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Full Length Research Paper

Rwandan Smallholder Households' Challenges and the Profitability of Pig Farming: A Case Study of the Musanze District

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Insecurity is a risk associated with the growing human population, particularly with regard to animal-based foods. Pigs contribute significantly to household income throughout all production levels. This study's primary goal was to examine Rwandan smallholder households' pig farming profitability and restrictions. A multistage sampling strategy was used to ensure the research's success. Five sections of the Musnze district were used for the study. Five sectors and the Musanze district were chosen using a purposive selection technique. However, a sample size of 120 pig farmers who responded was obtained using a random sampling technique. The profitability of pig farming was assessed by calculating the costs and returns involved in production, and the factors influencing pig farming among small householders were identified using STATA and a stochastic frontier production function. The results showed that the majority of respondents in the research area's pig farming production are men. According to the results of the regression analysis, pig farming in the study area was influenced by five factors: education level, market availability, off-farm generation, feed availability, and access to veterinary services. These factors were all positive and statistically significant at the P ≤ 0.01 level of probability. Additionally, the results showed that Net Farm Income (NFI), Gross Margin (GM), Total Revenue (TR), and Total Cost (TC) were all statistically significant at (p < 0.01). According to the research findings, pig farming is a lucrative enterprise in the region under investigation. Regression analysis results also showed that, at the P < 0.01 level of probability, the three factors—income generation, employment prospects, and new job creation—had positive and statistically significant effects on pig farming in the research area. According to the study's findings, the most frequent obstacles to pig farming in smallholder households were inadequate initial capital, high feed costs, poor feed quality and sacristy, a lack of conservation facilities, pest and disease outbreaks, high piglet costs, a lack of farming knowledge, and substandard housing. notwithstanding the limitations mentioned by several study participants. In the research region, pig farming is a lucrative industry that can raise income, improve employment prospects, create new jobs, and obviously raise farmers' standard of living. The study's conclusions have led to recommendations for training and equipping pig farmers and veterinarians with new technology and innovations, as well as for promoting interventions that can help farmers or marketing organizations acquire initial start-up funding to help launch their farming operations. In order to support and enhance the underlying company progress or stunting, as well as to make wise decisions, encourage the examination of profitability, opportunities, and limits along the pig value chain.

Key words: Pig Farming, Profitability, Smallholder, Households.

INTRODUCTION

There will likely be a huge demand for food of animal origin due to factors like population expansion, urbanization, income development, and dietary changes (FAO, 2006; Thorton, 2010). If practical means of generating food are not taken advantage of, the growing human population poses a threat to food insecurity, particularly with regard to food originating from animals. As the primary source of essential animal protein, the livestock subsector of the agricultural sector plays a crucial role in the

national economy. The significance of the livestock subsector aligns with the FAO's (2003) guideline that a man should consume 65–72 grams of protein per day on average, with 53% (about 35 grams) of that amount coming from animal sources. The livestock industry directly supports the livelihoods of more than 600 million impoverished smallholder farmers in the developing world, employs over 1.3 billion people worldwide, and accounts for 40% of global agricultural output (FAO, 2011; Thorton et al., 2006). Worldwide, pig production is widely dispersed. With 56% of the world's total pork production, Asia is the world's top producer, outpacing North America (17%) and Europe (25%). 48% of the world's pork production comes from China alone (FAOSTAT, 2011). Pigs' capacity to turn many types of feed, including household scraps, into meat is one of their main advantages (Rahman et al., 2009). Pigs are by far the most efficient farm animal when it comes to converting feed energy into body energy when considering overall feed conversion. Another significant benefit of pigs is their high productivity rate, which ranges from 9.3 to 9.96 live piglets per sow. Okoli (2006) and CTA (1995).

According to estimates, Sub-Saharan Africa's yearly pork consumption is expected to rise by up to 155% between 2000 and 2030, while nations classified as low-income will see an even greater increase of 167% (FAO 2011). However, unless the correct products are produced in the right location at the right price, profitable pig production will not be possible. In order to establish the most efficient method of producing pigs, it is crucial for the prospective pig farmer to comprehend the economic, physical, social, ethnic, and religious variables at play. Pigs are still primarily kept for their meat production all throughout the world (FAO, 2018). The producer and his family may use the pork, or it may be sold to generate revenue. Additionally, processed meats like bacon sausage are being manufactured and are becoming more and more well-known. Particularly in Asian nations, by-products like pigskin and bristles are utilized in the production of light leather and brushes (FAO, 2018). Establishing intensive pig production in impoverished nations is quite simple if funding is available and sufficient feed supplies are guaranteed (Ogunniyi and Omoteso, 2011). Pigs offer a consistent and immediate source of income to help rural households with daily necessities including school fees, medical bills, and farm inputs. In addition to being a great fertilizer, pig dung may be aerobically digested to provide cooking gas and promote the growth of plants and microorganisms that can be fed to freshwater ducks and fish (Okoli, 2006).

