 to 10	9.7%	15
11 to 25	1.9%	3
Produced breeds		
Undefined breed	79.6%	288
Exotic or their crossbreeds	22.4%	81
Native	3%	11
Wild boar crossbreed with domestic pigs	2.5%	9

Table 3 – Characteristics of pig production in the Metropolitan Region of Curitiba (n=362).

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The results regarding the feed provided to the pigs are shown in Table 4. This table demonstrates that the diet of pigs on the evaluated farms is based on corn and other vegetables, of which the most common are: pumpkin, cabbage, cassava, kale, broccoli, yams, cauliflower, sweet potatoes, chayote, carrot, and beet.

Table 5 shows data on reproduction and health management at the evaluated sites. Regarding health data, we asked the farmers about disease occurrence: 55.5% (201) said they had never observed any disease or clinical manifestation in their pigs; 20.4% (74) reported the presence of diarrhea; 4.4% (16) dyspnea; 4.1% (15) abortion; 3.6% (13) runts; 3% (11) sudden death; and 8.8% (32) others. Other reported diseases or clinical signs were: parasitosis, arthritis, cough, anorexia, neurological signs, rectal prolapse, salmonellosis, paralysis, and epiphysiolysis. Among the farmers who described the presence of clinical manifestations, 93.8% (151/161) said that no diagnosis had been made; 5.6% (9/161) said that a clinical diagnosis had been made by a veterinarian; and one farmer (0.6%) reported that a laboratory test had been carried out. In 31.7% (51/161) of the cases, no type of treatment was carried out; 33.5% (54/161) got unspecified drug treatment; antibiotics were applied in 26.7% (43/161) of the cases; and in 8.1% (13/161) other treatments were used, namely: the use of anthelmintics, topical treatment, and homemade medicine.

Variable	Percentage	Number
Feed[1]		
Corn	93.4%	338
Vegetables	72.1%	261
Concentrated feed	38.1%	138
Kitchen waste	19.1%	69
Cut fodder or pasture	11.6%	42
Whey	8%	29
Other	11%	40
Thermal treatment of kitchen waste (n=69)		
Yes	2.9%	2
No	97.1%	67
Feed acquisition		
Own property	85.4%	309
Local shops (groceries and restaurants)	5.2%	19
Purchase	3.6%	13
Purchase to supplement what is on the property or what comes from neighbors	5.8%	21

Note: [1]19 farms (5.2%) provide only one feed variety; 343 farms (94.8%) provide two or more feed varieties.

Table 4 – Feed provided to pigs in smallholder pig productions in the Metropolitan Region of Curitiba (n=362).

Regarding the data obtained on productivity parameters, we found that the average number of live-born pigs per farrowing for undefined breed sows was 8.7±1.8, and 9.9±2.2 for exotic breed sows. The average age and weight of the pigs at slaughter was 11.1±5.6 months and 95.7±44.2 kg.

Pig production was destined for subsistence in all of the evaluated sites. In 42.8% (155), pigs were sold sporadically; in 25.1% (91), pigs were slaughtered and sold when there were interested buyers; and in 10.8% (39) piglets were sold to other farmers. In 79.2% of the farms (285/360), the farmers declared that pig production was of little importance in terms of family income; for 19.4% (70), it contributed to their income; and for 1.4% (5), it was an important part of the family income. When asked about the main difficulties involved in pig production, the farmers' answers were: the high cost of feed 42.8% (154); low financial return 10.8% (39); laborious activity or lack of time for 7.8% (28); low demand for 2.2% (8); lack of money to invest for 0.8% (3); diseases for 0.5% (2); other difficulties for 7.5% (27); and no difficulties for 32.2% (116).

4. Discussion

The socioeconomic data survey aimed to determine the profile of smallholder pig farmers in the Metropolitan Region of Curitiba. We found that more than 70% of the farmers included in the survey were men, as has been reported in studies on smallholder pig production conducted in Indonesia and Rwanda (Leslie *et al.*, 2015; Hirwa *et al.*, 2022). Surveys carried out in Cameroon and South Africa also reported figures close to 60% in terms of male involvement in pig production (Motsa'a *et al.*, 2018; Munzhelele *et al.*, 2017). In the present study, as well as in other studies assessing smallholder pig production, there was a small percentage of participants under the age of 30, which indicates low participation of young people in this activity (Munzhelele *et al.*, 2017; Rocha *et al.*, 2016; Hirwa *et al.*, 2022). Rocha *et al.* (2016) explain that it is common for children to leave rural areas and start working in the city when they reach a certain age.

