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AN ANALYSIS OF FACTORS THAT DETERMINES THE CHOICE OF INDIGENOUS CHICKEN (IC) OWNED BY RURAL HOUSEHOLDS IN ALICE COMMUNAL AREA, SOUTH AFRICA

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Abstract. Although African indigenous chickens (ICs) are commonly kept by households in rural areas for consumption and sale, their contribution to rural livelihoods is generally overlooked. Literature suggests that IC production plays a vital role in rural communities of South Africa as a source of household income and cheap animal protein. Despite these claimed benefits, the production of indigenous chickens in Alice and other parts of South Africa's rural areas is very low. This study utilised a purposive random sampling method to select 120 households, focusing on villages known to keep IC in Alice Communal Area, South Africa. A multivariate probit model was used to analyse factors that influence the choice of indigenous chicken owned by rural households. Results revealed that gender (p-value < 0.10), age (p-value < 0.10), household size (p-value < 0.10), association membership size (p-value < 0.05), access to formal markets (p-value < 0.10), access to veterinary services (p-value < 0.05), access to informal credit (p-value < 0.05), access to formal credit (p-value < 0.01) and diversity score (p-value < 0.01) drive ownership of different indigenous chickens at the household level. Therefore, this paper argues that the promotion of indigenous chicken ownership at the household level calls for strategic institutional alignment and a clear understanding of social-demographic characteristics of the targeted community, which should be supported by several awareness campaigns and client-based selection of indigenous chicken breeds of socio-economic importance to the households.

Keywords: indigenous chicken, rural livelihoods, multivariate probit, households

INTRODUCTION

The production of poultry in Africa plays a vital economic role for both rural and urban dwellers; it is practised by the majority of the rural population (Conan et al., 2012; Fotsa, 2008; Mubamba et al., 2018). Literature is awash with the importance of indigenous chickens (ICs) to rural, urban and suburban families in developing countries, including household consumption, scaling down malnutrition, providing extra income, socio-cultural practices, employment creation, reducing poverty reduction and promoting gender equality (Guèye, 2005; Moges, 2010).

Despite indigenous chickens' contribution to the development of rural livelihoods, they have continued to be less competitive than exotic breeds because ICs have low productivity. Moreover, the indigenous chicken production system receives little attention in research (Conteh and Sesay, 2019). Productivity is also hampered by the free-range system where birds are left to scavenge with minimum or no supplementary feeding. Other challenges that derail indigenous chicken

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production include but are not limited to lack of capital investment, disease outbreaks, predators, thieves, lack of proper housing and information on poultry rearing (Mahoro et al., 2017; Moussa et al., 2019). Notwithstanding these challenges, indigenous chicken breeds are tolerant of extreme environments, show disease resistance, have high genetic diversity for several traits and require fewer production inputs than commercial and exotic poultry breeds (Akinola and Essien, 2011; Mubamba et al., 2018).

The South African situation shows many similarities to other African and developing countries where the indigenous chicken production of low input is prevalent amongst resource-constraint rural households. In rural communities of South Africa, indigenous chicken plays numerous socio-economic roles as an essential source of animal protein, income, gift payments and various traditional, religious and other customs (Malatji et al., 2016; Tarwireyi and Fanadzo, 2013). Again, different types of indigenous chicken breeds are reared in South Africa's rural areas. Some of these breeds include but are not limited to the Naked Neck, Potchefstroom Kooekok, Venda and Ovambo (Manyelo et al., 2020; Mtileni et al., 2011). Despite this, empirical research supporting the production and ownership of indigenous chickens for poverty alleviation in South Africa is scanty (Idowu et al., 2018; Yusuf et al., 2014). This paper seeks to investigate drivers of indigenous chicken ownership in the Alice Communal Area of South Africa against this background.

PROBLEM STATEMENT

Although African indigenous chickens are commonly kept by households in rural areas for consumption and sale (Oluwatayo et al., 2016), their contribution to rural livelihoods is generally overlooked. However, the literature highlights that through the consumption of eggs and meat of indigenous chickens, most rural households have access to quality protein (Idowu et al., 2018). Indigenous chickens, therefore, provide a balanced farming system securing emergency cash income and high-quality animal protein critical for the socio-cultural livelihoods of the rural households (Raphulu and van Rensburg, 2018). Despite the claimed benefits, the production of indigenous chickens in rural areas is very low (Mazimpaka et al., 2018). Some households in rural areas do not own indigenous chickens (Makaya et al., 2012), despite their low cost of production (Mahoro et al., 2018; Mubamba et al., 2018), adaptability to local conditions and nutritional value – protein source (Idowu et al., 2018). The demand for indigenous chicken eggs and meat is generally assumed to be high due to taste, flavour and aroma (Bett et al., 2013; Escobedo del Bosque et al., 2020). With high demand, low production costs, adaptability to local conditions and nutritional value as suggested by the literature, intuitively, indigenous chicken production in rural areas should be high. On the contrary, however, production is declining and fast being replaced by hybrid breeds expensive to produce and associated with several health problems (Mazimpaka et al., 2018). This study, therefore, seeks to understand ownership of indigenous chickens at the household level, given their suggested benefits amid declining production.

