Challenges and opportunities of smallholder pig production systems in Rwanda

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Abstract

To decipher the dynamics, challenges, and opportunities of smallholder pig farming in Rwanda, a household survey was conducted in ten districts of the country. A total of 900 households selected randomly across four provinces and one city, 12 districts, 28 sectors, and villages were interviewed using a pretested printed questionnaire. Most of the respondents were heads of household: 70.9% for western, 63.5% in eastern, 54.1% in northern, and 52.5% in southern province, and their mean age was 46.7 years and had widely varying education levels. Crossbred pig genotypes were the most preferred due to their high growth rate and produce large litters compared to local pigs, as well as their high resistance to disease, and can better utilize low-quality feeds compared to pure exotic pigs. Piglets and sows were the biggest populations on most farms. Production of piglets for sale was the main purpose of rearing pigs in 63.7% of the farms. Natural mating was almost (99.1%) exclusive on all farms, implying that artificial insemination is yet to take root in Rwanda. Weeds were reported to be the main feed resource used particularly in wet season, while cereal grain mashes and concentrates were used by very few farmers due to high costs. Dominant challenges related to limited pig and pork markets, high taxation, limited extension services, and disease outbreak were highlighted. The most common diseases affecting pigs were swine erysipelas and internal parasites. Access to veterinary services by the households was limited especially in northern province (20%) leading to wrong diagnosis. Capacity building and provision of access to quality animal health services as well as setting up of markets were proposed as strategies to improve pig production by smallholders in Rwanda and grab a share of the lucrative pork market in the region.

Introduction

Pig farming is one of the most intensive livestock production systems in the world, with the global herd standing at 677.6 million in 2021 (https://www.statista.com). Whereas peak meat consumption has been reached in most countries especially in the west (Whitton et al. 2021), in developing countries particularly spurred by growing prosperity and consumer preferences, the demand is continuing to rise (Pig333 2019). Improvements to the pig production environment should be part of the continuous effort to enhance productivity as pigs respond well to such improvements (Zira et al. 2022). Pigs are adaptable animals and are reared mostly in three production systems, namely, intensive, semi-intensive, and extensive systems. In intensive production systems, pigs stay mainly indoors (Park et al. 2017), while pigs in semi-intensive and extensive systems are often found in outdoor or semi-outdoor environment. The pigs in the various production systems may be managed as family enterprises and/or as full and part-time family farms (Lukovic et al. 2017). Irrespective of system, pig farming fits very well with integrated farming and is complementary to intensive crop production in many parts of the world.

In Rwanda, pig farming has grown considerably in the last 5 years, though it remains largely informal at all value

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chain nodes (Shyaka et al. 2022). Demand for pork from the domestic market has led to a 76% growth of the national pig herd, rising from 706,000 pigs in 2010 to 1,492,000 in 2015 (www.euromeatnews.com) and thereafter rising further to 1.8 million in 2017 (Shapiro et al. 2017). The majority of these pigs are kept in traditional small-scale subsistence production systems (Shyaka et al. 2022). Pigs in such low-input systems provide value-added output for farmers by consuming feed that would otherwise be waste (Chauhan et al. 2016). Pig production in particular promotes greater self-sufficiency and provides a greater food security to urban households and increases incomes (Chauhan et al. 2016). Hitherto this study, the anticipated challenges of the pig sub-sector in Rwanda were hypothesized to include low productivity, low adoption of technologies in reproduction, nutrition, general husbandry practices, lack of proper markets and processing equipment, as well as reliance on live pig markets. Therefore, the objective of this study was to characterize pig production systems currently in use in Rwanda and to establish the real constraints in the sub-sector and propose strategies that will enhance the performance of the pig production sector in Rwanda.

