Journal of Agriculture and Environment for International Development - JAEID 2023, 117 (1): 5 – 20
DOI: 10.36253/jaeid-11997

Indigenous chicken market participation and smallholder farmers' well-being outcomes in Chiredzi and Mwenezi Districts of Zimbabwe

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Submitted on 2021, 16 September; accepted on 2023, 29 March. Section: Research Papers

Abstract: Climate change and extreme weather conditions remain major threats to the attainment of well-being outcomes such as food security in sub-Saharan Africa. Thus, it is critical to identify and promote resilient value chains in order to ensure food security in the wave of extreme weather conditions such as drought. This study seeks to evaluate the effects of participating in indigenous chicken markets on smallholder farmers' food and nutrition security in terms of household dietary diversity score. Cross-sectional data collected from 215 randomly selected farmers in Chiredzi and Mwenezi districts, Zimbabwe was used in this study. The endogenous treatment effect model was employed to determine the effects of market participation on household dietary diversity score. The findings showed that 76% of interviewed farmers participated in indigenous chicken markets. On average, participating in indigenous chicken markets increases the likelihood of having a higher household dietary diversity score by about 60%. This suggests that engagement in indigenous chicken value chain strengthens smallholder farmers' resilience through attainment of food and nutrition security. Therefore, investment in capacity building of smallholder farmers to engage in indigenous chicken value chains should be prioritised and to support market engagement, indigenous chicken production contract arrangements with private firms should be promoted.

Keywords: *climate change resilience, drought, endogenous treatment model, food security.*

Introduction

Scientific and empirical evidence has consistently shown that climate change mainly characterised by droughts remains a significant challenge among smallholder farmers in sub-Saharan Africa (Thorlakson & Neufeldt, 2012; Franke,

2021; Kogo et al., 2021; Stuch et al., 2021). Due to reliance on rain-fed agriculture and lack of capital to invest in adaptive measures such as irrigation facilities, smallholder farmers in Zimbabwe are most vulnerable to the vagaries of climate change (Hassan & Nhemachena, 2008; Mugari et al., 2016; Makate et al., 2017; Descheemaeker et al., 2018; Mutandwa et al., 2019). Thus, apart from recurring constraints such as pest infestation, successive droughts have exacerbated the socio-economic plight of smallholder farmers in achieving well-being outcomes such as food and nutrition security. As a result, policy and development effort has progressively shifted towards building resilience of smallholder farmers against climate change shocks and stressors through reinforcement of enterprises which adapt well to local conditions (Gabrielsson et al., 2012; Mutambara, & Bodzo, 2020; Mujeyi et al., 2021).

Promotion of agricultural enterprises which adapt well to local climatic conditions will greatly enhance farmers' ability to manage and cope with changing climate and attain well-being outcomes. However, a major challenge is the identification of resilient agricultural enterprises on which livelihoods of farmers will be protected. Production and marketing of indigenous chicken (Gallus domesticus) which is a local landrace produced under free range system has been proposed as one potential strategy for assisting smallholder farmers to better manage and cope with climate change. Available evidence suggests that, indigenous chicken adapt well to harsh local climatic conditions and help farmers to diversify their income base (Mapiye et al., 2008; Chisango, 2017). At the same time, livelihood diversification with such resilient enterprises has been alluded to increase farmers' incomes and strengthen their capacities to buffer against climate change shocks and stresses especially drought (Liao et al., 2015). Thus, income diversification through participating in indigenous chicken market is suggested to provide a pathway for smallholder farmers to build resilience in drought prone areas such as Chiredzi and Mwenezi districts.

