

## Research Article



# Gender Differences in Traditional Pig Farmers' Socio-Demographics, Awareness, and Attitudes Toward Reproductive Biotechnology in Zambia

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**Abstract** | Pig rearing with reproductive biotechnology utilization for increased production and productivity was recently recommended to reduce the animal protein deficit. This study aimed to assess the socio-demographic characteristics, awareness levels and attitudes of male and female traditional pig farmers toward reproductive biotechnology application. A cross-sectional descriptive survey was employed to obtain sex-disaggregated data from 622 respondents using a semi-structured questionnaire. Descriptive statistics including frequencies, mean, and standard error of the mean as well as inferential statistics, namely, Chi-square, Mann-Whitney U test, independent samples t-test, ANOVA, and the post-hoc tests were used to analyse the data. Out of 622 respondents, 66.9% were females while 33.1% were males. This study revealed significant association between the respondents' gender and their education status ( $P < 0.001$ ), income status ( $P < 0.001$ ), land size ( $P < 0.01$ ), rearing experience ( $P < 0.05$ ), and flock size ( $P < 0.05$ ). The age of respondents was not associated ( $P > 0.05$ ) with gender. Most (55.5%) male respondents as well as the majority of females (83.4%) had low awareness. The female respondents had lower biotechnology awareness than the males ( $p < 0.001$ ). The male respondents had significantly more favourable attitude evaluations than their female counterparts ( $p < 0.01$ ). The overall mean attitude scores for males ( $3.91 \pm 0.03$ ) and females ( $3.81 \pm 0.02$ ) were generally positive. The influence of awareness level on the mean attitude scores was significant for both male ( $P < 0.001$ ) and female respondents ( $P < 0.001$ ). In conclusion, this study has revealed significant disparities in socio-demographic characteristics, awareness, and attitudes between male and female traditional pig farmers. The observed gender gaps, if not attended to, may negatively impact on efforts to improve pig production through reproductive biotechnology application.

**Keywords** | Attitudes, Awareness, Gender, Reproductive biotechnology, Traditional pig farmers

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Food (nutritional) insecurity remains a burden especially in Africa where 675 million people are still food insecure and, out of these, 250 million are undernourished (FAO et al., 2020). Moreover, more females are food insecure compared to the male farmers (Actionaid, 2011; Broussard, 2019; FAO et al., 2020). In Zambia, over 40% of the rural population lack adequate food, while 77.9% of the rural population are reportedly poor (FAO, 2018; Mwanawenge and Cook, 2019). It was predicted that the demand for food, mainly animal proteins, will triple by 2050 largely due to the human population increase (Onteru et al., 2010; FAO et al., 2020; Hou-jones et al., 2020). Unfortunately, agricultural productivity in developing countries like Zambia is still low (FAO et al., 2020; Hou-jones et al., 2020). Thus, policies that promote among others; diversification to include livestock production, improve livestock production and productivity through reproductive biotechnology, gender mainstreaming, and conservation of indigenous genetic resources have been developed to deliver efficient food production systems (Mwanawenge and Cook, 2019; Hou-jones et al., 2020; Rota and Urbani, 2021).

The existing shortage of animal protein and the increasing demand for the same, remain crucial; one of the recommended strategies to reduce the protein shortage and poverty levels, particularly among farmers, was pig production (Muhanguzi et al., 2012; World Bank, 2019). Traditional farmers in Zambia reported that pigs support their livelihoods through income generation and meat production for their household needs and home consumption, respectively (Abigaba et al., 2022). Although the rural population, mostly females, have increasingly resorted to pig rearing to improve their livelihoods, production and productivity of pigs in Zambia remain low; for example, in the year 2020 the country's pork production was merely 65,224 metric tonnes (Ministry of Finance, 2021; Abigaba et al., 2022). This was not commensurate with the total human population of 18.4 million people because this results in merely 3.5 kg per capita pork consumption, which was generally lower than the 10.7 kg global average value in the same year 2020 (World Bank, 2021; OECD, 2022). Low production is largely attributed to the traditional rearing system; unfortunately, majority (90%) of the pig farmers practice this system, and many (65%) of the pigs reared in Zambia are indigenous (Phiri et al., 2013; MLNR, 2015). Although indigenous pigs are adapted to the local rearing conditions (Phiri et al., 2013; Authors' unpublished data), they still require improved management to increase their production and productivity.