A vital and fundamental component of Rwanda's agricultural economy, livestock production contributes to the creation of jobs, income for farmers, economic growth, vocation for farmers, and other multipurpose uses in addition to the direct production of food (FAO, 2012; MINAGRI, 2019). The primary species raised in Rwanda include cattle (991,697 heads), goats (1,270,973 heads), sheep (371,766 heads), pigs (211,918 heads), poultry (2,482,124 heads), and rabbits (489,401 heads). The animal husbandry subsector accounted for around 8.8% of the GDP (MINECOFIN, 2007). In terms of animal output, livestock production does not meet the nation's feeding needs (MINAGRI, 2008).

The primary reason limiting animal output today is the nutritional quality of feedstuffs, particularly forages, which is one of the many limitations facing animal husbandry. If the animal is not fed well, it will not show off its genetic potential or remain healthy (MINAGRI, 2008). One significant subsector of the livestock business is pig farming. However, in Rwanda today, pigs alone account for up to 21% of all meats produced and consumed. The production of pigs is special because it provides the fastest returns on investment and the highest turnover rate among animal operations (FAO, 2011).

Livestock output in Rwanda is currently increasing at an unparalleled rate. The production of livestock is increasing, and this trend is predicted to continue. This is especially because of the several policy initiatives that support food security. With 46% of the total meat production, cattle made a substantial contribution, compared to 21% for pigs (MINAGRI, 2019). Over time, there has been an increase in the production of animal products. This can be ascribed to many initiatives that assist the growth of the livestock industry, including the livestock intensification program and small stock development (MINAGRI, 2019).

Priority is given to livestock infrastructure development, animal health, animal feeding, and genetic enhancement through these projects run by MINAGRI, Districts, and other stakeholders. In an effort to improve diet, the government started a few projects. A human diet must include animal protein, particularly for young children. The most effective way to generate protein on a limited amount of land—a precious resource in Rwanda—is with small cattle (MINAGRI, 2019). Through investments, favorable policies for medium- to large-scale industrial operations, and subsidies to reduce poverty in low-income households and manage food security in vulnerable families, the government encourages increasing pig production and consumption (MINAGRI, 2019).

Regarding livestock, 68% of Rwandan homes own some kind of animal. Musanze District, where 69% of all households own livestock, has seen a modest decline. This demonstrated that the number of families keeping cattle in Musanze District is higher than the national average. There were 91,000 households in this district that raised livestock, mostly pigs. Still, just a small percentage of Musanze's population—roughly 3% of the nation as a whole—raise animals. Because of the lack of livestock and the growth of its market, Musanze is still dependent on agricultural output (EICV 3, NISR, 2011).

Despite certain challenges, Rwandan pig production has expanded significantly over the past 10 years and is comparatively well-developed (FAO, 2012). The high cost of feeds, restricted credit availability, diseases, poor marketing prospects, a lack of basic knowledge about pig management techniques, poor extension services, and a shortage of qualified veterinarians on pig diseases and preventive health are some of these issues (FAO 2011; MINAGRI, 2019).

Pigs contribute significantly to household income throughout all production levels. The selling of piglets and live adult pigs is how pig producers make money. In addition, pigs provide

food security, nutrition, manure, and waste disposal. Many farmers believe that raising pigs is the livestock counterpart of cash crops and has the ability to enhance rural incomes because of the animal's short breeding cycle. The proceeds from the selling of pigs are used to pay for hospital expenses, school fees, clothing, food, and improved household systems (FAO, 2012; Dietze, 2011).

Pigs are permitted to forage on pasture and be supplemented with available farm waste by many pig farmers in underdeveloped nations and the tropics (Rangoma, 2013). The majority of homes in the study region have some sort of kitchen waste that pigs can utilize, but it is insufficient and of poor quality to partially feed three mature pigs per family, whereas in sophisticated systems, pigs are completely contained and fed a balanced diet. The dietary needs of the various classes of pigs must be understood and satisfied in order to provide a balanced diet. Therefore, buying pre-made meals from reputable commercial sources is wise for pig breeders (Rangoma, 2013).

Significant obstacles prevent smallholder pig producers from taking advantage of improved marketing options and the growing demand for pork. Lack of genetic and breeding strategies; poor slaughter technologies and limited value addition; low production and productivity levels; low farm-gate prices and distressed pig sales; lack of organized producer groups and organizational strategies to achieve economies of scale; low bargaining power; poor husbandry and farm management practices; poor quality feeds and pig nutrition practices; limited access to inputs, extension services, agricultural insurance, credit, and other financial services; and a lack of fair and effective market linkages for smallholder farmers are some of these challenges (Tatwangire, 2013).

The most crucial factor in pig production is feed cost. 75–80% of the overall cost of raising pigs is spent on feed (Smith, 2006; FAO, 2012). Pig meals consist of 55-70% grains (Smith, 2006). However, a significant constraint in many developing nations is the lack of grain to feed both people and animals (Petrus et al., 2011). High feed prices and shortages are issues for small-scale pig producers in developing nations (Peters, 2004). In most research, the amount of feed and the frequency of feeding are not clear. Age, the pigs' physiological condition, and feed availability all have a major impact on how much feed is given (Hossain et al., 2011; Kagira, 2010).

