Factors affecting the level of commercialization of smallholder pig farmers in the west rand district municipality of gauteng, South Africa

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ABSTRACT

This study aimed to analyse the factors influencing the smallholder pig farmers' level of commercialization in the agricultural markets in the West Rand District of Gauteng Province, South Africa. A total population sampling was used, where data was collected from 84 smallholder pig farmers by a semi-structured questionnaire. Version 28.0 of the Statistical Package for Social Science (SPSS), binary logistic regression, and multinomial logit models were used to analyse the collected data. The results showed that 78.6% of the smallholder pig farmers lacked commercialization. The results further indicated that the pig unit size, level of the farmers' commercialization, number of piglets per sow, and farmers' affiliation had a significant influence on the smallholder pig farmers' access to high-value markets. Variables such as credit availability, market accessibility, and the quantity of the piglets per sow significantly impacted the level of commercialization among the interviewed smallholder pig farmers. Smallholder farmers' access to commercial and high-value pig markets is not easily accessible; therefore, the municipalities and local agricultural departments should make provision for an agricultural extension program that will prioritize and concentrate on the smallholder farmers' access to the high-value market.

Contribution/Originality: This study investigates the factors influencing smallholder pig farmers' level of commercialization in the markets by employing both binary and multinomial regression analysis methods. The study area has not witnessed any similar research before. The study contributes to strategic planning by highlighting the factors that influence access to high-value pig markets.

How to cite: G, P., DL, M., & MJ, M. (2024). Factors affecting the level of commercialization of smallholder pig farmers in the west rand district municipality of gauteng, South Africa. *Asian Journal of Agriculture and Rural Development, 14*(3), 95–101. 10.55493/5005.v14i3.5163

1. INTRODUCTION

Smallholder pig farming has a pivotal function as a revenue stream and a way to lessen food insecurity in South Africa (Munzhelele, Oguttu, & Fasina, 2016). Pig farming has been critical in improving the livelihoods of emerging small-scale and rural pig farmers in the Limpopo Province, South Africa (Kimbi, Mlangwa, Thamsborg, Mejer, & Lekule, 2016; Mokoele et al., 2015). Farming pigs can provide high food security and improve livelihoods in the West Rand Municipality. Agricultural production mostly follows three processes, which are farming as a hobby, subsistence production, and commercial farming (Perdomo, Schwarzbauer, Fürtner, & Hesser, 2021). However, most smallholder

farmers strive to become commercial farmers and participate in high-value agricultural markets. According to Ola and Menapace (2020), a high-value market is characterised as high-quality, demanding, varying products meeting good food standards, demanding intense coordination, and having high profitability and higher entry costs when compared to traditional markets. According to Abraham, Chiu, Joshi, Ilahi, and Pingali (2022), commercialization happens when farming systems evolve from subsistence and semi-subsistence agriculture to a profit maximization production system. Commercialization is important to smallholder farmers because farmers can get production inputs and sell their products in established markets (Abraham et al., 2022). This suggests that commercialization encompasses more than just selling agricultural produce; it also involves making production choices and input use decisions based on profit-making principles (Singh, Singh, & Sodhi, 2019).

According to Balana et al. (2022), smallholders are farmers that are faced with structural constraints such as access to resources, technology, and markets. Despite all the efforts by the South African government through farmers' training and funding programmes aimed at improving smallholder pig production, there are still some obstacles restricting production (Matabane et al., 2018; Munzhelele et al., 2016). Significant soft limitations that small farms face include limited access to credit, high-quality input, technology, machinery specific to their assets, information, and extension services that are necessary to generate a marketable surplus (Abraham et al., 2022). Studies in the study area have not specifically focused on the factors influencing smallholder farmers' commercialization of pig production. Hence, the study aims to probe factors affecting commercialization of smallholder pig farmers in the study area.