One of the viable strategies to increase production is to apply biotechnologies such as artificial insemination

(AI) and AI-supportive biotechnologies; however, traditional farmers in Zambia are not applying them to improve production of the mainly reared indigenous pigs (Magdalena et al., 2014; Abigaba et al., 2022; Hadgu and Fesseha, 2020). Thus, there is a need to modernise pig production while focusing on breed adaptability, preference, and gender factors. Operationalisation of gender-sensitive biotechnology programmes would even have a greater impact on pig production and productivity, of note, majority of the traditional farmers are females (Abigaba et al., 2022). Females, compared to males, are largely disadvantaged in light of the various productive resources; if they had similar production means as their male counterparts, production from their farming activities would increase (Agholor, 2019). Moreover, females greatly contribute to the household livelihoods and development (Paudel et al., 2009; Rota and Urbani, 2021).

Despite the government plans to promote reproductive biotechnology application, crucial issues for example, knowledge about indigenous pig biology and the psycho-socio-economic factors which affect reproductive biotechnology acceptance or adoption is needed (Abigaba et al., 2022). The baseline information on farmers particularly the sex-disaggregated data is crucial in establishing their needs, quantify changes resulting from an intervention, and/or predict the possible changes needed (Actionaid, 2011; Klasen et al., 2016). Previous researches reported the importance of psycho-socio-economic factors, such as the demographics, awareness of, and attitudes of farmers toward reproductive biotechnologies in influencing their acceptance and/or adoption rates (Adekoya and Oladele, 2008; Amin et al., 2011; Llewellyn and Brown, 2020; Maduka et al., 2020). However, to date, there is a dearth of this information, especially disaggregated by gender, about the traditional pig farmers in Zambia. Considering the previous reports of lower biotechnology adoption rates among different female livestock farmers compared to their male counterparts (Magdalena et al., 2014; Namonje-Kapembwa and Chapoto, 2016), the information about crucial factors associated with, for example, biotechnology acceptance/adoption more so in the disaggregated form, would be beneficial (FAO, 2018). Hence, this study was carried out with aims to (1) ascertain the socio-demographic characteristics of traditional pig farmers, (2) establish by gender the awareness levels and attitudes of traditional pig farmers toward reproductive biotechnology application, and (3) determine by gender, the relationship between awareness and the attitudes of traditional pig farmers toward reproductive biotechnology application.

## MATERIALS AND METHODS

### ETHICAL CLEARANCE AND INFORMED CONSENT

The study was carried out with approval (No. 1595-

2021) by The University of Zambia Biomedical Research Ethics Committee (UNZABREC). All participants were informed about the study objectives and signed consent was obtained from them.

**STUDY AREA AND THE PERIOD**

This study was conducted from Petauke and Gwembe districts of Eastern and Southern provinces, respectively (Figure 1), during May–September, 2021. Of the 10 provinces in Zambia, Eastern and Southern provinces had the highest pig proportion. The aforementioned districts are known to be the places of origin for indigenous pigs of Zambia (Ministry of Fisheries and Livestock, 2019). In addition, Gwembe lies within agro-ecological region I while Petauke lies within agro-ecological region II. The rainfall ranges are 400–750mm and 750–1000mm while temperatures are 30–36°C and 30–32°C for Gwembe and Petauke districts, respectively (Phiri et al., 2013).

the instrument included a total of 12 dichotomous items of which, eight were on whether respondents had heard or read about the listed biotechnologies, namely, AI, oestrus induction and synchronization, semen evaluation, semen preservation, heat detection methods, pregnancy diagnosis, and *in vitro* fertilization and embryo transfer, one item on information search, and the three items on reproductive biotechnology application. For attitude trait, a total of 18 Likert items each with a 5-point Likert scale were included; their construction focused on pragmatic opinions, feelings and behavioural intentions of farmers toward reproductive biotechnology application. In addition, dichotomous, multiple choice, and open ended questions were included to collect the data on the socio-demographic component. Tool pre-test was done for validation; the resulting internal consistency for awareness and attitude scales, KR-20 = 0.790 and Cronbach’s alpha ( $\alpha$ ) = 0.767, respectively, were acceptable.