Although there has been significant research on the importance of indigenous chicken enterprise, there are few studies which explicitly investigate how production and participation in indigenous chicken markets can reduce smallholder farmers' vulnerability against drought and attainment of well-being outcomes (Mapiye et al., 2008; Muchadeyi, 2014; Chisango, 2017). Thus, whilst many intuitively link participation in indigenous chicken markets with livelihood resilience, there is little empirical evidence particularly in study areas to ascertain such a hypothesis. Hence, it is not clear whether participation in indigenous chicken market is a viable form of enhancing smallholder farmers' resilience and attainment of well-being outcomes such as food and nutrition security in drought prone areas of Zimbabwe.

It is therefore against this backdrop which prompted this study to bridge the knowledge gap. The study examines how participation in indigenous chicken markets builds smallholder farmers' resilience. This is important for policymakers to support coping strategies which resonates well with local realities and farmers' needs (IFRCS, 2006). Specifically, the research study was aimed at addressing the following research questions:

1. How does participation in indigenous chicken markets contribute to well-being outcomes?

2. What are smallholder farmers' perceptions of indigenous chickens as a resilience strategy?

The findings of this study will help to bridge the knowledge gap on resilience literature particularly on what works in building resilience of smallholder farmers against drought in Zimbabwe.

Conceptual framework

As a way to strengthen resilience against climate variability and extreme weather events, smallholder farmers in Chiredzi and Mwenezi districts in Zimbabwe are participating in indigenous chicken markets. While the past few years have witnessed a significant evolution in prioritising resilience in policy programming, there are limited studies assessing the link and effect of participating in indigenous chicken markets on well-being outcomes. Conceptualising the linkage between indigenous chicken market participation and household dietary diversity score is therefore important to enhance our understanding of indigenous chicken market participation as a resilience pathway. As such, efforts were made here to illustrate how indigenous chicken market participation is envisioned to contribute to well-being outcomes among smallholder farmers (figure 1). This synoptic conceptual framework summarises the non-linear interconnectedness of 5 key pillars: (1) enabling environment, (2) vulnerability context, (3) adaptation strategy, (4) resilience strategy and (5) well-being outcome.

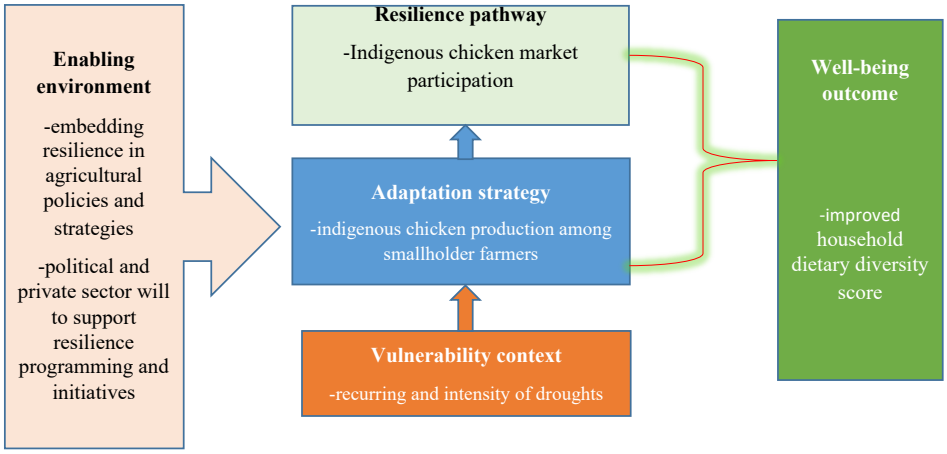

Figure 1 – Conceptual framework linking climate change, adaptation and resilience strategy and well-being outcome