Objectives

- To identify the types of indigenous chicken produced and owed by rural households in the study area.
- To estimate the diversity of indigenous chickens owned by rural households in the study area.
- To analyse factors determining the choice of indigenous chickens (ICs) owned by rural households in Alice Communal Area, South Africa.

LITERATURE REVIEW

This section presents literature related to types of indigenous chicken produced by rural households and factors that influence their production at the household level, as suggested by previous studies. Several indigenous chicken (IC) types are reported in the literature. These include the Venda, Potchefstroom Koekoek, Naked Neck, Ovambo and the Natal Game.

The Venda chickens are thought to have originated in the Venda area of Limpopo Province of South Africa, identified by Dr Naas Coetzee in 1979 (Grobbelaar et al., 2010). These chickens lay tinted eggs, which are very large. When fully grown, the male's average weight is between 2.9 and 3.6 kg, and that of the female can get up to 2.4–3.0 kg (Manyelo et al., 2020). This breed has good mothering ability and survivability (Idowu et al., 2018). At about five months, they attain sexual maturity (Manyelo et al., 2020). Additionally, they have high egg quality, self-sustainment and resistance against diseases, low food requirements and broodiness (Manyelo et al., 2020).

The Potchefstroom Koekoek has some of the most desirable traits in hatchability and the hen-house egg production per hen. Most importantly, it is a locally developed breed (Manyelo et al., 2020). The Potchefstroom Koekoek was bred specifically to meet consumer preferences, who preferred brown-shelled eggs produced by the Potchefstroom Koekoek compared to white-shelled eggs produced by other breeds (Van Marle-Köster and Casey, 2001). In addition, this IC shows good adaptability and high egg production, and it is a heavy breed (Idowu et al., 2018). Moreover, the Potchefstroom Koekoek can reach sexual maturity in 138.5 days; the females have an average weight of 2.1 kg while males weigh about 3–4 kg (Abudabos et al., 2017; Grobbelaar et al., 2010). Their average egg weight is estimated at around 55.7 g (Van Marle-Köster and Casey, 2001).

The Naked Neck can be found in diverse climates all over South Africa; hence it is a very adaptable breed. This chicken breed is suitable for rearing in most rural areas because of high egg and meat production. Mating between two tasselled birds results in indigenous chickens with totally naked necks (Mtileni et al., 2011). These chickens have red earlobes, reddish bay eyes and a large wattle with single red combs (Manyelo et al., 2020). The average weight of hens can reach up to 1.1–3 kg, while that of cocks ranges between 1.5 and 3.5 kg (Mosoeunyane and Nkebenyane, 2001). The Naked Neck hens usually produce their first egg at 129 days, and they can lay an average of 138.9 eggs annually (Glenneis, 2020). The average weight of the Naked Neck egg can reach up to 55.5 g, and they reach sexual maturity at 155 days (Abudabos et al., 2017).

The Ovambo chicken originated in the Ovamboland of northern Namibia (Manyelo et al., 2020). These chickens can be described as layers; they avoid predators by roosting in trees because they can fly due to their lightweight (McCullough, 2017). The Ovambo chickens are known for agility and aggression because they catch and eat young rats and mice. Females can reach an average weight of about 1.54 kg while males weigh up to 2.16 kg; they reach sexual maturity at 143 days (Manyelo et al., 2020). The average weight of the Ovambo egg can reach up to 52.5 g, and their hens can produce 129 eggs annually (Abudabos et al., 2017).

The Natal Game chicken is a South African breed that originated in Natal Province (Grobbelaar et al., 2010; SASPO, 2016). According to SASPO (2016), this breed has stiff feathers and takes long to reach sexual maturity. Hens produce only a few eggs per year. SASPO (2016) also reported that cocks weigh about 4.1 kg and hens about 2.7 kg.

FACTORS INFLUENCING THE PRODUCTION OF INDIGENOUS CHICKEN

Several socio-economic factors drive indigenous chicken production at the household level. In most rural communities, indigenous chicken production is a domain of women by culture, mainly for home consumption and local sales (Alemayehu et al., 2018; Hailemicheal et al., 2016). Therefore, the gender of the household head plays a significant role in the production of indigenous chicken, which is worth understanding, given the emerging commercial potential of indigenous chickens. This fact may attract the interest of males. A general trend suggests that most households that participate in village poultry production are middle-aged or elderly females with respect to age. The influence of demographic factors like education of household head and household size could be of interest to note given the association between education and information access and the potential labour required to produce these chickens at a large scale where family labour plays a significant role (Hailemicheal et al., 2016).