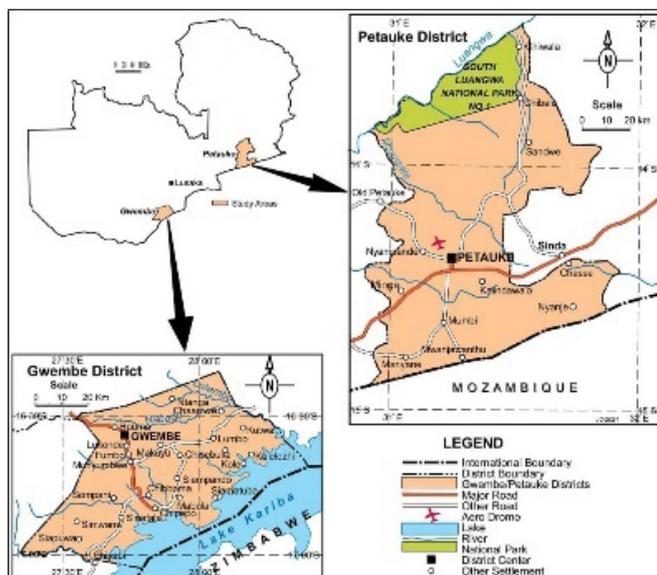
The sample size was estimated using a formula applicable at different population proportion levels and confidence levels (Adam, 2020). The formula used was:

$$n = \frac{N}{1 + Ne^2}$$

Where; n= minimum returned sample size; N= population size;  $\epsilon$ = Adjusted margin of error which is =  $[\epsilon = pe/t]$ ; e= degree of accuracy expressed as proportion (margin of error at 0.05); p= number of standard deviations; t = t-value for the selected alpha level or confidence level (Krejcie and Morgan, 1970; Adam, 2020). This formula yielded 383; however, an adjustment by 62% increment was done to compensate for the design effect due to sampling errors resulting from a mix of methods used in the multi-stage sampling strategy. Thus, the final sample size was 622 respondents; out of these, 353 and 269 respondents were recruited from Gwembe and Petauke Districts, respectively, for the interviewer-administered questionnaire survey. To obtain this number, 5 to 20 respondents were randomly selected from each village; the system of pig production and gender predisposition were among the issues considered for selection of the respondents. Accordingly, a total of 74 males and 195 females were selected from Gwembe district while from Petauke the males and females were 132 and 221, respectively. These were obtained from nine agricultural camps in total and, for each camp, six villages were randomly selected. The agricultural camps included Kalindawalo, Minga, Mumbi, and Petauke central from Petauke District; and then Lumbo, Gwembe central, Chipepo, Muyumbwe, and Makuyu from Gwembe District.

**STATISTICAL ANALYSIS**

All the data were analysed in the Statistical Package for the Social Sciences (SPSS) IBM® (SPSS IBM 26 version, USA).



**Figure 1:** The two Districts and agricultural camps where respondents were selected.

**Source:** Department of Geography and Environmental Studies, University of Zambia.

**STUDY DESIGN AND DATA COLLECTION**

This study was a cross-sectional descriptive survey which employed a quantitative data collection approach, the focus was on the socio-demographic factors of farmers, their awareness, and attitudes toward reproductive biotechnology. The study used multi-stage purposeful random sampling strategy to recruit the farmers.

The study used a suitably constructed questionnaire to obtain data from farmers; the design of the instrument was based on the previous biotechnology related studies (Klop and Severiens, 2007; Fawole and Tijani, 2014; Mezinska et al., 2020). The design and the items used in the questionnaire were modified according to the study topic. On awareness,

Descriptive statistics used were frequencies which employed Row X Column frequency tables for categorical data, as well as means and standard errors for continuous data. Before composite analysis, scale reliability for both awareness and attitudes, KR-20 = 0.873 and  $\alpha = 0.780$ , respectively, were obtained. For awareness, total scores from the questions answered correctly were computed for both the males and females, the scores were binned into low, moderate, and high awareness levels for further analyses. Average attitude scores for each male and female respondents were obtained, followed by computation of the mean attitude scores for their respective groups. The inferential statistics used were  $\chi^2$  test for association between the selected factors, Mann-Whitney U test and the independent samples t-test for two sample comparisons, and the one-way ANOVA for awareness influence on the respondents' attitudes. To locate the specific means with a significant difference, Post-hoc (Tukey's HSD) test was employed.