Materials and methods

Study area

Rwanda is located between latitudes 1°04′ and 2°51′ south and longitudes 28°45′ and 31°15′ east (Mazimpaka, 2017). The study was conducted in four provinces and one city (namely Kigali City), all including ten districts of the country, viz. eastern province (Rwamagana and Bugesera districts), southern province (Kamonyi and Nyamagabe districts), western province (Rubavu and Nyamasheke districts), northern province (Rulindo and Musanze districts), and Kigali City (Gasabo and Kicukiro districts) (Fig. 1).
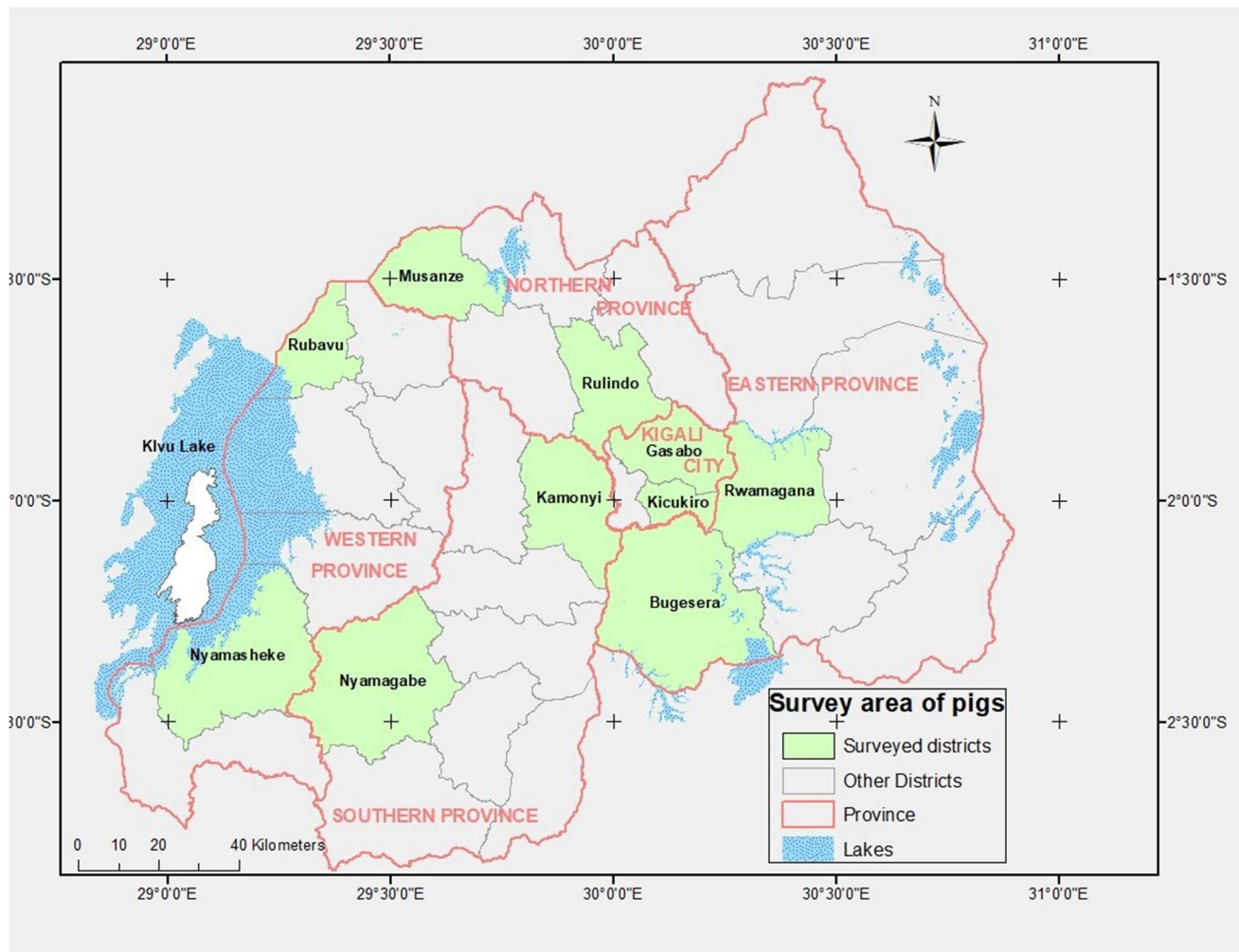

Fig. 1 Map of the study area

Data collection

Data on pig production systems was obtained through face-to-face personal interviews using a structured questionnaire. The aspects covered included demographic characteristics, pig management and practices, source and types of feeds, feeding practices, housing system, health status, pig marketing, production, and constraints as well as possible strategies for overcoming them.