Institutional factors also influence indigenous chicken production. According to Lemma and Tesema (2016), accessibility to extension service significantly improves free-range indigenous poultry production systems. This is possible through production information sharing and possible market linkages. Access to credit, both formal and informal, may also influence production by the purchase of vaccines and supplementary feeds (Linuma and Peter, 2017; Selaledi, 2017). On the contrary, since indigenous chicken depends mostly on scavenged feed resources with little supplementary grains, the influence of credit is therefore not apparent. Literature highlights several socio-economic and institutional factors that may influence the production of indigenous chicken worth further probing in different geo-political settings and, more importantly, at the household level to avoid concealing local dynamics.

METHODOLOGY

Description of the study area

The study was conducted in Alice Communal Area. It is a very small area situated under the Raymond Mhlaba Municipality in the Amathole District of the Eastern Cape Province of South Africa. It is located at an elevation of 1,720 feet (524 m) and lies on the south-western bank of the Tyume River, 100 km north-west of the city of East London.

Data source and sampling methods

The information on households was obtained using a semi-structured questionnaire focusing on types and number of indigenous chicken owned, household demographic factors and institutional factors. The data were collected from purposively selected villages (ones known to keep indigenous chickens) surrounding the Alice Communal Area using a cross-sectional survey. No documented registers existed for villages that keep indigenous chicken. As a result, the study used purposive sampling to choose the sampling frame focusing on communities known to keep indigenous chickens. Random selection was used to determine respondents for interviews from the purposively selected villages based on their willingness to participate and ownership of indigenous chickens. Hundred and twenty (120) rural agricultural households that keep indigenous chicken were chosen randomly.

Theoretical framework

The rational utility maximisation theory was used as the basis upon which the multivariate probit model was developed for this study. The study assumes that rural households select (own) their preferred indigenous chickens from a set of indigenous chickens available on the informal market as rational utility maximisation units. The assumption is that this decision is based on individual households' perceived utility of ownership subject to several household characteristics, location and resource constraints (Mudemba et al., 2020). Therefore, the utility associated with each choice is latent, whilst the selected (owned) indigenous chickens are noticeable and unordered, implying that the random utility maximisation theory can explain the selection and ownership of indigenous chickens at the household level (Deressa et al., 2008). We, therefore, argue that a rural resident "i" from Alice Communal Area in South Africa will choose indigenous chicken "b" over indigenous chicken "c", assuming the perceived utility the resident derives from indigenous chicken "b" is above that one of "c". Therefore, econometric estimations can be used to relate households' demographic, institutional and economic attributes to owned indigenous chickens (Taruvinga et al., 2016). Furthermore, assuming that families own a combination of indigenous chickens to mitigate against production risks and for substitutability and complementarity reasons rather than a single type of indigenous chicken, possible interrelationships among the dependent variable need to be captured to avoid bias and errors (Greene, 2012). Thus, instead of using a multinomial model, we used a multivariate model (Ekemini-Richard et al., 2020; Feleke et al., 2016; Ojo and Baiyegunhi, 2020), as detailed in the next section.

Analysis

A multivariate probit estimation model was used to analyse factors that determine the choice of indigenous chickens owned by rural households. We took note of several econometric models (ordered logit, poison count, binary, multinomial and probit regression) for estimation of household selection choices (Bryan et al., 2013; Mabe et al., 2014; Mukarumbwa et al., 2018; Taruvinga and Mushunje, 2010; Taruvinga et al., 2013; 2016; Zeleke and Aberra, 2014). This study took a different approach following several previous studies to accommodate simultaneous influences of predictor variables on the dependent variables that were correlated (substitutive) (Ekemini-Richard et al., 2020; Feleke et al., 2016; Ojo and Baiyegunhi, 2020; Lin et al., 2005).

Feleke et al. (2016) used a multivariate probit model to estimate determinants of climate change adaptation strategies among shoat producers in Ethiopia. Bearing in mind the potential correlation among the dependent variables, Feleke et al. (2016) opted for a multivariate probit model instead of a multinomial probit to capture the substitutive or supplementary components of the dependent variables (adaptation strategies). Ekemini-Richard et al. (2020) also used the multivariate probit model to estimate determinants of climate change adaptation methods used in Nigeria by underutilised indigenous vegetable farmers. While Ojo and Baiyegunhi (2020), targeting rice farmers, used the multivariate probit model and an endogenous switching regression model in south-western Nigeria to estimate drivers of climate change adaptation strategies and associated net farm incomes.