## RESULTS

### SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS BY GENDER

The socio-demographic findings for male and female

respondents are presented in Table 1. Out of 622 respondents, 66.9% were females while 33.1% were males. More females were above 45 years of age while most of the males were between 30 to 45 years. The education status for both male and the female respondents was generally low, further, it was lower among the females than males. Generally, the majority (89.8%) of the male respondents were married; the females were largely married (68.3%) and a considerable number (29.1%) of them was widowed or had divorced. Many of the male and female respondents were low-income earners; in addition, the females were generally poorer than the male respondents. Both genders owned more than 1 acre of land, and the males generally owned more land than the female farmers. The majority of the male and female farmers had less than six years of rearing experience; further, the males had more rearing experience than the female respondents. The male respondents generally owned larger flock size compared to the females. There was significant association between respondents' gender and their education status, income status, land size, rearing experience, and the flock size. There was no association between gender of the respondents and the age category, as well as the respondents' preference for the breed of pigs to rear.

**Table 1:** Socio-demographic characteristics for the respondents in Petauke and Gwembe Districts of Zambia.

Variable	Category	Male	Female	$\chi^2$ (df)	P value
		Frequency (%)	Frequency (%)		
Age	Below 30 years	36(17.5)	65(15.6)	0.083(2)	0.083
	30 to 45 years	99(48.1)	169(40.6)		
	Above 45 years	71(34.5)	182(43.8)		
Level of education	No education	12(5.8)	50(12.0)	53.697(3)	0.000***
	Primary	106(51.5)	297(71.4)		
	Secondary	85(41.3)	69(16.6)		
	Tertiary	3(1.5)	0(0.0)		
Marriage status	Never married	13(6.3)	11(2.6)	55.472(2)	0.000***
	Married	185(89.8)	285(68.3)		
	Widowed or divorced	8(3.9)	120(29.1)		
Monthly income	Below ZMW500	112(54.4)	293(70.4)	15.671(2)	0.000***
	ZMW500 to ZMW2000	68(33.0)	90(21.6)		
	Above ZMW2000	26(12.6)	33(7.9)		
Land size	Below 1 acre	22(10.7)	65(15.6)	10.993(2)	0.004**
	1 to 2 acres	59(28.6)	157(37.7)		
	Above 2 acres	125(60.7)	194(46.6)		
Rearing experience	Below 6 years	121(58.7)	289(69.5)	7.452(2)	0.024*
	6 to 10 years	39(18.9)	53(12.7)		
	Above 10 years	46(22.3)	74(17.8)		
Flock size	Below 6 pigs	148(71.8)	337(81.0)	6.848(2)	0.033*
	6 to 15 pigs	56(27.2)	77(18.5)		
	Above 15 pigs	2(1.0)	2(0.5)		
Breed preference	Exotic pigs	100(48.5)	183(44.0)	1.152(1)	0.283
	Indigenous pigs	106(51.5)	233(56.0)		

**Source:** Authors' survey data (2021). \*\*\*, \*\* or \* = Statistically significant at 0.001,  $p < 0.01$  or 0.05, respectively,  $\chi^2$  = Chi-Square; df = degrees of freedom.

**Table 2:** Cross-tabulation of gender across awareness and attitudes toward reproductive biotechnologies among respondents in Petauke and Gwembe Districts of Zambia.

Variable	Category	Male	Female	Statistic (U)	P-value
		Frequency (%)	Frequency (%)		
Awareness	Low awareness	114(55.3)	347(83.4)	z=-8.053	0.000**
	Moderate awareness	58(28.2)	55(13.2)		
	High awareness	34(16.5)	14(3.4)		
	Strongly positive	49(23.8)	47(11.3)		

**Source:** Authors' survey data (2021). U = Mann-Whitney U test, z = z-score value, % = Percentage, \*\* = Statistically significant at P<0.001.

