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DETERMINANTS OF THE RISK ATTITUDE OF INDIGENOUS CHICKEN FARMERS AND THE EFFECT OF RISK ATTITUDE ON INDIGENOUS CHICKEN PRODUCTIVITY IN KENYA

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Abstract. Indigenous Chicken (IC) keeping in Kenya is predominantly based on an extensive system that is characterized by high mortality rates, resulting mainly from disease outbreaks and predation. Information on farmers' risk attitudes is scarce despite the risks inherent in IC production systems. Similarly, it is unclear how socioeconomic factors influence IC farmers' risk attitudes and how their risk attitudes influence IC productivity. As a result, an understanding of the determinants of farmers' risk attitude and the effects of risk attitude on IC productivity are critical. Primary data were collected using a structured questionnaire. Multi-stage sampling procedure was used to sample 240 IC farmers from an accessible population of 598 chicken farmers in Nyanza region. Ordinary least squares regression analysis was carried out to determine the influence of the socio-economic variables on the risk attitudes of the IC farmers, and a two-stage least squares regression analysis was used to determine the effect of risk attitude on IC productivity. Total land size, family size, occupation of the farmer, and total household expenditure had a positive and significant influence on the risk aversion behavior of the farmers. Farming experience, number of chickens, and cost of depreciation had a negative impact on risk aversion. The risk aversion coefficient had a negative and significant relationship with chicken productivity. Farmers' risk attitude and socioeconomic characteristics should be considered part of the guide to formulating and implementing policy on risk management.

Keywords: Risk attitude, indigenous chicken, determinants, productivity

INTRODUCTION

Like any other business, farming is inherently risky (Ogurtsov et al., 2008). Agricultural risks are primarily caused by climate variability, biological diseases, production seasonality, different geographical production areas, consumers of agricultural production (McNeil et al., 2015; Ullah et al., 2015; Huong et al., 2018), regular natural disasters (World Bank, 2011), the unpredictability of agricultural products, production, prices, imperfect input/output markets, and a lack of financial and credit facilities (Musser and Patrick, 2002; Senyole et al., 2009; Xaba and Masuku, 2013).

Understanding individual risk attitudes and perception is a prerequisite to understanding economic behavior (Reynaud and Couture, 2012; Ullah and Shivakoti, 2014). They are crucial factors that affect farm production, investment, and management decisions (Ullah et al., 2015). Furthermore, the identification of farmers' preferences towards risk can be considered an essential element in creating effective and efficient risk management mechanisms (Komarek et al., 2020) and helping policymakers design more effective policies that can help farmers reduce various potential sources of risk in developing countries (Brauw and Eozenou, 2014).

According to their risk attitudes, farmers can be categorized into three groups: risk-averse, risk seekers, and

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risk-neutral farmers (Murray-Webster and Hillson, 2008). Risk-averse farmers are those who are extremely uncomfortable with an uncertain outcome. This may cause them to forego expected profit in order to avoid risk. They are willing to accept a lower average income to avoid or mitigate risks (Murray-Webster and Hillson, 2008). Furthermore, Kahneman and Tversky (1979) elucidated that risk-averse individuals would value a protective action that keeps the probability of injury at zero level. Risk seekers are quite interested in uncertainties, and they do not have a desire to avoid or reduce threats. They perceive risk as a profitable chance and thus, they seek to pursue the venture and accept losses to take their chances (Murray-Webster and Hillson, 2008). Between the two extreme attitudes, we have risk-neutral individuals who are uncomfortable with uncertainty in the long term. Therefore, they can take whatever necessary short-term activities to gain a certain long-term outcome. Risk-neutral individuals are deemed unconcerned with risk when deciding between investments. Thus, they are disinterested in the risk involved in the investment and are only concerned about the predicted outcome (Nguyen, 2007).

Indigenous Chicken (IC) contributes significantly to income generation and food and employment creation in rural communities (Thorton et al., 2012; Kyule et al., 2014; Ngongolo et al., 2021). However, the largest proportion of the indigenous poultry in Kenya is raised under harsh conditions such as the prevalence of diseases, predation, inadequate feeding, poor housing, extreme weather changes, and markets, which predispose them to risk and result in sub-optimal production levels and profitability (Bett et al., 2012; Chuma, 2019; Ngongolo and Chota, 2021).