2. MATERIALS AND METHODS

2.1. Study Area

The Gauteng Province of South Africa's West Rand District Municipality served as the study's location (Figure 1). Gauteng Province is the smallest province out of the nine provinces of South Africa and only takes up 1.4% (17,010sq. km) of South Africa's land (Johnson, Dorrington, & Moolla, 2017). The West Rand City has large tracks of land used for farming, including agricultural holdings and a rural residential node. The district produces more maize than average, and farmers grow cut flowers, vegetables, and livestock for both domestic and international markets (Basson, 2014).
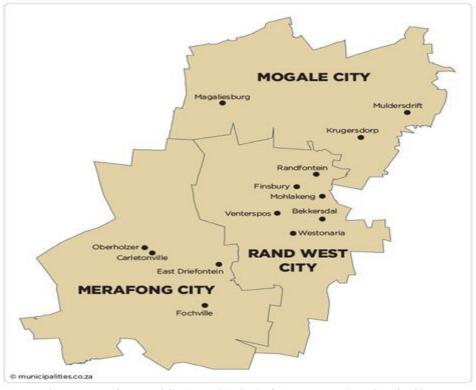

Figure 1. Map of west rand district municipality in the Gauteng Province of South Africa.
Source: www.municipalities.co.za.

2.2. Sampling Technique and Data Collection

In 2022, the Department of Agriculture and Rural Development of Gauteng (GDARD) provided an updated list of smallholder pig farmers in the study area. The list consisted of 84 smallholder pig farmers in the study area. We used a comprehensive sampling method, involving all 84 smallholder pig farmers in the study.

We created a structured questionnaire based on the study's objective and used it to collect primary data. The study information was gathered through in person meetings (face-to-face interviews) with all participating smallholder farmers in their respective farms.

2.3. Data Analysis

The collected data was organised and captured in SPSS Statistical Package for Social Science version 28.0 and then analysed.

2.3.1. Logit Model

We employed the logit model to determine the factors influencing smallholder pig farming access to high-value markets. The dichotomous dependent variable (access to high-value market) outcome took a value of 1 if the smallholder pig farmer had access to a high-value market, and 0 if they did not have access to a high-value market. Mathematics, particularly in statistics, specifies the logit function as the inverse of the sigmoidal function:

When one of the parameters of the function reflects a probability p, the logit function provides the log-odds $p/(1 - p)$.

The logit of a number p between 0 and 1 is presented as follows:

$$\text{logit}_{(p)} = log\left(\frac{p}{p-1}\right) = log_{(p)} - \log(1-p) = -log\left(\frac{1}{p}-1\right) \tag{1}$$

The "logistic" function of any number is presented by the inverse-logit:

$$logit^{-1}(\alpha) = \frac{1}{1+\exp(-\alpha)} = \frac{\exp(\alpha)}{\exp(\alpha)+1} \tag{2}$$

If p is a probability, then $p/(1 - p)$ is the corresponding odds; the logit of the probability is the logarithm of the odds. likewise, the variation between the logit of two probabilities is the logarithm of the odds ratio (R), thus, by adding and subtracting, one may quickly get the optimal combination of odds ratios:

$$\log(R) = log\left(\frac{P_1/(1-P_1)}{P_2/(1-P_2)}\right) = log\left(\frac{P_1}{1-P_1}\right) - log\left(\frac{P_2}{1-P_2}\right) = logit(p1) - logit(p2) \tag{3}$$

The key equation of multivariate logistic regression equation to fit the data is:

$$log\left(\frac{p}{p-1}\right) = (\alpha) + b_1 x_{i1} + + b_2 x_{i2} + \cdots + + b_p x_{ip} \tag{4}$$

Where Pi is the probability, and that Yi is 1

In the analysis, the function's maximum likelihood was satisfied during estimation and Y = 1 when the smallholder pig farmers have access to high-value markets, and Y = 0, otherwise.