**Table 3:** The mean attitudes across awareness category of the respondents in Petauke and Gwembe Districts of Zambia.

Awareness level	Male		Female	
	Number of respondents	Mean± SEM	Number of respondents	Mean± SEM
Low awareness	114	3.78±0.04	347	3.77±0.02
Moderate awareness	58	4.01±0.03	55	3.95±0.04
High awareness	34	4.17±0.05	14	4.26±0.09
Total	206	3.91±0.03	416	3.81±0.02

**Source:** Authors' survey data (2021). Mean rating scale: 1.00-1.80 (Strong negative), 1.81-2.60 (Negative), 2.61-3.40 (Neutral), 3.41-4.20 (Positive), 4.21-5.0 (Strong positive), SEM = standard error of mean

**AWARENESS LEVELS AND ATTITUDES TOWARD REPRODUCTIVE BIOTECHNOLOGY BY GENDER**

Many respondents, for both gender, generally had low awareness towards reproductive biotechnology. The distribution of the male and female respondents across awareness categories are presented in Table 2. Furthermore, awareness level (score) of the females was lower (mean rank = 271.16) than that of their male counterparts (mean rank = 392.97). Mann-Whitney U test revealed that the difference was statistically significant, U (n= 416 for females, n= 206 for males) = 26064.50, z= -8.053, p <0.001). With respect to attitudes toward reproductive biotechnology application, both the male and female respondents generally had positive attitudes, 3.91±0.03 and 3.81±0.02, respectively. The independent samples t-test, for equality of means, indicated that the male respondents had a significantly (p <0.01) more positive attitude evaluation than the females.

**THE MEAN ATTITUDES ACROSS AWARENESS LEVELS OF THE RESPONDENTS BY GENDER**

The mean attitude evaluations for males and females across all awareness categories were generally positive (Table 3). There was a significant correlation between mean attitudes of the male respondents and the level of awareness (F = 13.627, p <0.001); also, the mean attitudes of the female respondents was significantly correlated (F = 9.141, p <0.001) with the level of awareness. The post-hoc (Tukey's HSD) test indicated significant differences between mean attitudes for male respondents with low and moderate awareness (p <0.001), low and high awareness (p <0.001), but there was no significant difference in attitude

evaluations for those with moderate and high awareness levels (p >0.05). In addition, there was significant differences between the mean attitude evaluation for, female respondents with low and moderate awareness (p <0.001) and also, those with low and high awareness (p <0.001). No significant association (p >0.05) between the mean attitude evaluations for female respondents with moderate and high awareness levels was found.

**Table 4:** Source of information about biotechnologies among the respondents in Petauke and Gwembe Districts of Zambia.

Source of information	Male	Female
	Frequency (%)	Frequency (%)
Television or radios	18(8.8)	8(1.9)
Formal education	20(9.8)	10(2.4)
Fellow farmers	39(19.0)	48(11.6)
Extension workers	44(21.5)	25(6.0)
No answer	105(51.2)	329(79.3)

**Source:** Authors' survey data (2021).

**SOURCES OF INFORMATION ABOUT REPRODUCTIVE BIOTECHNOLOGY BY GENDER**

The sources of information regarding reproductive biotechnology application are presented in Table 4. The male respondents, largely (21.5%), obtained information from extension workers, while more of the females (11.6%) obtained it from the fellow farmers. Across the different sources of information, generally, male respondents had more access to information than the females. Among the female respondents, the majority of them (79.3%)

gave no answer on sources of information; the no answer category for males was considerably smaller (51.2%). It was observed that some respondents obtained information about reproductive biotechnology from more than one sources.

## DISCUSSION

Women play a crucial role in agricultural production, thus contribute to the household livelihoods and national development. Unfortunately, there is a dearth of agricultural related information on female farmers despite their role in agricultural production (Paudel et al., 2009; Actionaid, 2011). Hence, there is a need to collect gender-disaggregated data about farmers to better understand the various forms of gender inequality and inform the gender-sensitive policies (Klasen et al., 2016; Ramey and Piovani, 2020). Gender-disaggregated data would benefit the strategy to increase pig production through reproductive biotechnology, which, thereby, contributes to the reduced animal protein deficit. This is in light of the role of gender equity in increased production and reduced poverty among rural farmers (Muhanguzi et al., 2012; Agholor, 2019). Without the baseline information about male and female farmers, measurement of what change, and how much change will happen, is not possible (Actionaid, 2011; Klasen et al., 2016). The current study findings on socio-demographic characteristics, awareness levels, and the attitudes of the traditional pig farmers are deemed beneficial for breeding and/or reproductive biotechnology policy direction in Zambia. According to the previous reports, these factors influenced farmers' biotechnology acceptance and adoption rates (Adekoya and Oladele, 2008; Amin et al., 2011; Llewellyn and Brown, 2020).