The multivariate probit model with five dummy dependent variables representing different types of indigenous chicken owned by rural households from the study area was employed in this study. These dependent variables were: the Venda chicken (VC), Naked Neck chicken (NNC), Ovambo chicken (OC), Potchefstroom Koekoek chicken (PKC) and the Natal Game chicken (NGC). Therefore, the multivariate probit model estimated the association between a set of predictor variables on each dependent variable (different types of indigenous chickens) through five binary probit models allowing for the free correlation of the error terms (Ojo and Baiyegunhi, 2020). Following Lin et al. (2005), we specified the multivariate probit model as illustrated in equation 1.

$$Yi = 1 \text{ if } X'\beta i + \varepsilon i > 0$$
$$Yi = 0\ X'\beta i + \varepsilon i \leq 0,\ i = 1, 2, 3, \ldots, n \qquad (1)$$

where:

Yi – is a vector of dependent variables (different types of indigenous chicken owned dummied 0:1)
X' – is a vector of explanatory variables
βi – is a vector of coefficients
εi – is a random error term
n – is a number of observations with zero means and unitary variance.

RESULTS

The study results are presented in this section. Initially, we introduced basic sample statistics results (Table 1), followed by descriptive statistics results (Fig. 1, 2 and 3) and lastly, econometric results (Table 2) for drivers of indigenous chicken ownership at the household level estimated using the multivariate probit model.

Basic sample statistics

A total of 120 respondents were considered in this study, with a mean age of 57 years. The sample composition had more male-headed households than female-headed ones. The majority of respondents attained secondary education. Household size of 5 family members was dominant, with a minimum of 1 family member and a maximum of 12 family members. The minority of respondents had access to formal markets, formal credit, veterinary services and agricultural extension services. In addition, the minority of the sample were active farmer association members. The majority, however, had access to informal credit, as detailed in Table 1.

Table 1. Basic sample statistics summary

Variables	N	Mean	Std. dev.	Min.	Max.
Gender	120	0.37	0.484	0	1
Age	120	57.27	12.428	29	89
Education	120	2.69	0.942	1	4
Marital status	120	2.31	1.019	1	4
Household size	120	5.23	2.019	1	12
Association membership	120	0.34	0.476	0	1
Formal market access	120	0.44	0.499	0	1
Access to extension	120	0.43	0.498	0	1
Access to vet services	120	0.20	0.402	0	1
Informal credit	120	0.55	0.500	0	1
Formal credit	120	0.28	0.453	0	1

Key:
Gender: 0 = Male, 1 = Female
Education: 1 = No formal education, 2 = Primary level, 3 = Secondary level, 4 = Tertiary level
Marital status: 1 = Single, 2 = Married, 3 = Widowed, 4 = Divorced
Association membership: 0 = No, 1 = Yes
Formal market access: 0 = No, 1 = Yes
Access to extension: 0 = No, 1 = Yes
Access to veterinary services: 0 = No, 1 = Yes
Access to informal credit: 0 = No, 1 = Yes
Access to formal credit: 0 = No, 1 = Yes

Indigenous chicken produced by rural households

Figure 1 presents the percentage share of respondents' ownership of indigenous chicken in the study area. The results indicate that rural households own different types of indigenous chicken, as illustrated in Figure 1.

The majority of respondents kept the Venda (24%), Naked Neck (23%) and Ovambo chickens (21%). The respondents highlighted that these chickens are adaptable to local conditions, resistant to most diseases and low feed eaters. Some minor chickens reported in the study area included the Potchefstroom Koekoek (19%) and the Natal Game (13%). However, the respondents noted a slow growth rate for most Natal Game chickens, a possible reason for low ownership of this type of chicken in the study area.

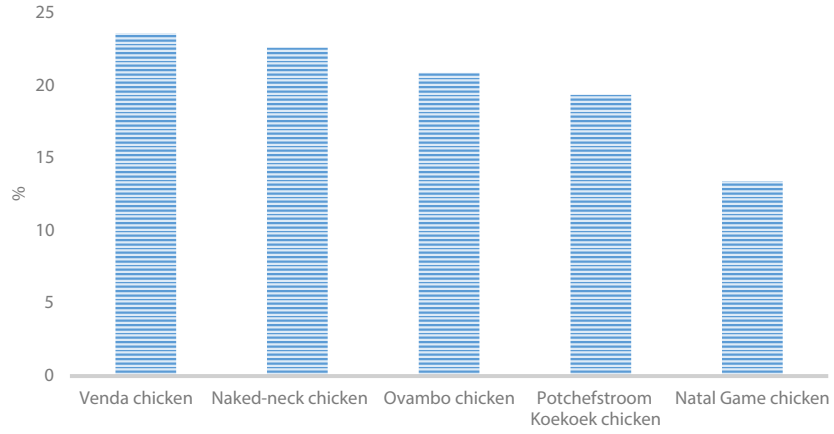

Fig. 1. Indigenous chicken owned by respondents in the study area
Source: own elaboration.