2.3.2. Multinomial Logistic Model

The smallholder pig farmers in this study have more than two alternative levels in agricultural commercialization. Their level of commercialization is classified as fully commercial, partly commercial, and not commercial. The multinomial logistic model was used because it allows judgements made across two or more categories in the dependent variables. The level of commercialization is discrete since it is selected among other choices. Let Pij represent the probability of pig commercialization by the pig smallholder farmers, then the equation is as follows:

$$Pij = \beta0 + \beta1X1 + \beta2X2 + \beta3X3 + \cdots + \beta kXk + \varepsilon \tag{5}$$

Where i takes values (1, 2, 3), each representing level of commercialization (fully commercialized = 1, partly commercialized = 2, not commercialized = 3). Xi are factors affecting the level of commercialization, β are parameters to be estimated, and ε is randomized error.

With j alternatives, probability of the level of commercialization j is given by:

$$prob(Y_i = j) = e_{zj} / \sum_{k-0}^{j} ezk \tag{6}$$

Where zj is level and zk is a choice that could be selected. The model estimates are used to determine the probability of the level of commercialization given j factors that affect the choice Xi. With several alternatives, the log odds ratio is computed as:

$$ln(P_{ij}/P_{ik}) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + e_i \tag{7}$$

Pij and Pik = Probabilities that a smallholder pig farmer will choose a given level of commercialization and alternative level, respectively.

ln(Pij/Pik) = Natural log of probability of level of commercialization j relative to probability of level of commercialization k.

α = Constant.

β = Matrix of parameters.

e = Error term.

In this study, the Multinomial Logit Regression Model will be as follows:

$$ln(Pj/P1) = \beta_{0j} + \beta_{1j} X_{1i}\beta_{2j}X_{2i} + \cdots + \beta_{kj}X_{ki} + U_{ij} \tag{8}$$

Table 1 displays and defines all the variables used in the study analyses.

Table 1. Description of variables (Binary logistic and multinomial regression models).

Variables	Description of variables	Unit of measurement
Dependent variable		
Level of commercialization (Multinomial regression)	Fully commercialized farmer - 1. Partly commercialized farmer – 2. Not commercialized farmer – 3.	Number
Access to high value market (Binary logistic regression)	1 = Access to high value market, 0 = Otherwise	Dummy
Independent variables		
Age	Age of smallholder farmers	Number
Gender	1 if the farmer is male, 0 otherwise	Dummy
Marital status	1 if the farmer is married, 0 otherwise	Dummy
Level of education	Years of schooling	Number
Household size	Number of people in the house	Number
Distance to market	Distance farmers travel to market	Kilometers (Km)
Land size	Amount of land at farmer disposal	Hectares (Ha)
Level of the farmers' participation In the commercial market.	1 = Fully participating, 2 = Partly participating; 3 = Not participating	Dummy
Pig unit size	Size of the pig unit	Square meters
Access to credit	1 if a farmer has access to credit, 0 otherwise	Dummy
Access to commercial market	1 if a farmer has access to commercial markets, 0 otherwise.	Dummy
Employment status	1 if full time farming, 0 if part time farming	Dummy
Farmers' affiliation	1 if farmers are affiliated, 0 otherwise.	Dummy
Transport costs	Transport cost per month	Number

3. RESULTS AND DISCUSSION

3.1. Factors Influencing the Smallholder Pig Farmers' Access to High-Value Markets

Table 2 shows the results of the binary logistic regression. The results indicated that out of 13 variables, only 4 variables (pig unit size, level of the farmers' commercialization, number of piglets per sow, and farmers' affiliation) had significant influence on the smallholder pig farmers access to high-value markets.

Pig unit size had a positive relationship with the access to high-value pig markets of the smallholder pig farmers and was statistically significant at a 5% significant level. This suggests that an increase in pig unit size enhances the smallholder farmer's chances of accessing high-value pig markets. Majority of farms in the world are small and marginal in scale. Approximately 475 million, or 84%, of the 570 million farms worldwide are thought to be smaller than two hectares (Gomez y Paloma, Riesgo, & Louhichi, 2020). Land area has a favourable impact on livestock marketing rates, and it is important since it offers a chance to produce food for livestock, as well as a space for raising additional animals and utilizing contemporary technologies to increase growth beyond needs, all of which supports the supply of goods for consumers (Belay et al., 2021).