Basically, as a response to climate change, indigenous chicken production is being promoted among smallholder farmers. However, to realise improved well-being outcomes farmers need to participate in output markets (Mulenga et al., 2021). As such, smallholder farmers are participating in indigenous chicken markets as a resilience pathway. By increasing production and participating in indigenous chicken markets, it is envisioned that, smallholder farmers will attain improved household dietary diversity score. Increased household income through participating in markets support consumption-smoothing of more diverse and nutritious basket of food products (Mulenga et al., 2021). The enabling policy

environment also shapes and support initiatives aimed at strengthening indigenous chicken production and market participation. This conceptual framework however is not prescriptive rather it aims to aid our understanding on how indigenous chicken production and market participation can contribute to improved well-being outcomes. Given increased frequency and intensity of droughts, participation in indigenous chicken markets is assumed to strengthen resilience in drought prone areas like Chiredzi and Mwenezi districts. This dovetails with the urgent need to find sustainable solutions to ongoing food insecurity crisis due to climate change and other economic shocks (Jacobs, 2011; Wheeler & Von Braun, 2013).

Materials and Methods

Study area

The study was conducted in Chiredzi and Mwenezi districts. The districts are located in Masvingo province, in the South-Eastern low-veld. The major livelihood activity among smallholder farmers in these districts is agricultural production. However, the districts are generally affected by rainfall variability and droughts (Mugari et al., 2016; Gadzirayi et al., 2020). The data was collected in July 2019 in ward 2, 11, 22, 25 in Chiredzi and 4, 5, 6, 10 in Mwenezi. These wards have been selected as the Enhancing Community Resilience and Sustainability (ECRAS) programme; a local consortium of NGOs led by Care International under Zimbabwe Resilience Building Fund is promoting indigenous chicken production as a resilience strategy among smallholder farmers.

Sampling procedure and methods of data collection

The target population for this study were smallholder farmers engaged in indigenous chicken activity in ECRAS project areas. A multi-stage sampling was used in selecting study areas and respondents. In the first stage, purposive sampling was employed to select Chiredzi and Mwenezi districts by virtue of being among the districts in Zimbabwe mostly experiencing climate change shocks especially drought and with relatively high indigenous chicken production levels. In the second stage, purposive sampling was used to select the wards and villages to conduct questionnaire survey. The wards and villages were selected by virtue of relatively high indigenous chicken production status in respective districts. Lastly, a random sampling procedure was employed to select indigenous chicken producers for questionnaire survey using ECRAS beneficiary lists. However only smallholder farmers who were willing to participate and provided their consent were interviewed.

The data was collected from 215 randomly selected smallholder farmers through face-to-face interviews. The justification for the sample size was based on the argument that, a minimum of 30 respondents is considered reasonable in social science research and statistically large enough to make scientific conclusion (Bailey, 1994; Saunders *et al*., 2007). The main instrument for data collection during the survey was a structured questionnaire. The structured questionnaire was administered to study respondents with the assistance of ten (10) trained enumerators assisted during data collection. Permission to conduct the research was granted from all responsible authorities in the study areas.

Analytical framework and measurement of variables

Model choice and specification

Endogenous treatment effect model was employed to determine the effects of market participation on household dietary diversity score. This model accounts for both selection bias and potential endogeneity arise from unobserved factors that potentially affect both participation and dietary diversity score (Heckman, 1979; Adebayo et al., 2018). Such biases related to unobserved characteristics of the farmer cannot be controlled by ordinary least square or propensity score matching (Adebayo et al., 2018). Although used in a number of impact evaluation studies, propensity score matching only control the systematic differences based on observed factors (Smale & Olwande, 2014; Adebayo et al., 2018; Manyumwa et al., 2018) but yield biased and inconsistent estimates due to unobserved factors such as entrepreneurial skills and motivation that potentially affect both treatment and outcome equation (Heckman, 1979; Seng, 2016; Danso-Abbeam et al., 2018; Adebayo et al., 2018). Hence, justifies the use of an endogenous treatment effect model (Heckman, 1979). Following Heckman (1979), the model can be outlined as follows:

Potential outcome for participants (Y1) and potential outcome for non-participants (Y0):

$$Yi = \beta + pXi + \alpha iAEi + \varepsilon i \qquad (1)$$

Where Yi represents the observed outcome (in this study well-being outcome is measured by household dietary diversity score), AEi is the treatment variable (market participation-1 if the farmer participates in the market and 0 otherwise), αi measures the effect of market participation on the outcome variable, Xi is a set of exogenous variables, *p* is a parameters to be estimated and εi is the error term.