Pig farmers in Rwanda often struggle with issues such adequate housing, pig feed supply, price, and accessibility. Farmers must feed their pigs balanced commercial or homemade feeds in order to increase the pigs' weight and production and generate respectable income. This is rarely the case because the majority of pig farmers give their animals low-nutrient feedstuffs, such as agricultural waste. The majority of pig deaths happen when the piglets are young (FAO, 2012).

Because pre-weaning mortality in piglets is frequently caused by exposure to adverse weather conditions, including cold, rain, and predators, housing is crucial. By offering suitable and safe housing, young pig mortality can be prevented (Madzimure et al., 2013). A farmer may effectively raise 85% of all live-born piglets to market weight in the lowest amount of time with the aid of good housing, which also simplifies management (Gikonyo, 2010). Worm infestation is a major public health issue in rural areas due to inadequate husbandry measures and a shortage of meat inspectors (Veary and Monato, 2008). African Swine Fever (ASF), porcine cysticercosis, mange, pediculosis, and infestations of worms, ticks, and jiggers are among the major diseases that affect pigs (FAO, 2012). According to other research, pig productivity is significantly hampered by pests and diseases (Muhanguzi et al., 2012).

The absence of structured breeding programs to support genetic improvement is another obstacle to increased pig production in poor nations like Rwanda and others (Kahi et al., 2008). The absence of adequate, trustworthy records and sound pedigree structure has been a barrier to genetic improvement initiatives. The majority of pigs in the nation are extremely inbred, and this problem needs to be addressed immediately (Kahi et al., 2008). Although Rwanda's existing system has been found to be ineffectual and unable to satisfy the demands of local farmers, agriculture extension is a potent instrument with a wealth of potential to empower and promote rural livelihoods (Rola et al., 2002) (FAO, 2012).

In any industrial system, but especially in pig production, the development of a stable market is crucial (Michael Levy, 2014).

In rural regions, pig farming is underdeveloped and fails to meet community requirements, such as improved earnings and food and nutritional security. These are caused by a number of limitations, including a lack of initial investment capital, the tiny amount of land set aside for livestock keeping, a lack of knowledge, and the fact that pig breeding and consumption are forbidden by the Muslim faith (FAO, 2018). Currently, more and more people are interested in eating pig, despite the difficulties mentioned above. Farmers now have more markets for their products since the cost of other meats is rising relative to pig and because there are more outlets, including small-scale processors and local butchers (FAO, 2018).

The majority of the clients in this area have strong demands for pig meat. Even yet, the pig industry is important because of the nutritional content of pig meat, the contribution of pig production, and the range of agricultural operations. The profitability and limitations of pig farming in the study area have not been evaluated by any research. However, the purpose of this study was to examine the profitability and limitations of pig farming in Rwandan smallholder households, using the Musanze district as a case study. Identifying the factors that influence pig farming in smallholder households in the study area, analyzing the profitability of pig farming in smallholder households in the study area, calculating the contribution of pig farming to smallholder households in the study area, and determining the constraints of pig farming in smallholder households in the study area are each of the specific objectives.

MATERIALS AND METHODS

Description of Study Area

The investigation was carried out in the Musanze region of Rwanda's five-pronged northern province. The Musanze district is 1849 meters above sea level and is situated at latitude 1.50 and longitude 29.63. The majority of the Volcanoes National Park is located in this area, which is the most mountainous in Rwanda. The majority of Rwanda's mountain gorillas can be found in this district, which makes it the most visited tourist destination in the nation. The district, which has an average elevation of 1860 meters, is divided into two zones and, as a result, has two different types of soils: volcanic ash soils with lava-predominant stones and a volcanic area with moderate slopes (www.musanze.gov.rw.).

Steep hills with active erosion make up the last portion. The high-altitude tropical climate of Musanze District features an average temperature of 20ºC and rainfall that ranges from 1400 to 1800 mm. The District's economy depends heavily on agriculture. Agriculture employs at least 91% of the population. Musanze is regarded as a national granary. The district has a total size of 5,304 km². Musanze is separated into 432 settlements, 68 cells, and 15 sectors. There were 368,563 people living there in total in 2012, with a gross density of 695 people per km2. With 174,760 males and 193,803 females, it has an average annual growth rate of 1.8% (NISR, 2012).

Sampling Technique and Sample Size

The pig farmers in the Musanze district were the study's population of interest. To find and examine the social and economic factors affecting smallholder households' pig farming, profitability, and social and economic impact on smallholder households, as well as the limitations in the study region, the study used a cross-sectional research design. A multistage sampling strategy was used to ensure the research's success. A purposive sample of the Musanze district and its five sectors—Rwaza, Nkotsi, Muko, Kimonyi, and Remera—was conducted in the first stage. In the second step, twenty-four (24) pig farmers were randomly selected from each of the selected sectors, for a total of 120 pig farmers. The District Veterinary Officer gave the list of pig farmers that were available in the district agriculture office. These sectors were selected because, in comparison to the other ten sectors in Musanze, there are a greater number of pig farmers in them. Structured questionnaires were used to gather primary data from the chosen pig farms. Descriptive statistics, cost-benefit analysis, and the stochastic frontier production function were used to analyze the data collected from those farms.