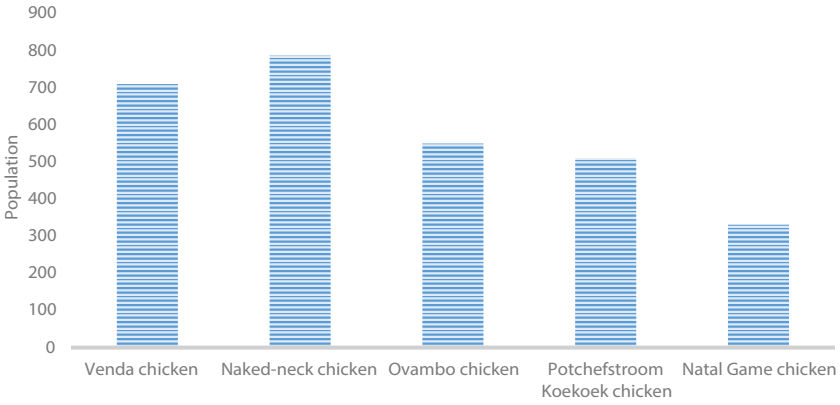

Fig. 2. The population of indigenous chickens in the study area
Source: own elaboration.

In terms of numbers Figure 2, indicate that the Naked Necks were more numerous compared to all types of indigenous chickens, followed by the Venda chicken. The Natal Game and Potchefstroom Koekoek chickens were the least numerous, respectively. The results suggest that the Naked Neck, Venda, and Ovambo chickens were popular ICs based on household ownership and numbers in the study area.

Figure 3 presents the observed ownership diversity of indigenous chicken in the study area. The results reveal that, on average, each household has three types of indigenous chicken (Naked Neck, Venda and Ovambo).

The distribution indicates that 20% of the respondents had all five types of indigenous chickens, implying a high level of diversity. Conversely, only 7% of the respondents had one type of indigenous chickens, suggesting low diversity. The following section presents econometric results of estimated drivers of indigenous chicken ownership.

Factors influencing indigenous chicken ownership at the household level

This section presents the econometric results of the study. Firstly, we offer the correlation matrix of the dependent

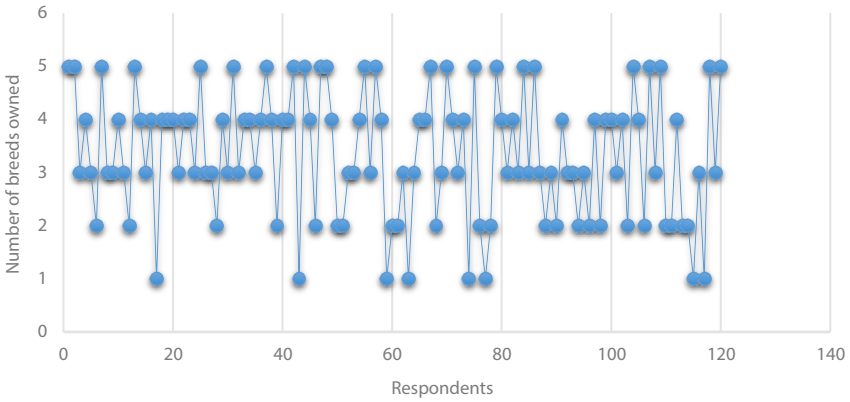

Fig. 3. Ownership diversity of indigenous chicken in the study area
Source: own elaboration.

Table 2. Correlation matrix of different types of indigenous chicken owned

	Venda	Naked Neck	Ovambo	Potchefstroom Koekoek	Natal Game
Venda	1.0000				
Naked Neck	–0.3085	1.0000			
Ovambo	–0.3287	–0.1563	1.0000		
Potchefstroom Koekoek	–0.1629	–0.2940	–0.2863	1.0000	
Natal Game	–0.1565	–0.2738	–0.1829	–0.3445	1.0000

Source: own elaboration.

variables (Table 2), explaining the use of the econometric model. Then, the multivariate probit model results with five binary probit models for each dependent variable (different types of indigenous chicken owned) are presented in Table 3.

Correlation matrix of different types of indigenous chicken owned by rural households

Table 2 presents the correlation matrix from the multivariate probit model of different types of indigenous chicken owned by rural households. Based on the results, we rejected the independence of the error terms in the different indigenous chicken equations: likelihood ratio test [$Chi^2(10) = 80.892$; $P > 0.000$]. Breusch-Pagan test of independence: $Chi^2(10)$: 80.892, Pr = 0.000.

Therefore, we accepted the alternative hypothesis arguing that there was interdependence among the different types of indigenous chicken owned. The use of the multivariate probit model is therefore appropriate. Furthermore, the pairwise correlation coefficients for all chickens were negatively correlated, suggesting substitutability among the different types of indigenous chicken owned (Belderbos et al., 2004).

Drivers of indigenous chicken ownership at the household level

This section presents estimated drivers of indigenous chicken ownership at the household level, as detailed in Table 3.