Most of the interviewees had incomplete primary education, stating that access to education used to be more difficult due to the lack of means of transportation and the significant distance between schools and rural areas. Even so, the percentage of people who did not attend school was lower than that reported by Hirwa *et al.* (2022) in Rwanda (21.6%), by Munzhelele *et al.* (2017) in South Africa (18.2%) and by Nath *et al.* (2013) in India (10%). This may be related to the higher level of urbanization and development in the region assessed in this study.

Variable	Percentage	Number
Reproduction (n=207)[1]		
Natural mating	100%	207
Boar	79.7%	165
Borrowed boars from local breeders	20.3%	42
Weaning age (n=207)[1]		
30 to 45 days	30.9%	64
60 days	46.9%	97
90 days	12.1%	25
Natural weaning	8.7%	18
Unable to respond	1.4%	3
Advice seeking in case of illness		
Farm stores	45.3%	164
Veterinarian	16.6%	60
Family, friends, or other farmers	1.9%	7
Internet	1.7%	6
Does not seek advice	34%	123
Could not answer	0.6%	2
Use of anthelmintics		
Yes	91.4%	331
No	8.6%	31
Vaccines		
Yes	8.8%	32
No	91.2%	330
Indicated vaccines (n=32)		
Salmonellosis	43.8%	14
Rabies	9.4%	3
Parvovirosis	6.3 %	2
Pasteurellosis	3.1%	1
Polyvalent vaccines	9.4%	3
Could not answer	31.3%	10
Application of iron to piglets raised in confinement or loose housing (n=149)		
Yes	65.1%	97
No	34.9%	52

Note: [1]Only farrow-to-finish operations were considered.

Table 5 – Reproduction and health management carried out by smallholder pig farmers in the Metropolitan Region of Curitiba (n=362).

Some interviewees felt uncomfortable with questions regarding their monthly income and preferred not to answer. Among those who responded (34.2% of the total interviewed), 47.1% had a family income between one and two minimum wages, which was equivalent to approximately US$300.00 to US$460.00 in 2022. According to the Brazilian Institute of Geography and Statistics (IBGE) (2023), the real average monthly income of Brazilians in 2022 was R$2,533.00 — around US$480.00 — therefore many of the families included in this study had an income lower than the country's average. As for the main source of income, we found that for more than half of the interviewees, their livelihood was not based on farming, but on wages, business, or retirement. This fact supports discussions posed 20 years ago: Balsadi (2001) explains that the practice of commuting to work in the urban area and returning to the rural area, either daily or at another frequency, helps understand the phenomenon of rural population's activity in non-agricultural occupations. Additionally, the growth of urban areas has reduced the distance between rural and urban areas, so nowadays this practice has become even more common. Basaldi (2001) also addressed the difficulty of a significant number of rural families in surviving solely on agricultural production oriented for sales.

Our results show that the rural properties surveyed in this study were small — up to 10 acres — as are 50.1% of rural properties in Brazil, (IBGE, 2018). Studies on the Northeast region found similar results, however, we found a higher proportion of farms larger than 10 acres (27.9%) compared to the results of Silva Filha *et al.* (2008) (7.4%) and Souza *et al.* (2010) (0%) — which can be attributed to a greater diversity of properties in the Metropolitan Region of Curitiba when compared to those of Northeast Brazil. The work done on the farms relied on family labor, which may be related both to the small volume of agricultural production and to the fact that more than half of the families had farming as a secondary activity, as discussed above. Agricultural production of different crops — mainly corn — was present in 80.9% of the sites. Alongside industrial, mining, and timber sectors, agriculture stands out as a large-scale activity in the Metropolitan Region of Curitiba (COMEC, 2017). Among the interviewees who engage in agricultural production, 15.7% said they did not use pesticides. The decision to opt out of pesticides was generally related to the goal of selling organic products as a means to increase income.

The literature describes various forms of pig rearing, such as keeping the animals loose, concrete pens, and structures made out of locally sourced materials, including bamboo, wood, mud bricks, and straw. It is common for farmers in the same region to use varying housing arrangements (Nath *et al.*, 2013; Chah *et al.*, 2014; Leslie *et al.,* 2015; Gomes and Code, 2020). Similarly, we identified different systems in this study: free-range, loose housing, and confinement, all of which had varying levels of monetary investment in construction (Figure 1). In addition, research carried out in the northeast of Brazil and Uganda has described the practice of keeping pigs tied by ropes around their necks (Silva Filha *et al.*, 2008; Souza *et al.*, 2010; Nantima *et al.*, 2016), which was not observed in the present study.