Data analysis techniques

The socioeconomic characteristics of the pig farmers, including gender, age, educational attainment, farming experience, occupation, marital status, and family size, were described in this study using descriptive statistics like frequencies and percentages. Version 20 of the Statistical Package for Social Science (SPSS) was used to analyze this. However, the factors impacting pig farming among small homeowners were identified using STATA's stochastic frontier production function, and the profitability of pig farming was then estimated using cost-benefit analysis and farm net revenue for pig production. If the BCR is greater than 1, pig production is lucrative. The profitability of the pig producing industry increases with the BCR.

Model Specification

To ascertain the viability of pig production, an analysis of the costs and returns related to pig farming was conducted. Using budgetary methodologies, the cost and returns of pig production in the study area were calculated using net farm revenue and gross margin. The farm budgetary analysis assists in calculating the overall expenses and income incurred by the business within a given production period.

Where:

GM = Gross Margin TR = Total Revenue

TVC = Total Variable Cost TFC = Total Fixed Cost NR= Net Returns

TC= Total Cost

NFI= Net Farm Income ROI= Returns On Investment GR=Gross Ratio

OER=Operating Expense Ratio DER=Depreciation Expense Ratio NFIR=Net Farm Income Ratio BCR=Benefit Cost Ratio

RESULTS AND DISCUSSION

Socioeconomic Features of Pig Farmers surveyed

According to the results in Table 1, the majority of respondents (59.2%) in the pig farming production industry are men, whereas the majority of pig farmers in the research region are women (41.8%). This suggests that men produced pigs at a higher rate than women. The study was backed by Umeh et al. (2015), who found that men make up the majority of pig farmers in the study area and that sex may boost technical efficiency because male producers are typically the head of the household and are active in obtaining and managing production inputs. On the other hand, Osondu et al. (2014) found that although males are more involved in pig production, females also helped with minor farm tasks including cleaning the pighouse and giving feed and water.

According to the results in Table 1, the majority of pig farmers in the research region are between the ages of 36 and 45 (37.5%), followed by respondents who are between the ages of 18 and 35 (34.2%), and those who are over 45

(25.7%). 2.5% of the respondents were under the age of 18, making them the lowest class. This indicates a decline in youth involvement in pig farming. This ought to be the result of the issue of insufficient startup funds for the pig industry. However, because they have beginning capital, the adults in the research region are more involved in pig farming production.

According to Table 1's findings, the majority of pig farmers in the study region are primary school graduates (46.7%), with secondary school graduates (24.2%) coming in second. The percentages for non-formal education and tertiary education are 10.8% and 18.3%, respectively. This suggests that pig farmers possess a degree of education that greatly aids in the adoption of new innovations and technology for improving the quantity and quality of pig products.

According to the results in Table 1, the majority of pig farmers in the research area—69.1%—are married, with 19.2% being single. However, 9.2% of the pig farmers in the study area are widows. The results of this study demonstrated that 2.5% of all respondents were divorced individuals who were involved in pig farming. The low participation of widows and divorced individuals may be the result of their inability to start this business with a pig or piglet because they always have different problems to handle on their own, whereas those families have both husband and wife to assist one another, as the saying goes.

According to the results in Table 2, the majority of pig farmers are between the ages of 1 and 5 (43.3%), followed by those between the ages of 6 and 10 (37.5%). The last class with the lowest percentage in the research region for pig farming productivity is families with more than 11 members (19.2%). This is because family members provided the labor force. This implies that the labor force involved in the various tasks necessary for pig farming production increases with the number of family members.

According to their farming experience, the majority of pig farmers in the research region (51.7%) had between two and six years of experience, followed by those with seven to eleven years (28.3%). 6.7 percent of the population in the research region has 12–16 years of farming experience. Nonetheless, the final group, which includes those over 17, accounts for 3.3%. This is because, in contrast to other livestock farming, particularly that of cattle, goats, and sheep, which are regarded as traditional activities, respondents said that pig farming was the new enterprise in the research area.

The Elements Affecting Smallholder Household Pig Farming Production

A multivariate regression analysis was employed to identify the variables impacting smallholder families' pig farming output. Age, gender, educational attainment, pig farming land size, farming experience, market accessibility, revenue generation, feed availability, feed cost, availability of credit facilities, availability of veterinary care, and information availability were the socioeconomic factors. Five of the twelve variables—education level, market availability, off-farm generation, feed availability, and access to veterinary services—were statistically significant at the P ≤0.01 level of probability, according to the results of the regression analysis in (Table). Additionally, the results demonstrated that an R-squared of 0.76 indicates that 76% of independent factors account for the impact of these variables on the productivity of pig farms in the research area.