Gender: The results revealed that gender positively influences ownership of indigenous chicken (Potchefstroom Koekoek). The results also suggest that female-headed households are more likely to own indigenous chicken (Potchefstroom Koekoek chicken) than their male counterparts, for chickens are considered women

Table 3. Results of multivariate probit model for determinants of indigenous chicken ownership at the household level

Independent variables	Dependent variables				
	Venda	Naked Neck	Ovambo	Potchefstroom Koekoek	Natal Game
Gender	–0.0606 (0.421)	–0.0347 (0.666)	0.487 (0.518)	0.1577 (0.062)*	–0.1111 (0.148)
Age	0.0015 (0.678)	–0.0066 (0.096)*	0.0050 (0.183)	–0.0008 (0.846)	0.0010 (0.800)
Education	–0.0284 (0.559)	0.0170 (0.744)	0.0126 (0.795)	0.0080 (0.882)	–0.0092 (0.852)
Marital status	–0.0323 (0.432)	–0.0277 (0.528)	0.0318 (0.438)	–0.0082 (0.857)	0.0364 (0.383)
Household size	–0.0335 (0.061)*	0.0321 (0.093)*	0.0030 (0.864)	0.0094 (0.634)	–0.0111 (0.539)
Association membership	–0.0787 (0.304)	–0.1573 (0.056)*	–0.0174 (0.819)	0.0563 (0.508)	0.1971 (0.012)**
Access to markets	–0.1052 (0.168)	–0.0686 (0.399)	–0.0171 (0.822)	0.0587 (0.489)	0.1323 (0.089)*
Access to extension	0.0162 (0.837)	0.0515 (0.541)	–0.0336 (0.670)	–0.0281 (0.747)	–0.0058 (0.943)
Access to vet services	–0.0147 (0.873)	–0.2295 (0.021)**	0.0860 (0.351)	0.1388 (0.177)	0.0195 (0.835)
Access to informal credit	–0.0483 (0.498)	–0.1057 (0.167)	0.1459 (0.042)**	–0.0729 (0.358)	0.0809 (0.264)
Access to formal credit	0.0782 (0.361)	–0.1069 (0.245)	–0.0005 (0.995)	–0.2233 (0.021)**	0.2524 (0.004)***
Diversity score	0.1869 (0.000)***	0.1439 (0.000)***	0.2244 (0.000)***	0.2101 (0.000)***	0.2347 (0.000)***
Constant	0.4994 (0.097)	0.7160 (0.027)	–0.5460 (0.071)	–0.0749 (0.822)	–0.5947 (0.053)

*, ** and *** are at 10, 5 and 1% level significant, respectively.
Coefficient outside parentheses, *p*-values inside parentheses
Source: own elaboration.

assets in most rural areas that are kept for domestic use (meat and eggs consumption) and sale of surplus to raise household income (Alemayehu et al., 2018; Hailemicheal et al., 2016; Tarwireyi and Fanadzo, 2013). The high egg-laying potential of the Potchefstroom Koekoek is likely to trigger women interest in domestic egg consumption and sales of surplus to raise household income. Previous studies highlight that women are more likely to keep domestic food security livestock species, typically small ruminants and *Avis* species (Taruvinga et al., 2013). The observed association between women-headed households and ownership of the Potchefstroom Koekoek indigenous chicken in the study area could be a result of its ability to produce more (196 eggs per year) brown-shelled eggs wanted by the market (Idowu et al., 2018; Manyelo et al., 2020; Van Marle-Köster and Casey, 2001). This would mean a dual-purpose indigenous chicken capable of meeting domestic household egg supply and surplus for sale to raise the much-needed household income compared to other indigenous types

that produce an average of 60 eggs annually (Moges, 2010).

Age: With reference to age, the results indicate that age negatively influences ownership of indigenous chicken (Naked Neck chicken). These findings suggest that older household heads are more likely to own indigenous chicken (Naked Neck chicken) than younger household heads. Common knowledge indicates that despite the claimed nutritional value of indigenous chicken, younger generations prefer exotic hybrids (broilers and layers) with high-fat content and tender meat, which is easy and fast to cook. Indigenous chicken meat is tough with a unique flavour, coloured skin and egg yolk (Kyarisiima et al., 2011) that may appeal to older generations (Doyer et al., 2007). Also, indigenous chickens typically display a slow growth rate (25–30 weeks against 6–8 weeks for hybrid broilers), late sexual maturity (6–10 months), low feed efficiency and low egg production (average of 60 eggs per year) (Moges, 2010). These attributes make indigenous chickens unpopular among younger generations, which generally keep chickens primarily for commercial purposes. Despite the potential of the Naked Neck breed to produce up to 138.9 eggs annually, as suggested by literature (Glenneis, 2020), this is far too low from a commercial point of view compared to exotic hybrid layers that can produce 200–300 eggs per year (Damme, 2011). Therefore, the negative association is explained by variations in taste and commercial motives as enshrined in different age groups.