Table 2. Binary regression model: Factors influencing access of smallholder pig farmers to high value markets.

Variables	B	Std. error	Beta	t	Significance.
Age	0.026	0.037	0.059	0.701	0.485
Marital status	0.047	0.050	0.072	0.944	0.349
Level of education	-0.042	0.050	-0.076	-0.847	0.400
Employment status	0.076	0.090	0.060	0.838	0.405
Land size	-0.013	0.054	-0.019	-0.237	0.813
Pig unit size	0.088	0.037	0.189	2.376	0.020**
Level of the farmers' commercialization	-0.291	0.113	-0.239	-2.567	0.012**
No: of piglets per sow	0.212	0.060	0.257	3.535	0.000***
Access to credit	0.034	0.152	0.018	0.227	0.821
Farmers' affiliation	0.437	0.084	0.461	5.225	0.000***
Farmers' experience	-0.037	0.065	-0.045	-0.573	0.569
Type of transport to the market	-0.062	0.070	-0.068	-0.880	0.382
Transport costs	0.102	0.076	0.098	1.337	0.185
Constant	0.224	0.417		0.538	0.592

Note: ** and *** mean statistically significant at 10% and 5% respectively.

Table 2 revealed that the farmers' level of commercialization had a negative relationship with the access of high-value pig markets of the smallholder farmers and was statistically significant at a 5% significant level. This means that

a decrease in the number of farmers commercializing increases the likelihood that smallholder pig farmers will gain access to high-value pig markets. According to Belay et al. (2021) the commercialization of smallholder agriculture is a crucial step towards the development of rural economies. Belay et al. (2021) further stated that when farms become more commercialized, dependent on hired labor, and employ more family members for managerial and supervisory roles. This could have something to do with making specific resources available for employment elsewhere in the economy.

Number of piglets per sow was positively significant at a 1% significant level. This implies that an increase in the number of piglets per sow increases the likelihood of the smallholder farmer accessing to a high-value pig market. Farmers' affiliation to a pig production organization was positively significant at a 1% significant level. This implies that the farmers with affiliations to a pig production organization were more likely to have access to high-value pig markets. This may be because the affiliations' provide farmers with services such as marketing, training, and extension information.

3.2. Level of Commercialization Among the Smallholder Pig Farming

The results in Table 3 indicated that smallholder pig farmers who were fully commercialized amounted to 2.4%, those who were partly commercialized amounted to 19%, and 78.6% of the smallholder pig farmers were not commercialized. According to the study results, it is clear that the majority of the smallholder pig farmers were not commercialized. The result of the study differs from those reported by Mothiba, Mthombeni, and Antwi (2023), where it was reported that 72% of smallholder farmers selling groundnuts in the Limpopo province of South Africa were commercialized, while only 28% of the farmers were not.

Table 3. Smallholder pig farmers level of commercialization.

Level of farmer's commercialization	Frequency	Percentage
Fully commercialized	02	2.4%
Partly commercialized	16	19%
Not commercialized	66	78.6%
Total	84	100%

Table 4. Multinomial regression model: Level of commercialization among the smallholder pig farmers.