Measurement of household food and nutrition security

Household dietary diversity score (HDDS) was used as a proxy for household food and nutrition security. HDDS is the commonly used measurement of households' economic ability to consume a variety of foods items and an increase in the score reflects food and nutrition security at household level (Swindale & Bilinsky, 2006; FAO, 2011; Mango et al., 2014). HDDS in this study is calculated using the Zimbabwe Resilience Building Fund (ZRBF) programme indicators on food and nutrition security status (UNDP, 2016). This involves summing up the number of food groups consumed over a reference period, in this case 7 days recall period. The HDDS provides an estimation of the quality of a diet thus predict nutrient adequacy (Goshu et al., 2013; UNDP, 2016). Therefore, a high HDDS reflects a diversified household diet hence a balanced consumption of calories, protein and micro-nutrients whilst a low HDDS projects prevalence of malnutrition. However, HDDS has been criticised on failure to clearly pinpoint the causes of consumption patterns and on methodological grounds such as lack of universally accepted standard for the main food groups (Mango et al., 2014). Nevertheless, regardless of such short falls the HDDS remains useful and a good proxy for food and nutrition security at household level. As such, HDDS was used employed in this study and efforts to control for its methodological shortfalls were not attempted since it was beyond the scope of this study.

During the survey, households were asked to indicate the number of days they had eaten from each of the 7 food groups in a 7-day recall period. The 7 food groups were: A, cereals and roots and tubers; B, sugar beans and other legumes; C, vegetables including orange, green leaf and other types of vegetables; D, fruits both orange fruits and other types of fruits; E, meats, fish and sea-foods and eggs; F, dairy products and G, oil and fats.

Following ZRBF indicators, the HDDS is calculated as follows:

HDDS = sum (A+B+C+D+E+F+G) (2)

Results

Socio-economic characteristics of respondents

The major livelihood activities of interviewed smallholder farmers were crop production (60%) and livestock production (45%). Some were also engaged in non-fam activities through formal employment (7%). Majority (56%) of the households were male-headed households whilst female-headed households constituted 44%. Generally, most of the interviewed households have some level of education with 73% attended only primary education and 27% attended secondary education. Most of the farmers participated in indigenous chicken markets (76%) with participants being generally older producers (mean age of 60 years) as compared to non-market participants (mean age of 48 years). On average, market participants had a higher HDDS than non-market with 90% of market participants had an acceptable HDDS compared to 78% of non-market participants. In fact, the average HDDS is 14.5 % higher for market participants than non-market participants. The results of farmers' socio-economic characteristics are summarised by table 1 below.

Table 1: Summary description of respondents' socio-economic characteristics

Variables definition	Variable description	Mean		Difference in means and significance
		Participants	Non-participants	
Demographic characteristics				
Age	Age of household head in years	60	48	0.29
Household size	Total number of members of household	7	7	0.35
Primary education	Household heads with primary education	0.3	0.2	0.36
Secondary education	Household heads with secondary education	0.3	0.2	0.36
Training on indigenous chicken production	Household heads trained on indigenous chicken production	0.8	0.5	0.00***
Physical Assets and livestock				
Cattle	Number of cattle	9	7	0.17
Goats	Number of goats	11	12	0.16
Flock size	Number of indigenous chickens	64	29	0.00***
Mobile phone	Mobile phone ownership	0.98	0.93	0.25
Television	TV ownership	0.20	0.17	0.71
Bicycle	Bicycle ownership	0.6	0.5	0.19
Oxcart	Oxcart ownership	0.6	0.4	0.00***
Improved fowl run	Improved fowl run ownership	0.9	0.8	0.03**
Feeders	Feeders' ownership	0.6	0.2	0.00***
Water pots	Water pots ownership	0.8	0.6	0.00***
Cage	Cage ownership	0.3	0.1	0.03**
Social capital				
Contract scheme	Member of contract scheme	0.4	0.02	0.00***
Access to public agricultural extension services	1 if a farmer has access and 0, otherwise	0.96	0.85	0.07*
Membership in a farming group	1 if a farmer is a member to a farming group and 0, otherwise	0.6	0.4	0.04**
Financial capital				
Credit access	1 if a farmer access credit and 0, otherwise	0.3	0.00	0.00***
Savings	1 if a farmer keeps savings, 0 otherwise	0.6	0.3	0.00***