The availability of feed, revenue generation, market accessibility, education level, and veterinarian services all exhibited positive coefficients. For example, this suggests that a 0.6% increase in pig farming production will result from a one-year increase in the respondent's educational attainment. Additionally, it suggests that pig farming production will rise by 0.9% and 0.3%, respectively, for every unit increase in market and feed supply. This may be the case because education enables farmers to make wise and practical managerial and economic decisions by improving their understanding of the innovations brought to them in the production of pigs. The quality of farmers' skills, their capacity for allocation, and their level of knowledge about the advances and technology in their environment should all be influenced by their educational attainment. This is due to the fact that individuals with greater educational attainment typically adopt innovations in various fields more quickly.

Additionally, pig farming production was positively correlated with farming experience. This suggests that a one-year increase in the respondents' pig farming experience in the research area will lead to a 0.4% rise in high pig farming productivity. This ought to be the case since farmers with greater expertise are probably going to run the farm more effectively and make better decisions. The study by Oluwatayo IB et al. (2008) validated the findings, which showed that farmers with more experience would be more productive, have a better understanding of the market and climate, and so be expected to run a more successful and efficient business. Additionally, it confirms the findings of Onyebinama UA (2004), who found that farmers with prior farm business management expertise are better able to detect production risks, allocate, combine, and use resources efficiently, and set realistic time and cost targets.

Indicating that the increasing off-farm revenue from other domains influenced pig farming productivity in the research area, the results showed that off-farm income was positive and significantly influenced pig farming production at the P≤ 0.01 level of probability. This suggests that for every 1% increase in respondents' off-farm income, pig farming output should rise by 1.1%.

At the P < 0.05 level of probability, the results showed that gender had a positive and substantial impact on pig farming production, indicating that the research area's greater gender balance in pig farming had an impact on pig farming output. This suggests that a 0.3% increase in pig farming production will result from a unit increase in the number of women engaged in pig farming. Osondu et al. (2014) provided support for the study by demonstrating that men

are more involved in pig production and that females also helped with light farm tasks like cleaning the piggery and serving feed and water. As the majority of pig farmers in the study area are male producers who are often the head of the household and actively involved in obtaining and managing production inputs, Umea et al. (2015) also noted that men are primarily involved in pig production and proposed that sex may increase technical efficiency. According to the study's findings, the price of feed and the availability of credit facilities had a detrimental impact on the output of pig farms in the research region. For instance, this suggests that a 0.8% drop in the number of farmers and direct pig farming output will result from a unit rise in the price of pig feed. The reason for this is that as feed prices increased, more farmers left the domain since the prices were too high and there was little pig production in the area.

Pig farming's profitability in smallholder households

Using the cost-benefit method, the financial gains from pig farming in smallholder households were examined and contrasted. Cost and profitability are two indicators of the economic health of pig producers. Additionally, the results showed that net farm income, gross margin, total cost, and farm revenue were all statistically significant at $p < 0.01$.

Comparatively, the results in Table 3 showed the economic returns and investment costs for a single female pig in a smallholder household unit region. According to calculations, the gross margin was 436167.5 and the net farm revenue per female pig was 172167.5Rwf. This suggests that less educated and more seasoned farmers produced more pigs than newcomers to the field. This ought to be the result of a variety of school-based skills and knowledge as well as the expertise and instruction given by veterinary professionals and technicians who visited the current farmers in the study area. Furthermore, the high cost of feeds brought on by COVID-19 and the closure of international boards, especially those between Rwanda and Uganda, should be primarily blamed for the low economic return in the research area. Additionally, the results showed that net farm income, gross margin, total farm revenue, and total cost were all statistically significant at ($p < 0.01$).

According to the study's findings, the operating expense ratio—a gauge of the proportion of farm income devoted to variable operating expenses—was 60.3%. The net farm income ratio, however, was 15.7%. Likewise, the benefit-cost ratio (BCR) was 1.2, indicating that 1.2 francs of revenue are generated for every franc invested in the research area. Pig farming is a lucrative enterprise in the study region, as evidenced by the benefit-cost ratio (BCR) of 1.20, which is greater than one. In general, regular, appropriate feeding and immunization, which help to maximize the weight and health of pigs, could be credited with the high economic return connected with pig farming production. In the study region, proper feeding—especially that which is rich in various nutrients—also encourages the pig to be fully and well-developed, which leads to a higher production or number of piglets per mature female pig.

Furthermore, the investment yielded 0.2% profits, while the depreciation expense ratio was 24%. Furthermore, the economic investigation and analysis showed that, in spite of certain negative effects, such as the high cost of depreciation, the issue of high feed costs in pig farming production as a business was prevalent in the study area because of the global Covid-19 pandemic and the absence of international trade between nations. However, as farmers in the study area have indicated, in order to maximize net farm income and improve and increase efficiency in terms of technique and pig farming production, farmers should be encouraged to breed modern pigs and sell the piglet for approximately seven months, rather than selling piglets of two months.