Variables	B	Std. error	Wald	Significance.
Fully commercialized vs not commercialized				
Age	-16.550	79.192	0.044	0.834
Gender	-0.030	0.049	0.368	0.544
Marital status	0.055	0.095	0.329	0.566
Level of education	0.416	0.263	2.503	0.114
Employment status	-0.037	0.065	0.045	0.569
Land size	-0.714	0.690	1.073	0.300
Pig unit size	0.566	0.666	0.721	0.396
Number of piglets per sow	1.583	0.662	5.716	0.017**
Access to credit	-3.051	0.853	12.79	0.001***
Access to high-value market	0.100	0.032	9.701	0.002***
Farmers' affiliation	-0.513	0.810	0.400	0.527
Farmers' experience	0.102	0.076	0.098	0.185
Type of transport to the market	-0.542	0.664	0.666	0.414
Transport costs	0.252	0.626	0.162	0.687
Intercept	7.576	4.058	3.486	0.060
Variables	B	Std. error	Wald	Sig.
Partly commercialized vs not commercialized				
Age	0.002	0.049	0.368	0.544
Gender	-0.612	0.634	0.932	0.334
Marital status	0.054	0.099	0.295	0.587
Level of education	-0.227	0.263	0.722	0.395
Employment status	0.025	0.032	0.600	0.439
Land size	0.566	0.666	0.721	0.396
Pig unit size	-0.004	0.004	0.791	0.374
Number of piglets per sow	-0.472	0.652	0.525	0.469
Access to credit	1.238	0.658	3.545	0.060*
Access to high-value market	-1.683	74.521	0.001	0.982
Farmers' affiliation	0.314	0.623	0.254	0.614
Farmers' experience	-0.062	0.070	-0.068	0.382
Type of transport to the market	-0.071	0.635	0.012	0.911
Transport costs	-0.062	0.070	-0.068	0.382
Intercept	-0.529	3.989	0.018	0.894

Note: *, ** and *** mean statistically significant at 10%, 5% and 1% respectively.

In Table 4, the results from the multinomial logistic regression model determining the level of commercialization among the smallholder pig farmers revealed that the number of piglets per sow had a positive relationship with the level of commercialization and was only significant in relation to the farmers who were fully commercializing. This implies that an increase in the number of piglets per sow increases the likelihood of the smallholder pig farmer to fully commercialize their produce.

In the study area, access to credit was statistically significant for both fully and partly commercialized smallholder pig farmers. However, it had a negative coefficient in relation to the fully commercialized smallholder farmers and a positive coefficient in relation to the smallholder pig farmers who were partly commercialized. This implies that the access to credit for the fully commercialized smallholder farmers decreases as they become fully commercialized. This could be because the smallholder pig farmers who are fully commercialized do not rely on credit, they operate their pig production with the revenues they get from being commercial farmers. Partially commercialized smallholders pig farmers are likely to have access to credit. Though according to Abraham et al. (2022) small farms face challenges such as limited access to credit and quality inputs.

Access to high-value markets had a negative relationship with the level of commercialization and was only significant in relation to the farmers who were fully commercialized. This implies that smallholder pig farmers with access to high-value pig markets were less likely to be fully commercialized. However, according to Mothiba et al. (2023) commercialized farmers elicit increased output, which translates to more surplus for them to sell in the agricultural markets.

4. CONCLUSION AND RECOMMENDATIONS

Factors such as pig unit size, level of the farmers' commercialization, number of piglets per sow, and farmers' affiliation influenced the smallholder pig farmers' access to high-value markets. According to the research, smallholder farmers should increase the size of their pig units to increase their chances of accessing high-value markets. Increased production will result from this, giving farmers more surplus produce to sell. Additionally, smallholder farmers ought to have resources and encouragement to raise their level of commercialization to fully commercialize, so that they can sustain their enterprises with the revenues from being commercial rather than relying on credit. More emphasis should be on the smallholder pig farmers to increase the number of piglets produced by sows for sales purposes in the high-value markets.

Most of the smallholder pig farmers (78.6%) in this study were not commercial. The significant factors: number of piglets per sow, access to high-value markets, and access to credit were considered in the multinomial logistic model analyses. Therefore, we recommend considering these factors when formulating policies and providing assistance to smallholder pig farmers. Therefore, we advise smallholder pig farmers to expand their pig unit sizes to boost their big production and to join a pig association to enhance their access to high-value agricultural markets.