Sample size determination

A minimum sample size of 900 respondents was determined using the formula of Krejcie and Morgan (1970):

$$N = \sum_{i=1}^{n=10} (2n)(3c)(3v)(5f)$$

where:

N   Sample size.

i   Number of selected district.

n   Number of selected sectors per district.

c   Number of selected cells per sector.

v   Number of selected villages per cell.

f   Number of selected pig farmers per village.

Sampling technique

The study used a descriptive, purposive, and stratified survey design with stratification at province, district, sector, cell, and village, being the smallest administrative unit in Rwanda. From the city and each of the four provinces, two districts with the highest density of pigs were selected, and then from each district, 36 sectors were randomly selected followed by further random selection of two cells from each sector, and from each cell, five pig keeping farms/households were randomly picked giving a total of 900 pig farming households distributed across ten districts (Fig. 1). Households were selected using systematic random sampling method, and respondents there were interviewed at their respective homesteads. Households were selected bearing in mind the differences in pig production systems within sectors, cells, and villages for each of selected districts. In each selected sector, three cells were randomly selected, and respondents were then randomly selected from each village in accordance with sample size. Pretested questionnaires were administered to pig farmers by trained enumerators. The target population was all pig smallholder farmers irrespective of the number of pigs kept.

Data management and analysis

Data was first entered into Microsoft Excel computer program and thereafter screened for errors that might have occurred during the entry, and any error was corrected by rechecking against the original data forms. Analyses were then performed using the Statistical Package for Social Sciences (SPSS, 2015) and presented as tables, graphs, and charts.

Results

Demographic characteristics of pig farming households in Rwanda

Households were predominantly headed by males (76.1%), and of those that were female-headed, majority (31.4%) were in the southern province (Table 1). Pertaining to the age of the head of household (HH), the highest proportion was aged above 50 years, followed by those in their 30 s and 40 s, while a few were below 30 years. However, the southern province had the highest average age (45.8 years) of the HH. The study revealed that most of pig keepers (82.8%) were married and 1.7% were divorced (Table 1). Overall, most respondents were household heads (60.2%), and across provinces, there were no differences ($P > 0.05$) in the observed proportions for spouse, child, or other relation respondent. Forty-one percent of the HHs had primary school level of education, while 21.6% had no formal education across all the provinces. Education levels varied greatly across provinces, and only 3.5% of the respondents attained university education with 5.1% of these coming from the western province of Rwanda.

Pig genotypes reared, herd structure, and production

Farmers kept different pig breeds and their crosses. Forty-one percent of the households kept crossbred pigs, local (19.7%), Landrace (18.7%), Large White (12.1%), Pietrain (8.1%), and other breeds (0.3%). More piglets (females and males) were reported in farms than other categories of pigs. However, by category, sows were the most (18.9%) kept by farmers, followed by male piglets (17.6%), female piglets (17.2%), gilts (15.5%), male growers (8.7%), female growers (8.1%), boars (7.3%), male finishers (5.7%), and female finishers (1.1%). Significant differences were observed within and between provinces ($P < 0.05$) between the different pig age groups. The average number of sows (19.5%), gilts (21.0%), male piglets (19.2%), and female piglets (22.2%) were the most observed in east, west, north, and south, respectively (Table 2).