In order to maximize profit, the government should also establish long-lasting policies that make it easier for farmers to obtain agricultural loans. Along with reducing pig and piglet mortality through improved knowledge and skills related to the factors of pig farming production, particularly the proper feeding, vaccination, and housing that in turn increase income from pig farming, it should also be better to expand extension and veterinary services.

The profitability ratio technique used in the analysis shows that pig farming is a viable enterprise in the study area, despite the high prices of the feeds used. Farming is a very alluring and lucrative business for pigs. A farmer must receive training and expand their knowledge of farming in order to properly raise pigs. This is due to the fact that in order to efficiently raise pigs, farmers must provide them with ideal housing. They ought to provide wholesome food and appropriate medical care. It is impossible to make a lot of money without raising pigs correctly.

Pig farming's impact on smallholder households in the research area

Pig farming has had a positive impact on smallholder households in Burera and Musanze districts on seven out of ten factors, according to the results of Tobit regression analysis in Table 4. These factors include income generation, animal manure, employment opportunities, protein supply, access to agricultural credit, information access, and infrastructures. At the $P < 0.01$ level of probability, the results in Table 4 demonstrated that the three factors—income generation, employment prospects, and new job creation—had favorable and statistically significant effects on pig farming in the research area. Pig farming in the research area was positively and significantly impacted by the four factors—animal manure, nutrition supply, access to agricultural loan, and information availability—at the $P < 0.05$ level of probability. Infrastructure, for example, has a positive coefficient but is not significant when it comes to pig farming in the research area. On the other hand, pig farming in the research area was negatively impacted by two variables: poverty reduction

and food security control.

Numerous participants in the research region said that pig farming had a favorable impact on their standard of living. They claimed that the production of pigs, especially meat and oil, led to the creation of new jobs, particularly in the restaurant industry. According to their statement, they favored dining above other pursuits because of the daily rise in demand, particularly in urban regions where there are more tourists and visitors than in rural ones. For instance, a 1% increase in pig farming should result in a 0.5% increase in the study area's income output. This is due to the fact that the more demand there is for pig production (meat), the more supply there is at a competitive price, which in turn promotes pig farming in the research region. Growing pig output also encourages the government and business sector to construct additional facilities, such as feeder roads, markets, electricity, and state-of-the-art slaughterhouses. Many new jobs were made available to both educated and uneducated individuals in rural regions as a result of the construction of these new infrastructures, particularly for the workforce and Labor Day. Additionally, it suggests that a 1% increase in pig farming should result in a 0.8% increase in employment opportunities, which will impact human livelihood. This is because there will be a need for graduate veterinarians to adhere to the standards of manufactured meat on a daily basis as the number of clients requesting meat rises, creating job opportunities. According to communities, the lack of interest in pig raising and consumption in the past, particularly among females, was mostly caused by the incompatibility with the culture of the largely uneducated and insecure population.

These days, rural Rwandans, especially those living close to Musanze town, are content with the employment prospects in pig farming and selling pig meat in restaurants, despite the increased interest of men. Some respondents, particularly young women from various parts of the nation, stated that they frequently take great pride in their pay. Regression analysis results generally imply that pig farming is a lucrative enterprise in the studied area. Generally speaking, the high economic return linked to pig farming output may be ascribed to consistent, appropriate feeding that is bolstered by high and quality production of various crops grown nearby that support feeds from the market.

Limitations of Smallholder Household Pig Farming

Pig farming is one of the most lucrative industries globally for a number of reasons, chief among them being the creation of revenue. The majority of Rwandan farmers, both large and smallholder, do not now keep pigs for profit. A healthy flock of pigs or piglets depends on a number of elements, the two most crucial of which are management and environment. Pigs that are in good health consume less food, rest for longer periods of time, and yield a desirable amount of meat in terms of both quality and quantity. When they have adequate shelter and a good feeder to feed and meet other needs, they are easier to care for and medical expenses are lower. Furthermore, Tatwangire (2013) pointed out that smallholder pig farmers have numerous obstacles that prevent them from taking advantage of improved selling prospects and the growing demand for pork. Poor feeds and pig nutrition practices, a lack of genetic and breeding methods, inadequate slaughter technology, insufficient value addition, and restricted access to inputs, extension services, agricultural insurance, loans, and other financial services are some of these difficulties. The study's results, however, showed that the most frequent barriers to pig farming in smallholder households were the high cost of feed, insufficient initial capital (100%), feed sacristy and quality (9.5%), lack of conservation facilities (89.9%), outbreaks of pests and diseases (75.6%), high piglet costs (70.1%), lack of farming knowledge (65.7%), and substandard housing (50.4%).

All respondents (100%) stated that the primary barriers to pig farming output in the research area were the high cost of feeds and insufficient beginning capital. In addition to lowering the quantity and quality of pig farmers, the high cost of feeds also lowers the number of farmers in the area. In the study area, it was also discovered that one of the things impeding pig farming production was the prevalence of pests and disease outbreaks (75.6%). This is because, when pigs and piglets are kept together in unsuitable pig homes, the disease can spread quickly among them. Additionally, they share bowls for food and water, which can spread diseases and sickness from sick to healthy hens. Ascaris, salmonellosis, colibacillosis, and pest pigs are the primary illnesses mentioned by research participants.