Majority of the respondents in this study were females which concurred with earlier reports in Botswana, where the females dominated (62%) the pig farming activity (Thutwa et al., 2020). Thutwa et al. (2020) attributed the small size of pigs to the observed females' dominance in pig rearing because small-livestock unlike the large-livestock can easily be managed by this gender. Also, probable is the patriarchal environment in developing countries like Zambia, which tends to put men in the ownership of large-livestock, leaving small-livestock such as pigs to women, because they consider pig rearing a minor activity (Paudel et al., 2009; FAO, 2018; Abigaba et al., 2022). Similarly, the rural population is largely made of females hence the possible cause of the observed disparity (FAO, 2018). Thus, participation in livestock farming, more so pig farming, would be the best entry for gender equality promotion in rural areas (Paudel et al., 2009; Ramey and Piovani, 2020). Moreover, many women are usually disadvantaged with regard to the alternative sources of income, hence

targeted improved pig production through reproductive biotechnology application would greatly empower this gender.

In this study, respondents' gender was not associated with the age similar to the previous study by Yakubu and Joshua (2020), who reported no association ( $\chi^2 = 0.458$ ,  $P > 0.05$ ) between gender of the respondents and age. Nevertheless, more males were middle-aged while more females were in the older category; this finding was similar to another study in Nigeria (Faborode et al., 2020). According to Yakubu and Joshua (2020), gender influences the nature or type of work/ tasks that males and females perform; further, the roles may vary per group, country, and generation. This, and in view of the current findings, probably, influenced the males to raise pigs for income generation given their household responsibilities, for example, taking care of the family. Noteworthy, many males in this age category are usually married and need to take care of their families; similarly, the substantial proportion of older females was possibly attributed to the need to raise money for the same since many females were widowed or divorced. Of note, the habit of males abandoning household responsibilities leaving them to females cannot be ignored. The observed gender-based disparity, in view of the participation in pig farming with regard to the age of respondents, demonstrated the need for gender-disaggregated data and its importance amidst efforts to improve production of pigs.

In the current study, respondents largely had low education status which disagreed with previous study in Nigeria, where more males (42.1%) and more of the females (36.38.0%) had completed the secondary level of education (Faborode et al., 2020). Of gender importance, and in agreement with previous reports (FAO, 2018; Faborode et al., 2020), this study found that more males progressed to secondary education than did the female respondents. Another study reported that higher education status was associated with a more active knowledge seeking behaviour, greater potential to appreciate reproductive biotechnology benefits, and thus higher adoption rate (Llewellyn and Brown, 2020). Considering, generally, the low education status of both gender, and the association between education status and gender of the respondents, critical attention is called for during the design and implementation of pig breeding and/or reproductive biotechnology policy. Availability of knowledge about farmers' education status assists in predicting their adoption rate (Llewellyn and Brown, 2020), hence the current findings, moreover gender disintegrated, could be beneficial. In the short-term, however, there is a need for a solid extension service delivery system to counteract the negative effects of the observed low education that could potentially result in low adoption rates (Dhraief et al., 2019).

With regard to income status, the majority of both gender earned below a dollar per day consistent with another study in Nigeria, which reported that 50.9% and 55.7% of the male and female respondents, respectively, were low income earners (Faborode et al., 2020). The observed respondents' income was 5 times less than the average per capita income in Zambia. The current findings support existing data which indicate that 77.9% of rural population live below poverty datum line (FAO, 2018). Noteworthy, however, the female respondents generally earned less than males which agreed with the earlier reports in Zambia and South Africa (Halimani et al., 2013; FAO, 2018). Nevertheless, given the potential of pig production such as prolificacy, faster growth, and cheaper nutritional source, application of reproductive biotechnology will further boost the productivity and production, and improve farmers' livelihoods especially the with increasing participation of females. (Paudel et al., 2009; Actionaid, 2011; Faborode et al., 2020). Therefore, the income status alongside gender predisposition of the farmers, given association with awareness and attitudes toward reproductive biotechnology acceptance and adoption, must be appreciated and considered (Ayandiji and Gureje, 2014; Adebisi et al., 2015).