Note: Concrete pen, well-structured and requiring greater investment (A); wooden housing, improvised (B); pigs kept outdoors in a large paddock with good vegetation coverage (C); pigs kept outdoors in a small area with no vegetation coverage (D).
F**igure 1** – Different structures used to house pigs in smallholder farms in the Metropolitan Region of Curitiba.

Pigs of undefined breed, present in most of the farms surveyed and generally referred to by farmers as "common pigs", are mostly animals with traits of Brazilian breeds, which possibly resulted from the disorganized crossing of various local breeds or genetic groups, and commercial breeds introduced into the herds (LEITE *et al.*, 2021). There was little interest in acquiring commercial breed pigs, which were present in 22.4% of farms, but also little concern about the preservation of autochthonous breeds, which were present in only 3% of farms. Figure 2 illustrates the genetic variations in pigs observed during the research.

Corn was the main source of feed in the farms, used by 93.4% of the interviewees and generally planted on the properties themselves. The farmers also used locally sourced vegetables as a way of reducing food costs, as they are highly available in the region. The Metropolitan Region of Curitiba has the largest vegetable production in the state of Paraná, in addition to corn production, which is present in all the cities in the region (Paraná, 2021).

Other studies have reported the use of locally available agricultural products to feed the pigs, which includes fruit, legumes, vegetables, grains, and tubers (Nath *et al.*, 2013; Kambashi *et al.*, 2014; Leslie *et al.*, 2015). According to Riedel *et al.* (2014), feeding management in smallholder pig farms is generally determined by the availability of food rather than the nutritional needs of the pigs. Furthermore, the farmers have little knowledge of food's chemical composition and the role of each nutrient in the development of animals. Thus, there are obstacles to balancing animal diets, which can result in poor diet or malnutrition (Nath *et al.*, 2013; Kambashi *et al.*, 2014). We observed that it is common to use kitchen waste to feed the pigs in only 19.1% of the evaluated farms, unlike what was pointed out by Souza *et al.* (2010) in subsistence farms in the state of Paraíba, Northeast Brazil, where all farmers feed it to their animals. This type of food can carry pathogens and is considered a risk for disease transmission (Mbuthia *et al.*, 2015). If used, it must be cooked, a process observed in only 2.9% of the farms where kitchen waste was utilized.

In 46.9% of the evaluated farms, piglets were weaned at around two months old. Similarly, other studies have reported weaning at two months (Rocha *et al.*, 2016) and 2.5 months (Kambashi *et al.*, 2014; Hirwa *et al.*, 2022). Meanwhile, Chah *et al.* (2014) reported weaning between five and six weeks in farms in Nigeria and, conversely, Riedel *et al.* (2014) described that the natural weaning age in small traditional farms in China was at around four months. Even with these variations, it is possible to conclude that the practice of early weaning (at 21 days) is not carried out on smallholder farms, as opposed to the intensive pig farming system (ABCS, 2014). As these smallholder production systems are not focused on productivity, there is no ideal age at which weaning should be carried out, consequently, the sow's physical condition and the piglets' stage of development should instead be taken into account.

Due to the high density of pigs housed, there is a major health challenge in intensive production systems, and investment in both prevention and control of diseases is essential (Dias *et al.*, 2011). On the other hand, there is little concern about health in smallholder farms, as exemplified by the low proportion (16.6%) of interviewees who sought a veterinarian for guidance. This is related to the lack of financial resources, but also to the low occurrence of diseases as identified by farmers. Even though it is likely that clinical signs may have gone unnoticed and that the farmers may have failed to identify sick animals. Also, it is understood that the occurrence of health problems in the visited farms is reduced due to the low animal density.

Note: Undefined breed pigs (A and B), autochthonous breeds with low body score (C), and crossbreeds of exotic breeds (D).
Figure 2 – Breeds of pigs and their crossbreeds present in farms located in the Metropolitan Region of Curitiba.

Investment in health care was restricted to the use of anthelmintics, demonstrating the farmers' concern about the occurrence of parasites. Conversely, the application of iron was not carried out in 34.9% of the farrow-to-finish operations with a confined or loose housing system, even though it is an essential handling practice for piglets that are raised entirely in confinement (Dias *et al.*, 2011). Vaccines were used in 8.8% of the farms, most of them to prevent salmonellosis, a common disease in the area that causes mortality in piglets. Considering that there are no mandatory vaccines in pig production and that the decision about which vaccines should be used depends on an individual assessment of each production, it can be concluded that this resource is being used appropriately (ABCS, 2014).