Table 1 Characteristics of pig farming households in Rwanda

Parameter	Level	Provinces					
		Eastern	Western	Northern	Southern	Overall	*P*-value
		% of respondents					
Gender of head of household (HH)							
	Female	22.2	18.8	23.1	31.4	23.9	0.130
	Male	77.8	81.2	76.9	68.6	76.1	
Age of HH (years)							
	< 30	18.4	7.9	5.9	9.3	10.5	0.002
	31–40	30.4	26.3	31.9	22.9	27.9	
	40–50	28.8	23.7	21.0	22.0	23.9	
	> 50	22.4	42.1	41.2	45.8	37.6	
Marital status of HH							
	Married	78.6	85.3	88.4	79.2	82.8	0.002
	Single	11.1	2.6	1.7	2.5	4.6	
	Divorced	3.2	0.9	0.8	1.7	1.7	
	Widowed	7.1	11.2	9.1	16.7	11.0	

HH head of household.

P-values correspond to comparisons between provinces.

Table 2 Pig herd composition on farms located in various provinces of Rwanda

Pig category	Number of pigs per province				Total	*P*-value
	East	West	North	South		
Boars	5.5	2.6	15.6	13.9	7.3	0.353
Sows	19.5	18.4	17.5	19.8	18.9	**0.026**
Gilts	12.5	21.0	12.3	14.2	15.5	0.273
Male piglets	17.6	18.0	19.4	14.9	17.6	0.112
Female piglets	17.1	14.9	16.9	22.2	17.2	0.220
Male growers	10.9	5.6	8.7	9.5	8.7	0.081
Female growers	11.2	6.6	7.3	4.0	8.1	**0.012**
Male finishers	3.4	12.8	1.7	0.9	5.7	0.443
Female finishers	2.3	0.1	0.6	0.5	1.1	0.126

Business objective, reasons for farming pigs, and length of experience with farming pigs in Rwanda

In aggregate of provinces, the business objectives of the pig farmers were piglet production (63.7%), both piglet production and fattening (13.7%), production of finishing pigs (9.8%), production of fattening pigs (10%), and production of breeding stock (2.9%). For reasons of engaging in piggery business, most farmers reported (a) economic-related benefits such as household income (81.4%), high profitability (22.4%), and poverty reduction (2.5%) and (b) production-related benefits such as fast growth rate (44.2%), high litter sizes (9.5%), easy to manage (2.5%), and manure production (2.7%). Other reasons were as follows: pigs are the only available livestock species for beginners (5%), easier feeding due to ability to utilize poor quality feeds (2.5%), pigs are not labor intensive (compared to other species such as cattle) (2.5%), and disease tolerance (11.8%). The average duration of rearing pigs generally categorized as experience was similar in western, northern, and southern provinces (6.2 years), while eastern was least (4.4 months).

Breeding and performance indices

The average age at sexual maturity for gilts and boars was within a range of 7 to 9 months (Table 3), and results within the provinces differed significantly ($P < 0.001$). The number of litters farrowed per year was reported and varied within a range of two to three times per year, with an average of seven piglets per sow. The average birth weight of piglets was reported to be 2.1 kg and showed no variation ($P > 0.05$) between provinces. The maximum and average number of piglets per sow, the average birth weight, number of weaners, and the age at weaning did not differ ($P > 0.05$) between provinces.

Table 3 Reproduction and production parameters

Performance parameters	Level	Province					
		Eastern	Western	Northern	Southern	Overall	*P*-value
Age at sexual maturity (months)	Male	7.6	8.2	9.1	8.6	8.3	0.000
	Females	7.4	7.9	9.4	9.1	8.4	0.000
No. of litters farrowed per sow/year		3.3	2.6	2.0	2.1	2.5	0.000
Number of piglets born per litter	Maximum	9.6	9.3	9.7	9.5	9.5	0.713
	Minimum	5.9	5.4	4.9	5.3	5.4	0.002
	Average	7.1	6.9	7.0	6.9	7.0	0.783
Birth weight (kg)		1.9	2.1	2.1	2.1	2.1	0.185
Piglets weaned per litter		6.8	6.5	7.0	6.9	6.8	0.258
Age at weaning (months)		2.4	2.6	2.4	2.7	2.5	0.369
Farrowing interval (months)		5.5	5.1	7.1	6.6	6.1	0.000
Body weight (kg) of females	6 months	39.1	39.7	32.2	32.4	35.9	0.000
	12 months	76.9	80.3	60.6	62.2	69.6	0.000