****, **, * significant at 1%, 5% & 10% level respectively*

Indigenous chicken production and market participation status

All the interviewed households keep indigenous chickens. The major breeds produced by interviewed farmers were the mixed breeds (88%) followed by boschveld (34%) and lastly the leghorn (12%). Seventy eight percent (78%) of interviewed farmers were trained on indigenous chicken production. These trainings were conducted by public agricultural extension agents (70%), Non-Governmental Organisations (5%) and private sector (National Organic Poultry) (2%). Majority (76%) of farmers participated in indigenous chicken markets. The average flock size of market participants is 64, which is more than twice the flock size (29) of non-market participants (table 1). Among the market participants, 63% engage with ECRAS poultry activity compared to 44% of non-market participants. Twenty percent (20%) of those engaged with ECRAS poultry activity, produced indigenous chickens through a contract farming arrangement with National Organic Poultry. National Organic Produce is a private firm supporting farmers with day old chicks of boschveld breed, train farmers on indigenous chicken technical production skills as well as providing a guaranteed market.

Among those participated in the market, majority (54%) sold indigenous chickens to local markets such as staff at schools, clinics and local shops whilst 20% sold to National Organic Produce and 4% at farm gate whilst the remaining percent sold to restaurants in Beit-bridge and Chiredzi towns. The local markets were identified as main buyers accounting for over two thirds (2/3) of poultry sales at the time of the study. National Organic Produce accounted for 49% market share, although only about 25% producers identified them as their main buyer.

Furthermore, among market participants, 87% of farmers perceived indigenous chicken marketing as a resilient strategy due to two main reasons. Firstly, they believed that indigenous chickens adapt well to drought (85%) and secondly, due to diversity of marketing channels (58%). The results on indigenous chicken market participation are summarised in table 2 below.

Table 2: Indigenous chicken market participation status

Variable		
Market participation (% producers last production cycle)		76
Main buyer (% producers)	National Organic Produce	25
	Restaurants	3
	Local individual buyers	67
	Farm gate	5
Average quantity sold by market participants (n= 174)		33
Total quantity poultry sold (n =174)		4003
Mean per main buyer (Qty sold / Qty sellers to that buyer)	National Organic Produce (n= 43)	45
	Restaurants (n= 6)	41
	Local markets (n= 117)	15
	Farm gate (n = 8)	8
Market share as % per main buyer	National Organic Produce	49
	Restaurants	6
	Local individual buyers	44
	Farm gate	1

Regression results

In order to establish if participating in indigenous chicken market significantly enhances food and nutrition security among smallholder farmers, an endogenous treatment effect model was employed. In this model, the outcome equation (household dietary diversity score) was jointly estimated with the selection equation (market participation decision). The Wald test of independent equations was significant indicating that, the null hypothesis of no correlation between the treatment variable errors and outcome errors is rejected ($p<0.1$). These results suggest the presents of endogeneity hence justifies the use of endogenous treatment regression model. The estimated correlation between the treatment variable errors and the outcome errors, ρ, is -0.374. The negative relationship indicates that unobservable factors that raised observed dietary diversity score tend to occur with unobservable factors that lower probability of market participation decision. The implication is that, unobservable factors influencing farmers' indigenous chicken market participation increases household food and nutrition security. Therefore, ignoring potential endogeneity might affect both statistical significance of market participation estimates and direction of influence on dietary diversity.