World over, gender equity is generally regarded as a fundamental human right and is one of the essential portals to reduced poverty and improved livelihoods (Paudel et al., 2009). To date, however, many of the rural farmers especially females still lack access to productive resources such as extension services, technologies, land, and other valuable goods including livestock (Namonje-Kapembwa and Chapoto, 2016; FAO, 2018). Related to land rights, this study revealed an association between land size and gender of the respondents which agreed with findings from another study in Nigeria (Yakubu and Joshua, 2020). Generally, the male farmers owned more land than their female counterparts which was also consistent with the earlier reports (FAO, 2018). Of note, FAO (2018) reported that a rural female farmer is free to utilize land or even co-own it with the husband but is generally restricted in regard to ownership, this inequality is attributed to the socio-cultural setting, for example, patriarchy. Hence, the reported land size by females in this study may not necessarily represent ownership. Lack of land access was previously associated with low production, mainly among traditional female farmers, and low reproductive biotechnology adoption rates (Thin et al., 2017; FAO, 2018; Yakubu and Joshua, 2020). Similarly, a positive association between land size and the attitudes toward reproductive biotechnology was also previously reported (Abigaba et al., 2022). Lack of land ownership disadvantages females, particularly when accessing loans since land is a key security farmers use to obtain loans. This notwithstanding, at least both gender had some land

sufficient to rear on, because pigs do not require a lot of space compared to the grazers (Motsa'a et al., 2018).

The majority of both females and males owned small numbers (<6) of pigs similar to the previously reported average flock size (5.8) per household by the Ministry of Agriculture and Livestock (2019). This study also observed that male respondents, on average, owned more pigs than the females despite dominance of the latter in pig rearing activity, this agreed with other findings in Nigeria and South Africa (Halimani et al., 2013; Yakubu and Joshua, 2020). Smaller flock size owned by the female respondents was probably due to unequal access to production resources like technology, extension, and credit services among males and females. Gender inequality with regard to productive resources was previously reported as one of the major production challenges especially among rural farmers in Zambia (Namonje-Kapembwa and Chapoto, 2016; FAO, 2018). With this finding and in light of the role of pigs in the livelihoods of rural farmers particularly women (Thin et al., 2017; Rota and Urbani, 2021), gender mainstreaming with a focus on productive resources is deemed crucial. Moreover, the current small-flock sizes can sufficiently be expanded through reproductive biotechnology application to empower these farmers.

Furthermore, even though pig rearing was suggested as a strategy to reduce animal protein deficit (Muhanguzi et al., 2012; Magdalena et al., 2014), sustainable production and conservation approaches will necessitate a better understanding of both the male and female farmers' choice of the breed(s), and the adaptability of pig breed(s) to the local rearing conditions (Halimani et al., 2013). The current study showed that majority of the male and female farmers would prefer to rear indigenous pigs over exotics. This finding was consistent with the previous study report in South Africa (Halimani et al., 2013). As such, it is not surprising that 65% of the national flock was reportedly comprised of indigenous pigs (MLNR, 2015). Previous studies attributed preference of farmers for the indigenous pigs to such traits as adaptability and/or ability to perform under local rearing conditions (Halimani et al., 2013; Thutwa et al., 2020; Authors' unpublished data).

According to the previous national report on biodiversity (MLNR, 2015), many farmers were resorting to indigenous pig farming. This is consistent with the current findings which has revealed majority of both gender having less than six years of rearing experience. Noteworthy, however, the female respondents generally had a shorter rearing experience than the male respondents, this was consistent with the earlier reports in Nigeria (Yakubu and Joshua, 2020). It is plausible that the worsening economic hardships, nutritional demands, and the changes in mind-set of the farmers, in terms of gender roles, have recently

encouraged the observed participation in pig farming particularly the female farmers (Abigaba et al., 2022). However, the existing low production and productivity of the indigenous pigs must be improved through gender-sensitive biotechnology promotion and training of sufficient personnel for the biotechnology services.