Breeding method used by the farmers

Natural mating was almost the exclusive method used by most farmers (99.1%) to breed their pigs. Overall, only a meager 0.2% of the farmers used AI, and 0.7% used both AI and natural mating. At the time of survey, all farmers in the eastern region used natural mating for their pigs. The artificial insemination was used at 0.2%, while the western region was the only that used it at 0.9%. Elsewhere, the use of artificial insemination was the sole method of mating in 0.9% of pig farmers of western province, and 0.9% of the western province farmers used both artificial and natural insemination. In the north, 1.1% of the farmers and 1% in the south relied on both mating methods. Farmers in the western region used both natural and artificial mating, natural being more practiced at the rate of 98.2%.

Pig feeding management practices

Confinement of pigs was the management system used by most farmers (average 94.8%), followed by a very low number of farmers using also scavenging (average 3.5%) and/or tethering (average 1.6%), with these latter two practiced in all but the northern province where confined management was exclusive.

The most available feeds were reported to be kitchen waste (in 89.2% of pig farms), weeds (88.4%), potato peels (85.2%), potato roots (83.6%), and potato vines (87.2%) across all provinces. They can hence be considered the major source of swine feed in Rwanda. The reported differences in production of potato vines, weeds, and kitchen waste were not significant (*P* > 0.05) between the provinces. Interestingly, pumpkin was less reported by farmers (6.5% overall) due to competition for it between humans and animals. Feed concentrates were being used by an average of 20.7% of all pig farmers who participated in this study. Overall, the most common feed source

(weeds) was collected in farms mostly during the rainy season with 93.3% of feed surplus. Half of all pig farms reported that they sourced pig feed from within the farm, while 3.7% relied primarily on the feed industries and the rest sourced feed both on and off-farm. The western region produced more feeds with 59.8%, followed by southern (49.2%), eastern (48.8%), and northern (42.6%) provinces. Feed concentrates were used in a very small quantity, the western region being the highest user than others. Most of the households experienced acute feed shortage in dry season with an average of 94.8% across all pig farms; as a result, most of the households thereby purchased feeds for pigs at prices higher than normal. Overall, 25.8% of farmers reported that no actions were taken during feed shortages. However, some did have clear interventions to the feed challenge, with the most common strategies for dealing with feed shortages being buying concentrates (13.1%), feeding pigs on kitchen waste (10.8%), purchasing feed ingredients and mixing/compounding them at home (9.2%), selling pigs off (1.9%), and giving pigs away too other farmers (1.5%). The main constraints to pig feeding were high feed costs and insufficient and poor quality of the feeds. Surprisingly, no one mentioned the lack of skills in the feeding practices. Feeding constraints were reported by order of importance in western, northern, eastern, and southern provinces.

Pig health management

Swine erysipelas (40%) and internal parasites (30%) were reported by farmers as the main diseases affecting pigs across provinces, and the minor diseases each reported by less than 10% of the farmers were diarrhea, skin diseases, coccidiosis, and other minor ones. The southern province was more affected by swine erysipelas, whereas eastern province was more affected by worms. Conventional treatment by veterinary officers and deworming were the main methods of

preventing diseases in pig farms. Vaccination and quarantine were known and are practiced by relatively few farmers.

Extension service provision to pig farmers

Results show that 66.5% of households had contacted veterinarians for knowledge on pig management, while 71.3% had received veterinary services by the time of the study. Farmers reported low access to extension services from veterinarians. The unavailability of veterinary was especially lower in northern province (38.6% of the pig farms there) compared to other provinces. Overall, most extension officers were private veterinarians (65%), government veterinarians at the sub-district level (25%), and community animal health workers (1%), and very few farms got extension services from both private and public sector vets.