According to the farmers, illness affects their livelihoods in a variety of ways, both locally and inside individual households. They claimed that because the piglets that would have been sold to survive or fed to guests or family are no longer available, priority needs shift within households. Therefore, farmers have less capital accessible to them, particularly when they are dying and not producing. Therefore, poverty affects rural households due to all of the aforementioned restraints, especially sickness.

One of the main issues in the restrictions was the use of insufficient pig feed. It occasionally occurs when there is a shortage of human food. Pigs currently have less access to food, which immediately lowers output. Pig farming is generally less profitable due to the expensive expense of proper feeds and medications, particularly when there are insufficient veterinary and extension services.

CONCLUSION

This study's primary goal was to examine Rwandan smallholder households' pig farming profitability and restrictions. Musanze district as a case study. The results showed that the majority of respondents in the research area's pig farming production are men. According to the results of the regression analysis, pig farming in the research area was influenced by five factors that were statistically significant at the $P \leq 0.01$ level of probability: education level, market availability, off-farm generation, feed

availability, and access to veterinary services. Additionally, the results showed that net farm income, gross margin, total cost, and farm revenue were all statistically significant at $p < 0.01$. According to the research findings, pig farming is a viable enterprise in the study area since the benefit-cost ratio (BCR) was (1.2) higher than a unit, indicating that one franc of investment in the study area produced 1.2 francs of revenue.

It is impossible to make much money if pigs are not raised properly. A farmer must receive training and expand their knowledge of farming in order to properly raise pigs. This is due to the fact that in order to efficiently raise pigs, farmers must provide them with ideal housing. They ought to provide wholesome food and appropriate medical care. Pig farming has had a favorable impact on seven out of ten criteria for smallholder households in the research region, according to the results of Tobit regression analysis. However, at the $P < 0.01$ level of probability, the three factors—income generation, employment prospects, and new job creation—had a positive and statistically significant impact on pig farming in the research area.

Even though pig farming has many obstacles, the study's findings showed that the most prevalent ones for smallholder households were the high cost of feeds, insufficient initial capital, feed sacristy and quality, lack of conservation facilities, pest and disease outbreaks, high piglet costs, lack of farming knowledge, and substandard housing. notwithstanding the limitations mentioned by several study participants. Several analysis techniques show that pig farming is a financially successful enterprise. In general, it contributes to the creation of new jobs, increases employment prospects, produces revenue, and unmistakably raises the level of living for farmers in the research region. The study's conclusions led to the following recommendations being made:

Encourage and educate farmer groups, particularly women, on the fundamentals of long-term accountability and participative group governance through fair elections. The unification of pig producers and marketing groups in the nation, as well as the development of powerful farmers' organizations, should result from this. Coordination, promotion, and regulation of the pig industry's growth are aided by the union of pig producers and marketing organizations.

Encourage initiatives that can assist in giving farmers or marketing organizations the early startup funds they need to get their farming business off the ground. Additionally, savings groups can be established to help generate funds for borrowing during peak markets and stressful times.

Encourage more direct involvement from the private sector and other suitable boundary partners who have a comparative advantage in the development of smallholder families' pig value chain operations in Rwanda, particularly in the study area, in order to promote sustainable pig value chains. This might necessitate redefining goals and coming up with fresh ideas for increasing farmers' access to financing, training opportunities, credit services, and markets for pig products—especially meat and manure.

Pig farming output in the research area was profitable, as can be shown, however the most obstacles to this industry were discovered to be the growing shortage and high cost of feeds. RAB and government organizations should, however, focus on ways to stabilize feed prices for smallholder households. Since this region is the nation's granary, particularly for potatoes, pig farmers in the study area should effectively and economically learn how to formulate and expand their feeds by using local crop feedstuffs in order to minimize cost feeds.

CONFLICT OF INTEREST

The author here declares that there is no conflict of interest in the publication of this article.

REFERENCES

Alex Tatwangire. 2013. Successes and failures of institutional innovations to improve access to services, input and output markets for smallholder pig production systems and value chains in Uganda.

C.T.A. 1995. Agricultural Extension in Africa, Technical Centre for Agriculture and Rural Cooperation. Yaunde Cameron.

Dietze, K. 2011. Pigs for Prosperity. FAO Diversification booklet.

FAO 2012. Pig Sector Kenya, FAO Animal Production and Health Livestock Country Reviews, No. 3. Rome, FAO. http://www.fao.org/docrep/015/i2566e/i2566e0 0.pdf.

FAO. 2003. Agriculture in Nigeria. F.A.O of United Nations, Rome.

FAO. 2006. State of Food Insecurity in the World.

Available at https://www.slideshare.net/KCNF/the state of-food-insecurity-the-world, accessed on 2nd May 2015.

FAO. 2011. World Livestock 2011, Livestock in food security. Food and Agriculture Organization, Rome, Italy.