Household size

The results indicate an inverse relationship between household size and the Venda indigenous chicken (IC) ownership, whilst the same variable family size positively influences the Naked Neck chicken ownership. This signifies that households with smaller family sizes are more likely to keep the Venda chickens, while those with bigger ones are more likely to rear the Naked Neck chickens. This could be attributed to the rate of breeding where the Naked Necks have higher breeding rates than the Vendas; hence, IC breeds with high reproductive rates are also conducive for bigger families because the disposable income of households decreases when family size increases. Therefore, large families would have less disposable income to spare on alternative meats; hence, they maximise IC breeds with high reproductive rates (Bett et al., 2013; Surendran and Sekar, 2010). Despite the free ranching characteristics of IC, the larger the number (typical of the Naked Necks), the more labour force is required to manage them (Hailemicheal et al., 2016). This could also explain the inverse relation between household size and Venda ownership, which were highly popular in the study area in terms of ownership (24%), but much lower than the Nacked Necks in terms of population.

Association membership

The results indicate that association membership negatively influences the Naked Neck chicken ownership while positively influencing the Natal Game chicken ownership. The results also suggest that association membership promotes the Natal Game chicken ownership and discourages the Naked Neck chicken ownership. The adaptability of the Naked Necks to South Africa's diverse climate makes these indigenous chickens easy to rear compared to the Natal Games. However, it seems that local farmer group associations promote producing and raising the Natal Game chicken over other indigenous chicken breeds, as such farmers benefit from information such as production, management and marketing from the association. The Natal Game chicken naturally has a slow growth rate compared to other indigenous breeds such as the Naked Neck and the Venda. This means an increase in membership of local farmer groups increases the farmer's probability of owning the Natal Game chicken probably because of further skills and information that farmers acquire from local farmer groups in producing this type of indigenous chicken.

Access to formal markets

The results revealed that access to the market positively influences ownership of ICs (Natal Game chicken). Furthermore, the findings indicate that the more rural households have access to formal markets for their ICs, the more ICs they own (Natal Game chicken). However, this is despite the slow growth rate of the Natal Game chicken compared to other pure indigenous chicken breeds like the Venda and the Naked Neck. A possible reason for this is increased promotion in the production and possible formal market linkages of the Natal Game chicken through local farmer group association as revealed in the preceding section. Such kind of promotion creates formal market awareness opportunities for the Natal Game chicken. Because generally, most households keep ICs for domestic use and sale of surplus

in the informal, highly flooded markets closer to their neighbourhood without much entry restrictions.

Access to veterinary services

Access to veterinary services has an inverse relationship with ownership of ICs (Naked Neck chicken). The results suggest that the more rural households have access to veterinary services, the less likely they own ICs (Naked Necks). For the few respondents who reported access to veterinary services, these households owned more hybrid chickens (broilers) for commercial purposes than ICs, suggesting that vet services promote hybrid chicken ownership. Most respondents highlighted that the need for veterinary services was more for households keeping hybrid chickens (broilers) for commercial purposes where strict management is required to maintain low mortality levels. This also confirms the norm, which characterises indigenous chicken farmers who only believe that veterinary services are of no use for ICs, for households can prescribe free local indigenous medication. Notwithstanding the importance of veterinary and extension services, it must be noted that lack of veterinary and extension services is a major challenge, which limits chicken viral vaccination, especially of free-range indigenous chickens (Malatji et al., 2016), given that some ICs (Naked Necks) are more prone to diseases (Idowu et al., 2018).

Access to informal credit

This study indicates that access to informal credit positively influences IC (Ovambo chicken) ownership. The findings suggest that as rural households have access to informal credit, they are more likely to own ICs (Ovambo chicken). The respondents noted that the Ovambo chicken originated from Namibia, and it is not readily available. Therefore, households have to purchase it from those who have it, especially given its favourable traits (considerable aggression and agility, avoiding predators by roosting in trees, producing about 129 eggs annually, an average weight of each egg of 52.5 g) as suggested by literature (Abudabos et al., 2017; Manyelo et al., 2020; McCullough, 2017). Thus, access to informal credit may promote ownership of other indigenous chickens (income effect) from different geographical locations with superior traits of socio-economic importance to local households.

Access to formal credit

Access to formal credit has an inverse relationship with the Potchefstroom Koekoek chicken ownership and a positive one with the Natal Game chicken ownership. The findings suggest that as rural households have access to formal credit, they are more likely to own the Natal Game chicken than the Potchefstroom Koekoek chicken. The previously revealed positive association between access to formal markets and the Natal Game chicken ownership suggests that the Natal Games are kept more for commercial purposes than domestic use, most probably due to their promotion and market linkages amplified by farmers' associations. Thus, households with access to formal credit are more likely to be encouraged to own the Natal Game chicken (with a commercial orientation) and purchase supplementary feeding and vaccinations (Linuma and Peter, 2017; Selaledi, 2017). This is against a background of guaranteed premium prices from formal markets (for ICs), which gives them the confidence to borrow from formal credit dealers. This might not be the case for households who keep other ICs (Potchefstroom Koekoek chickens) for domestic use and sale of surplus on the informal market that is not guaranteed and may offer low prices given that almost every rural household own ICs (flooded rural informal IC market).