Treatment model results

The treatment equation indicated that, receiving marketing information through mobile phone positively influence smallholder farmers' participation decision in indigenous chicken markets ($p<0.01$). Furthermore, perceiving climate change was found to be significant and positively related to indigenous chicken market participation ($p<0.1$) (table 3 below). Farmers who noticed a change in climate also perceived indigenous chicken to be resilient to drought and considered participating in indigenous chicken markets as a resilience strategy.

Table 3: Treatment model results

Independent variables	Average marginal effect	P-value
Training on indigenous chicken production by agricultural extension officers	-0.118	0.81
Membership in a farming group	0.060	0.87
Membership in a contract scheme	0.999	0.05
Radio ownership	0.169	0.50
Secondary education	-0.020	0.94
Household size	-0.006	0.86
Mobile phone ownership	0.861	0.15
Subscription to eco-farmer platform	-0.620	0.11
Perceiving climate change	0.642	0.07
Experience in indigenous chicken production	0.003	0.79
Ownership of improved fowl run	0.394	0.13
Bicycle ownership	0.163	0.51
Receiving market information through mobile phone	9.374	0.00
Market information from farming group	-0.103	0.78
Cons	-1.204	0.10
/athrho	-0.393	0.06
rho	-0.374	
Wald test of indep. eqns (rho=0) $X^2(1)=3.56$ Prob > X^2= 0.06		

Concurrently, indigenous chicken contract production scheme was found to have a positive bearing on smallholder farmers' market participation decision

($p<0.05$) (table 3 above). Thus, members in a contract scheme with National Organic Produce were more likely to sell indigenous chickens than their counterparts as contract farming provide smallholder farmers with a secured market access.

Outcome model results

The outcome model results showed that, participating in indigenous chicken markets increases the likelihood of having a higher household dietary diversity score by about 60% ($p<0.1$) among the interviewed farmers. Access to training on indigenous chicken production also increases the probability of having higher household dietary diversity score by 71%. It was also noted that, having a contract farming arrangement on indigenous chicken production increases the likelihood of having household dietary diversity score by 54%. Furthermore, keeping boschveld breed increases the likelihood of having higher household dietary diversity score by 32%. These results are shown in table 4 below.

Table 4: Outcome model results

Independent variables	Average marginal effect	P-value
Training on indigenous chicken production by agricultural extension officers	0.710	0.04
Membership in a farming group	-0.053	0.71
Membership in a contract scheme	0.541	0.00
Radio ownership	-0.009	0.95
Secondary education	-0.056	0.70
Household size	0.001	0.97
Awareness about locally formulated feed	0.205	0.19
Oxcart ownership	0.065	0.64
Keep savings	0.168	0.30
Keeping mixed breed as a major breed	-0.359	0.85
Keeping boschveld breed	0.318	0.07
Market participation	0.600	0.10
Cons	3.977	0.00
/athrho	-0.393	0.06
rho	-0.374	
Wald test of indep. eqns (rho=0) $X^2(1)=3.56$ Prob > X^2= 0.06		

Discussion

The study noted that, most interviewed farmers participated in indigenous chicken markets and majority sold their live indigenous chickens to local individual buyers such as staff at schools and business centres. Participating in indigenous chicken markets was found to increase the likelihood of having higher dietary diversity and market participants had higher HDDS than their counterparts. This entails that, indigenous chicken market participation significantly contributes towards attainment of food and nutrition security among smallholder farmers in drought prone areas. In fact, majority of market participants had an acceptable HDDS as compared to non-participants. This concurs with other studies which indicated that, participation in indigenous chicken markets not only contributed to smallholder farmers' economic resilience but also food and nutrition security (Dumas et al., 2016). As such, most respondents considered indigenous chicken

marketing as a resilient strategy to cope with drought. Earlier studies also underline that, indigenous chickens adapt well to harsh climatic conditions and its production helps to reduce smallholder farmers' vulnerability against drought (Mapiye et al., 2008; Chisango, 2017). Based on these findings, interventions to strengthen indigenous chicken markets access should be promoted and investments in indigenous chicken value chains should be prioritised.