FAO. 2011. Livestock and food supply. [Online] Available at:

<http://www.fao.org/docrep/014/i237e/i237e.p dfaccessed on 2nd May 2015.

FAO. 2012. Livestock Country Reviews (3) Pig sector in Kenya. FAO animal production and health. Food and Agriculture Organization, Rome Italy.

FAO. 2018. Environmental performance of pig supply chains. Guidelines for assessment (Vision 1). Livestock environmental assessment and performance partnership. Rome, FAO.

Gikonyo, S. 2010. Pig Production Manual for the Department of Livestock Production, Ministry of Livestock, Kenya.

Hossain, M.E., Chakma, S., Khatun, M.M., Hasanuzzaman, M., Miah, M.Y. and Biswas,

M.A.A. 2011. Production systems of swine in the rural areas

of Rangamati and Khagrachari districts of Bangladesh. Bangladesh Journal of Animal Science.

Kagira, J.M., Maingi, N., Kanyari P.W.N., Githigia, S.M., Ng'ang'a J.C, Gachohi, J.M., 2010. Characteristics of pig trade in low-income settings in Busia District, Kenya, Tanzania Veterinary Journal.

Kahi A.K., Illatsia E.D., Githinji, M.G, Muasya, T. K. and Okeno. 2008. Genetic parameter estimates for growth traits of Large White Pigs in Kenya. South African Journal of Animal Science.

Madzimure, J., Chimonyo, M., Zander, K.K. and Dzama,

K. 2013. Potential for indigenous pigs in subsistence-oriented and market-oriented small-scale farming systems of Southern Africa.Tropical Animal Health Production.

Michael Anthony Levy. 2014. Challenges and Opportunities of Smallholder Pig Production and Marketing in Western Kenya.

MINAGRI. 2008. Annual report, Kigali, Rwanda. MINAGRI. 2019. Annual Report 2019-2020

MINECOFIN. 2007. Indicateur du développement, Kigali, Rwanda.

Muhanguzi D, Lutwama V, Mwiine FN 2012. Factors that influence pig production in Central Uganda-case study of Nangabo Sub-County, Wakiso district.

NISR 2012. Rwanda National Institute of Statistic, Statistical yearbook. Kigali, Rwanda. http://statistics.gov.rw/publications/statistical- yearbook-2012

NISR 2018. Agricultural Household Survey 2017 report Ogunniyi L. T. and Omoteso O. A. 2011. Economic Analysis of Swine Production in Nigeria: A

Case Study of Ibadan Zone of Oyo State.

Okoli, C.I. 2006. Topical Tips On Intensive Pig Production; Animal Management and Health Issues. Technical Notes. Tapas Institute of Scientific Research and Development.

Oluwatayo IB, Sekumade AB, Adesoji SA. 2008. Resource use efficiency of maize farmers in Rural Nigeria, Evidence from Ekiti State. World Journal of Agricultural Science.

Onyebinama UA. 2004. Farm business management for smallholder farm firms in Nigeria. Owerri Alphabet Nigeria Publishers, Nigeria.

Osondu C. K., Ijioma, J.C., Anyiro, C. O., Obike K. 2014. Economic analysis of pig production in Abia State, Nigeria. International Journal of Applied Research and Technology.

Peters. D. 2004. Use of Sweet Potato in Pig Production in Asia: Agricultural & Socio-Economic Aspects, animalscience.com Review No.4, Pig News & Information 25(1), 25N-34N CABI Publishing.

Petrus NP, Schneider MB, Nepembe M 2011. The constraints and potentials of pig production among communal farmers in Etayi Constituency of Namibia. Livestock Research for Rural Development. http://www.lrrd.cipav.org.co/lrrd23/7/petr2315 9.htm

Poulton C, Kydd J, Dorward A 2006. Overcoming Market Constraints on Pro-Poor Agricultural Growth in Sub-Saharan Africa. Development Policy Review.

Rahman. 2009. Reducing food insecurity in developing countries through meat production: the potential of the Guinea pig (Cavia porcellus).

Rangoma, M. 2013. Some credit facilities available to livestock farmers in Kenya. Available at http://livestock Kenya.com/index.php/blog general.Accessed on 14 April 2015.

Republic of Rwanda 2012. EICV3 District Profile Musanze, National Institute of Statistics of Rwanda, Kigali.

Smith, B. 2006. The Farming Handbook. Pietermaritzburg: CTA and University of Kwa Zulu- Natal Press.

Thorton, P.K. 2010. Livestock production; recent trends, future prospects. Philosophical transactions of the Royal Society B.

Umeh J. C., Ogbanje C., Adejo M. A. 2015. Technical efficiency analysis of pig production: A sustainable animal protein augmentation for Nigerians. Journal of Advanced Agricultural Technologies.

Veary, C.M. and Manoto, S.N. 2008. Neurocysticercosis: a possible cause of epileptiform seizures in people residing in villages served by the Bethanie clinic in the North West Province of South Africa. Journal of the South African Veterinary Association. www.musanze.gov.rw