Pig marketing and records

Table 4 shows the age, weight, and price of pigs as differentiated by purpose (breeding, fattening, or slaughter). Pigs are sold based on age, weight, and the price. In the study, the price of piglets differed significantly between provinces for piglets of about the same age (Table 4). The average age of piglets sold to other pig farmers and for fattening significantly differed ($P < 0.05$), while the differences in weights and prices between those two categories were also significant ($P < 0.05$) as would be expected. The average weight, price for finished pigs, and the price of piglets for breeding and slaughtering purposes did not differ significantly ($P > 0.05$).

The majority of the farmers (87.7%) did not keep the records on their pig herd, and only a few of them (12.3%) did. Fifty percent of the respondents in western province kept their farm records, while in other regions, recording was

rarer. The reasons for not keeping records on the pig enterprise were lack of knowledge on the importance of recording (29.5%), lack of knowledge on recording (28.5%), belief that records are not necessary (34%), other reasons such as inability to write, and lack of preparation to record (8%).

Challenges in the pig industry

Challenges that affect piggery farming were unreliable markets for both piglets and slaughter pigs (5.4%), long distance to the pig markets (2.2%), low prices for pigs (1.2%), diseases (0.3%), high taxation regimes (0.3%), expensive feeds (0.3%), and limited pig and pork demand (0.3%). However, in a very surprising twist, a staggering 90% of the respondents reported that they had no major challenge to their pig enterprises.

Discussion

The respondents to this study generally had a low level of education with majority having attained primary school level of education, potentially negatively affecting uptake of information provided by extension service providers as has been reported elsewhere (Nsoso et al. 2006; Karimuribo et al., 2011) particularly regarding disease control and improved pig management. The findings were at par with records on national standards for adult literacy rate in Rwanda that report majority of the adult people (73.2%) as being able to read and write. The average age of pig farmers was 46.7 years, showing that pig farming is for middle aged, possibly due to the need for investment capital that would be limiting to youth farmers and the need for regular intensive labor that would be limiting for the elderly. The mean age was close to 49 years recently reported for Kenya pig farmers (Kirima et al. 2017),

Table 4 Pig sale characteristics

Characteristics	Level	Province					
		Eastern	Western	Northern	Southern	Overall	P-value
Piglet sold for breeding	Age (months)	2.3	2.4	2.4	2.3	2.3	0.649
	Weight (kg)	12.4	14.3	11.2	11.2	12.4	0.000
	Price (RwF)	15,456	20,302	14,518	12,624	15,863	0.000
Piglet sold for fattening	Age (months)	4.0	4.3	3.4	3.5	3.8	0.012
	Weight (kg)	23.1	29.1	15.8	17.2	21.8	0.000
	Price (RwF)	29,918	39,735	20,459	21,455	28,708	0.000
Fattened/finished pig sold for slaughtering	Age (months)	8.4	9.2	12.1	10.8	10.1	0.000
	Weight (kg)	54.2	57.2	61.2	57.7	57.5	0.578
	Price (RwF)	70,699	83,179	70,926	67,819	73,238	0.226
	Price/kg of pig reared for breeding	1703	1608	1630	1654	1647	0.972
	Price/kg of pig reared for slaughter	1510	2017	1468	1816	1697	0.191

RwF—Rwanda Francs, 1US$ = 833.1 RwF

41 years for Botswana (Nsoso et al. 2006), and 38 years in Tanzania (Karimuribo et al., 2011).

The crossbred pig genotypes were preferred in Rwanda because of their rapid growth rate, good disease resistance, ease of feeding by being able to utilize low-quality feed, as well as high litter sizes. Different reasons were reported by farmers for selecting the Landrace, Large White, and Pietrain pig breeds. Exotic pigs and their crossbreeds with local pigs present with high productivity, high profitability, disease tolerance, and easier management of rearing facilities. Studies in East Africa such as Muhanguzi et al. (2012) also found crossbred pigs being the most dominant (67.4% of farms) pig genotype kept, and for Uganda, the choice was mainly driven by disease resistance, litter size, and higher growth rate exhibited by the genotypes. Possession of a desirable growth potential and high fecundity were reported as drivers for preference of exotic breeds (Ilatsia et al. 2008), while in India, preference for crossbred pigs was justified by their better growth performance, large litter size, low mortality rate and high back fat thickness (Rahman et al. 2008), and rapid growth rate (Njuki et al. 2010). However, a recent contemporary study in Rwanda reported divergent position on pig breed preferences (Mbuza et al. 2016).