According to the farmers, the average number of piglets born alive per birth was 8.7 for undefined breed sows and 9.9 for exotic breed sows. This rate is higher than the one described by Gomes and Code (2020) in subsistence farms in East Timor (5.76), by Riedel *et al.* (2014) in small traditional farms in China (5.8), and by Hirwa *et al.* (2022) in Rwanda (7). It is similar to the one obtained by Madzimure *et al.* (2013) in autochthonous breeds in South Africa (8.4 to 10.5) and by Rocha *et al.* (2016) in the municipality of Senador Canedo, in the state of Goiás, Center-West Brazil (9.3). Therefore, the number of piglets generated per sow does not represent a productivity problem for farmers in the Metropolitan Region of Curitiba.

We observed a slower growth rate of the pigs in the evaluated farms when compared to intensive productions, which may be related, among other factors, to unbalanced nutrition (Rocha *et al.*, 2016). Based on the producers' reports, the pigs remain in the herd for an average of 11.1 months and weigh an average of 95.7 kg at slaughter. However, this information is not the result of any technical record, so it must be carefully interpreted.

All interviewees said that their production was aimed at family consumption, and 78.7% also sold live or slaughtered animals sporadically. They also reported that slaughter takes place on-site, usually performed by the farmers themselves, a fact that was also pointed out by other authors (Leslie *et al.*, 2015; Class *et al.*, 2020). This practice poses a health risk to the population due to the lack of inspection of animal products, which can lead to the transmission of zoonoses such as brucellosis, teniasis, toxoplasmosis, salmonellosis, and tuberculosis. It is important to highlight the risk of possible transmission of these zoonoses not only to both the consumer — who in these cases are family members — and to the local community, but also to the person responsible for handling the animal at slaughter (Viana *et al.*, 2014).

According to what was reported by the survey participants, pig production has little economic value for these families. Many say that the economic gain lies in access to animal protein without the cost of buying it, although there is the cost of production. On the other hand, in studies carried out with pig farmers in Northeast Brazil, Souza *et al.* (2010) found that 25.14% of respondents had

pig farming as their main source of income, 42.50% as their second source of income, and 32.36% as their third source of income. Silva Filha *et al.* (2008) reported that 11.8% of respondents had pig farming as their first source of income, 44.3% as their second, 43.4% as their third, and 0.5% as their only source of income. This divergence is likely related to the greater level of urbanization and development in the Metropolitan Region of Curitiba when compared to the regions covered in other studies.

Additionally, many farmers reported that they continue to raise pigs due to the custom of having the animals on the property, family tradition, a preference for lard over vegetable oil, and for eating "*caipira*" (free-range) pig meat. These reports demonstrate that the practice is of cultural rather than economic importance since many farmers mentioned that it would be more profitable to sell the corn produced on their property instead of using it to feed the pigs.

Other authors have discussed the importance of implementing improvement measures on these farms, such as actions by public authorities and closer communication between animal health professionals and farmers (Nath *et al.*, 2013; Leslie *et al.*, 2015; Munzhelele *et al.*, 2017). These studies also point out that actions such as the provision of technical assistance must be permanent, and that farmers will only be encouraged to make adjustments to their farms if they obtain financial return, which depends on the implementation of measures to organize the trade (Riedel *et al.*, 2014; Class *et al.*, 2020). Guidance from professionals is likely to be better accepted and incorporated by farmers who develop pig production directed at income (FAO, 2019). However, the surveyed smallholder pig farmers in this paper are not interested in improving their productivity because they consider that the activity does not bring a financial return.

Given the data presented, we believe that it is imperative to raise awareness among breeders. It is also of note that public policy actions and technical assistance should be focused on single health, acting to preserve the environment and the well-being of pigs, rural producers, and the local community. Government measures to encourage and ensure market access are also of interest to breeders who are interested in commercial activity.

5. Conclusion

Smallholder pig farming is diverse and each country and region has its own characteristics, which are closely related to the socioeconomic and cultural profile of the producers and the region. The majority share the same characteristics: non-incorporation of technological advances, small number of pigs produced, low investment, use of family labor, and difficulty in accessing markets. On the other hand, they vary greatly in terms of management, housing methods, breeds, zootechnical performance, and health challenges. The fact that farmers in the Metropolitan Region of Curitiba are not financially dependent on the activity means that they have no interest in improving productivity. Therefore, we postulate that the approach used to raise awareness among smallholder farmers needs to be different from the one normally used for producers who are financially dependent on livestock farming, thus ensuring that the activity does not pose a risk to them, the community, the animals, and the environment.

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