Diversity score

The diversity score is positive and significant for all five (5) types of indigenous chickens. The findings suggest that the more rural households own a diversified combination of ICs, the more likely they are to hold other types of ICs. Furthermore, highly diversified families argued that diversity creates more productive and adaptable mixed indigenous breeds with an average performance above the initial parental averages. Therefore, expected heterosis from crossing and backcrossing explains the positive association between households with diversified ICs and ownership of other ICs for improving productivity and adaptability of their ICs. This is in line with the genetics of breeding that has been utilised to enhance many local indigenous livestock breeds as long as inbreeding depression is controlled.

CONCLUSIONS AND RECOMMENDATIONS

With reference to indigenous chicken ownership, the paper concludes that the majority of the respondents kept the Venda (24%), Naked Neck (23%) and Ovambo chickens (21%). Households highlighted that these

chickens were more adaptable to local conditions, resistant to most diseases and low feed eaters. Some minor chickens reported in the study area included the Potchefstroom Koekoek (19%) and the Natal Game (13%). The respondents noted a slow growth rate for most Natal Game chickens, a possible reason for low ownership of this type of domestic fowl in the study area. In the same vein, the study results suggest that the Naked Neck, Venda and Ovambo chickens were popular in the study area based on household ownership and numbers. The results of the multivariate probit model revealed that several socio-economic and institutional factors such as gender, age, household size, association membership, access to formal markets, access to veterinary services, access to informal credit, access to formal credit and diversity score drive production and ownership of different indigenous chickens at the household level. Therefore, the paper concludes that indigenous chicken ownership at the household level is conditioned by socio-economic and institutional factors worth understanding for strategic targeting by rural development agencies that seek to promote indigenous chicken production.

From a social demographic point of view, gender, age, household size and diversity play a significant role in indigenous chicken ownership and production. Therefore, efforts to promote IC ownership and output should not underestimate these social demographic factors. Consequently, we share the following social demographic policy insights:

- Promotion of IC in areas dominated by male-headed households may require initial awareness campaigns to get their buy-in (preferred breeds, their general perceptions) because model results revealed a decline in IC ownership by males as compared to females (given that males typically view IC as an enterprise for women).
- Promotion of IC in areas dominated by female-headed households may also require a clear understanding of preferred breeds because model results revealed particular preference for the Potchefstroom Koekoek (19%) ahead of the most dominant types like Venda (24%), Naked Neck (23%) and Ovambo chickens (21%).
- Promotion of IC in areas dominated by young household heads may also require extensive awareness campaigns and understanding of perceptions shared by this age group, given the revealed inverse relationship between age and IC ownership.
- Lastly, household size may be leveraged for its labour benefits to cater for more flock numbers. However, it might negatively affect interest in ownership of other IC with a low productivity rate.
- Diversity may also be leveraged to speed up the process of tangible benefits (superior cross breeds – heterosis) than trying to promote individual breeds that may fail to perform as expected by the beneficiaries

Therefore, we argue that promoting IC ownership in rural areas should not be considered a general recommendation but should be targeted and guided by social demographic attributes of beneficiaries, preferred breeds and supported by an initial awareness campaign.

From an institutional angle, the following factors condition IC ownership at the household level: access to formal markets, access to veterinary services, membership of farmer organisations and access to both formal and informal credits. Therefore, we suggest the following institutional policy insights:

- Formal markets always drive production if they offer lucrative prices and easy entry requirements. Therefore, the promotion of formal IC markets in villages and townships may be used to trigger rural IC production.
- Access to veterinary services by rural households may also trigger IC production through the provision of information on production and early disease identification and management, significantly reducing mortality rates. In addition, given the poor ratio between rural households and veterinary officers, the promotion of online veterinary platforms leveraging offline technologies and toll-free mobile applications may be considered.
- Farmer organisations promote information access and market linkages that may trigger productivity worth promoting.
- Despite literature claims of low costs associated with IC, the high productivity of indigenous chickens is associated positively with supplementary feeding that requires capital. Thus far, public policies that promote easy access to formal and informal credit by rural households may trigger IC ownership.

Thus, the paper argues that the promotion of ownership of indigenous chicken at the household level calls for strategic institutional alignment and a clear understanding of social-demographic characteristics of the targeted community, which should be supported by several awareness campaigns and client-based selection

of indigenous chicken breeds of socio-economic importance to the household.

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