REFERENCES

Abraham, M., Chiu, L. V., Joshi, E., Ilahi, M. A., & Pingali, P. (2022). Aggregation models and small farm commercialization–A scoping review of the global literature. *Food Policy, 110*, 102299. https://doi.org/10.1016/j.foodpol.2022.102299

Balana, B. B., Mekonnen, D., Haile, B., Hagos, F., Yimam, S., & Ringler, C. (2022). Demand and supply constraints of credit in smallholder farming: Evidence from Ethiopia and Tanzania. *World Development, 159*, 106033. https://doi.org/10.1016/j.worlddev.2022.106033

Basson, G. C. (2014). *The economic impact of a changing urban mining region: The case of the West Rand District municipality in Gauteng province.* Doctoral Dissertation, Stellenbosch: Stellenbosch University.

Belay, G. H., Mengstu, K. A., Mehammedberhan Kahsay, H., Hosseininia, G., Işık Özgüven, A., Viira, A. H., & Azadi, H. (2021). Determinants of smallholder commercialization of livestock: A case study from Tigray, Ethiopia. *Cogent Food & Agriculture, 7*(1), 1921950. https://doi.org/10.1080/23311932.2021.1921950

Gomez y Paloma, S., Riesgo, L., & Louhichi, K. (2020). The role of smallholder farms in food and nutrition security. In (pp. 251): Springer Nature. https://doi.org/10.1007/978-3-030-42148-9.

Johnson, L. F., Dorrington, R. E., & Moolla, H. (2017). Progress towards the 2020 targets for HIV diagnosis and antiretroviral treatment in South Africa. *Southern African Journal of HIV Medicine, 18*(1), 1-8. https://doi.org/10.4102/sajhivmed.v18i1.694

Kimbi, E. C., Mlangwa, J., Thamsborg, S., Mejer, H., & Lekule, F. P. (2016). Smallholder pig marketing systems in the Southern Highlands of Tanzania. *Journal of Natural Sciences Research, 6*(14), 87-98.

Matabane, M. B., Nephawe, K. A., Thomas, R. S., Maqhashu, A., Ramakhithi, F., & Netshirova, T. (2018). Pre-weaning growth performance of piglets at smallholder farms in Gauteng province. *Journal of Agricultural Science, 10*(4), 18. https://doi.org/10.5539/jas.v10n4p18

Mokoele, J. M., Janse van Rensburg, L., Van Lochem, S., Bodenstein, H., Du Plessis, J., Carrington, C. A., . . . Fasina, F. O. (2015). Overview of the perceived risk of transboundary pig diseases in South Africa. *Journal of the South African Veterinary Association, 86*(1), 1-9. https://doi.org/10.4102/jsava.v86i1.1197

Mothiba, M. E., Mthombeni, D. L., & Antwi, M. A. (2023). Determinants of commercialization and choice of market channels among smallholder groundnut farmers in the Capricorn district, Limpopo Province, South Africa. *African Journal of Food, Agriculture, Nutrition and Development, 23*(8), 24443-24458. https://doi.org/10.18697/ajfand.123.23780

Munzhelele, P., Oguttu, J. W., & Fasina, F. O. (2016). Is a 10-sow unit economically sustainable? A profitability assessment of productivity amongst small-holder pig farmers, Mpumalanga, South Africa. *Onderstepoort Journal of Veterinary Research, 83*(1), 1-11. https://doi.org/10.4102/ojvr.v83i1.1011

Ola, O., & Menapace, L. (2020). Revisiting constraints to smallholder participation in high-value markets: A best-worst scaling approach. *Agricultural Economics, 51*(4), 595-608. https://doi.org/10.1111/agec.12574

Perdomo, E., E Alejandro, Schwarzbauer, P., Fürtner, D., & Hesser, F. (2021). Life cycle assessment of agricultural wood production—methodological options: A literature review. *BioEnergy Research, 14,* 492-509. https://doi.org/10.1007/s12155-021-10266-4

Singh, P., Singh, G., & Sodhi, G. (2019). Energy auditing and optimization approach for improving energy efficiency of rice cultivation in South-Western Punjab, India. *Energy, 174,* 269-279. https://doi.org/10.1016/j.energy.2019.02.169