The experience of farmers on rearing pigs in Rwanda was an average of 5.7 years. This duration shows that pig farmers do not invest in the enterprise for a long time, compared to durations in rearing other livestock species particularly cattle where experience goes into decades (Hirwa et al. 2017). Elsewhere, Nantima et al. (2015) had reported a high 10 years of experience for Uganda pig farmers, while Kagira et al. (2010) reported a very low length of experience in Kenya of a mere 1 year. From our study, we report that the foundation breeds in Rwanda were purchased by the farmers from the local market (91.7% of all farms), quite comparable to Kirima et al. (2017) that found that 95.2% of farmers in Kenya sourced replacement pig stock (for breeding) through local purchase. Indeed, other results from Kenya (Kagira et al. 2010 and Madzimure et al. 2012) did not differ. It is noteworthy that this mode of acquisition of pig breeding stock may lead to inbreeding and subsequently low productive performance of the pig enterprises.

The biggest challenges to swine farming in Rwanda were found to be market related—unfair pricing for both breeding and slaughter stock coupled with few marketing points making farmers move long distances to central markets as well as unfair taxation regimes. There is therefore a need to set up more markets good enough, and the demand for pork appeared mostly to be stable. Limited access to extension services and diseases was also of concern. Swine erysipelas and worms were reported by farmers as the main diseases affecting pigs in Rwanda, whereas the eastern region was more affected by worms, similar to findings of other contemporary studies (Murungi et al. 2021). Previously, Mbuza et al. (2016) had reported the pig industry challenges as lack of affordable quality feeds (66.8%), lack of breeding pig stock (43.5%), diseases (38.2%), marketing problems (37.4%), and lack of finance/credit facilities (26.9%). Whereas farmers in the Mbuza et al. (2016) study got all the challenges each pig farmer faced, our study sought to get the most challenging situation, and that explains the wide differences in the findings of the two contemporary studies. The most dominant prevention method reported by Rwandan pig farmers was treatment in the case of swine erysipelas and deworming in the case of parasitic diseases. Njuki et al. (2010) suggested similar prevention methods (conventional, deworming) for pigs affected by worms and swine fever. The primary purpose for keeping pigs was income generation. Leslie et al. (2015) reported similar results where farmers raised pigs for extra income (69%). The challenges observed point to some clear opportunities that could see a transformation of the pig industry in Rwanda. Leading among these are establishment of new markets that could target the huge market in the Democratic Republic of Congo that could very competitively purchase the pigs and products produced in Rwanda. A growing middle income in Rwanda could also be targeted to be a niche market for some of the good pork cuts and by-products that the pig industry is surely capable of producing.

In conclusion, the smallholder pig production system in Rwanda can be characterized as low input with an objective of income generation. The poor husbandry practices are likely to be an impediment to the marketing of pigs emanating from the 10 districts of Rwanda. Future research and development approaches should focus on the integration of smallholder farmers into the country's market value chains. There is a need to improve access to quality extension services and seek solutions to constraints using locally available resources. This report provides the baseline situation of pig production, management, and marketing in Rwanda. Pig farming business interventions should be focused on the improvement of pig production, disease control, adoption of improved breeds, and improvement of feeding practices which are the key interventions to have a positive impact on productivity. For this to happen, capacity building and improved access to veterinary services will need to be stepped up.

Code availability Not applicable.

Declarations

Ethical statement "All applicable international, national, and/or institutional guidelines for the care and use of animals were followed."

Consent to participate Not applicable.

Consent for publication Not applicable.

Conflict of interest The authors declare no competing interests.

Statement of animal right "All applicable international, national, and/or institutional guidelines for the care and use of animals were followed."

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