With regard to awareness towards reproductive biotechnology, both gender categories had many respondents with low awareness levels although females had lower awareness than the males. Such a gender disparity disadvantages the female farmers given the influence of biotechnology awareness on acceptance and/or adoption rates. Similar findings were also reported among farmers in Malaysia (Amin et al., 2011). Of note, the main vehicle through which agricultural information reaches farmers, so that they become aware, is through extension services (Adekoya and Oladele, 2008; Maduka et al., 2020). Accordingly, the lack and an unequal access to agricultural information in the current study may be faulted for the observed low awareness among respondents. A previous study in Nigeria reported that males tend to have more access to agricultural information than the females (Adebisi et al., 2015). Nevertheless, the observed low awareness was suggestive of the lack of a solid extension service delivery. This is in view of the reported challenge of weak extension system in Zambia (FAO, 2018). Noteworthy, more females accessed information from fellow farmers compared to the males, while more male respondents relied on extension agents for the same. It is suggested, however, that farmers get exposure from as many information sources as are available to make them more aware (Maduka et al., 2020). Nevertheless other crucial factors associated with awareness of farmers such as the level of education, income status, and unequal household time and activity schedules for the two gender require due attention (Actionaid, 2011; Adebisi et al., 2015; Agholor, 2019).

Strikingly, both gender had positive attitudes toward reproductive biotechnology application. However, male respondents had significantly more favourable attitudes than the females, which was probably because females were less aware of reproductive biotechnologies than the male respondents. The current study revealed that respondents' awareness level, for both gender, influenced their attitude evaluations. This is consistent with existing reports which indicated that awareness, and thus knowledge, significantly affected farmers' beliefs and perceptions thereby culminating into a decision to accept or not to accept a reproductive biotechnology (Adekoya and Oladele, 2008; Maduka et al., 2020). Similarly, Llewellyn and Brown (2020) reported that individuals first become aware of a reproductive biotechnology, learn about its relative advantages, and then form attitudes toward a biotechnology. Significantly, though, the farmers simply

needed to be aware of reproductive biotechnology in order to form favourable attitudes around it. Accordingly, a solid and gender-sensitive livestock extension system will likely increase the awareness of farmers, particularly females, thereby further contribute to more favourable attitudes toward reproductive biotechnology and its utilization for increased production (FAO, 2018; Maduka et al., 2020).

## CONCLUSION

Indigenous pigs are among the valuable livestock which are essential to both the male and female traditional farmers in Zambia. This study found that females compared to the male farmers were less educated, had a lower monthly income, with less years of rearing experience, owned smaller flock sizes as well as land; however, they dominated the pig rearing activity. In addition, female respondents had lower awareness than their male counterparts. There was a lack of access to agricultural information, especially among the female category, probably due to the weak livestock extension system. This was a concern since information access is associated with the awareness of farmers; moreover, this study revealed that respondents' awareness level, for both gender, influences their attitudes toward reproductive biotechnology. It is not surprising that males compared to females had more positive attitude evaluations because the latter had a lower awareness level than the former. Hence, biotechnology awareness promotion among females will further impact on their attitudes and, consequently, acceptance/adoption rates. By and large, the current study has revealed a gender gap which puts female farmers at a disadvantage and, thus, renders the current study findings of biotechnology and/or pig breeding policy significance. To enhance indigenous pig production through reproductive biotechnology, gender-sensitive approaches with a focus on the relevant issues such as socio-demographic characteristics, awareness, and attitudes of traditional pig farmers will be crucial.

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The current study has, for the first time, generated the sex-disaggregated data on traditional pig farmers' socio-demographic, their awareness and attitudes toward reproductive biotechnology application. This information will benefit various stakeholders during planning, formulation, and implementation of the pig breeding/biotechnology policy; further, it will guide the implementation of gender-sensitive pig production interventions aimed to better livelihoods of traditional farmers.

## AUTHOR'S CONTRIBUTION

RA conceived and designed the study, collected and analysed the data, and wrote the manuscript draft. PCS and PHN designed and supervised the study, and reviewed the manuscript. ESM and WNMM supervised the study and reviewed the manuscript. All authors read and approved the final manuscript for publication.

## CONFLICT OF INTEREST

The authors have declared no conflict of interest.

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