Other factors identified to have significant effect on HDDS include access to training on indigenous chicken production. This was consistent with other studies which pinpoint the importance of trainings through agricultural extension services in improving productivity and hence food and nutrition security status (Kassem, 2014; Ragasa et al., 2016). This suggests the need for strengthening capacity building on improved indigenous chicken production technologies among smallholder farmers. Such capacity building initiatives should also embed trainings on production of improved breeds of indigenous chicken such as boschveld. This is because such improved breeds such as boschveld matures early thereby providing source of protein (meat & eggs) and income during short period.

It was also noted that, having a contract arrangement for indigenous chicken production with National Organic Produce plays critical role in strengthening both farmers access to markets and attainment of higher HDDS. This concurs with prior studies which alluded that, contract farming enhances access to and increases the likelihood of smallholder farmers to participate in agricultural markets (Miyata et al., 2009). Concurrently, earlier findings showed that, participants in contract farming arrangements seems to be better-off in well-being outcomes such as income and food security (Miyata et al., 2009; Bellemare and Novak, 2017; Adebisi et al., 2019). This entails the need to stimulate private sector investments in indigenous chicken value chains.

Apart from contract farming, other factors influencing indigenous chicken market participation included access to market information through mobile phone. This was consistent with other studies which showed that, access to market information through information and communication technology gadgets such as mobile phone and radio seems to positively influence farmers' participation in agricultural markets (Siziba et al., 2011; Zamasiya et al., 2014). This confirms the importance of digital innovations in promoting market access and strengthening market participation among smallholder farmers. Furthermore, perceiving climate change also stimulate farmers to engage in indigenous chicken market participation. Thus, those farmers who noticed a change in climate considered indigenous chickens to be resilient to drought and participated in indigenous chicken markets as a viable strategy to build resilience against climate change.

Conclusions and recommendations

The study concludes that, participating in indigenous chicken markets increases the likelihood of having a higher household dietary diversity score. This suggests that engagement in indigenous chicken markets strengthens smallholder farmers' resilience through attainment of household food and nutrition security. Local markets were identified as the main buyer of indigenous chickens and over two thirds of poultry producers sold through these local markets such as staff at business centres and at schools. Majority of smallholder farmers also perceived

participation in indigenous chicken markets as a resilience pathway in Chiredzi and Mwenezi districts.

Since HDDS indicates the ability of a household to consume a variety of nutritious foods, it is therefore important for policymakers to allocate more resources to strengthen market access. Thus, in order to protect gains and increase well-being outcomes, initiatives to strengthen indigenous chicken markets access should be promoted among smallholder farmers. Further investment in capacity building of smallholder farmers to engage in indigenous chicken value chains should be prioritised. To support market engagement, contract indigenous chicken production arrangements should be promoted. For sustainability of those contracts, institutions which governs contracts farming should be strengthened to build trust and ensuring mutual benefits between producer and buyer. Farmers should also diversify their current indigenous chicken breeds with the production of boschveld breed which matures early thereby providing source of protein (meat & eggs) and income after selling within a short period.

Acknowledgements

Special thanks to my co-authors, Professor E. Mutandwa, Dr. T. Katema, Dr. J. Stack and Ms. D. Tirivanhu for mentoring and guidance. The financial support from African Economic Research Consortium (AERC) and Resilience Knowledge Hub is highly and thankfully acknowledged which made my MSc studies and this research more enjoyable. Concurrently, it is through the technical support and guidance from ECRAS team in Chiredzi which greatly contributed to quality data collection for this study.

Conflict of interest

Authors declare no conflict of interest.

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