Moreover, the productivity of indigenous chickens in Kenya expressed in terms of egg production, growth, and survival of chicks is quite low (Magothe et al., 2006; Olwande et al., 2010; Okeno et al., 2011). Despite the aforementioned risks in IC production systems, only a few studies have reported farmers' attitudes toward risk (Mose et al., 2018a). The extent to which socioeconomic factors affect the risk attitude of IC farmers and how their risk attitudes have an effect on IC productivity is unknown. Therefore, an understanding of farmers' attitudes towards risk, determinants, and effect of IC productivity is vital for the implementation of risk management tools in IC production. Previous studies on indigenous chickens in Kenya have concentrated mainly on the production and marketing of birds with limited information on the behavior of farmers towards risk (Ochieng et al., 2012; Bett et al., 2012; Olwande et al., 2013). In addition, the studies that have been done on risk attitude did not use econometric measures to estimate attitude and hardly considered determinants of these attitudes and their influence on IC productivity (Korir, 2011; Tongruksawattana, 2014; Mose et al., 2018a). Therefore, this study fills the gap by carrying out detailed research to determine how socioeconomic variables of IC farmers affect their risk attitude and the effect of risk attitude on chicken productivity.

METHODOLOGY

Study area and sampling procedure

The research was rigorously designed to ensure representativeness. It was carried out in the Nyanza region, which has six Counties: Siaya, Kisumu, Homabay, Migori, Kisii, and Nyamira, as well as one of the highest populations of indigenous chickens in Kenya (MOLD, 2008; Mose et al., 2018a). The study utilized a multistage sampling procedure, carefully selecting respondents to maximize representation within the population. In this approach, at level one, purposive sampling was used to select four counties in which TECHNOSERVE operates in Nyanza region for ease of accessing the respondents since the lists of the farmers and the number of IC they kept already existed in these counties. At level two, IC farmers who kept more than 50 birds and were commercially oriented were purposively selected from a list of 1520 IC farmers to form an accessible population of 598 farmers. At level three, proportionate sampling was used to sample 240 respondents from the accessible population of the four counties as shown in Table 1. At the final level, simple random sampling

Table 1. Proportionate sampling per county

County	Accessible population per county	% per county	Sample size per county
Migori	147	24.58	59
Siaya	222	37.12	89
Kisumu	104	17.39	42
Homabay	125	20.9	50
Total	598	100	240

Source: own elaboration.

procedure was used to select IC farmers for interview at the county level. This involved assigning random numbers to all the IC farmers who kept more than 50 birds in a particular County. Then, the numbers were selected randomly to form the sample size per County.

Sample size determination

The study adopted Yamane's (1967) formula of sample size determination as shown in equation 1 (Yamane, 1967).

$$n = \frac{N}{1 + N(e)^2} \quad (1)$$

where n = required sample size, N = population, and e = margin of error at 5% (standard value of 0.05).

Taking the study accessible population of 598 IC farmers, the sample size of the study was computed as follows:

$$n = \frac{598}{1 + 598(0.05)^2} \quad (2)$$

Data collection

This study employed a structured questionnaire for data collection. The questionnaire was pre-tested to ascertain the validity of the instrument with a sample of 30 IC farmers in Nyamira, a location within the study area but not among the counties selected for the actual data collection. Thereafter, necessary changes were made on the questionnaire before the actual data collection. Data collected included household characteristics, farm size, information on the flock size, price of various types of chicken, types and cost of feeds, cost of labor, cost of drugs, and information on the indigenous chicken farmers' perception of and attitude towards risks associated with IC production. To assess multicollinearity in the independent variables, the Variance Inflation Factor (VIF), a measure of reliability, was used (Andreev et al., 2009). A VIF value less than 10 is acceptable (Gujarati, 2013).

Ethical consideration

The study sought approval from Maseno University Ethical Review Committee (REF: MSU/DRPI/MUERC/00598/18. Prior to data collection, informed consent was obtained from the IC farmers, emphasizing the voluntary nature of their participation and ensuring they were fully informed about the implications without any form of pressure or coercion. Throughout the research process, the utmost objectivity was maintained in discussions and analyses. The principle of confidentiality was upheld, guaranteeing that the identities of all IC farmers remained anonymous, and their provided information was treated with the utmost respect and discretion. Measures were taken to ensure the confidentiality of research data, including secure storage protocols such as password protection for digital data and the use of encrypted storage where possible. Paper-based data were securely filed in a locked cabinet to prevent unauthorized access.

Data analysis

Determination of the effect of socioeconomic variables on risk attitudes of IC farmers

The ordinary least squares (OLS) regression model was used to determine the effect of socioeconomic variables on the risk attitudes of indigenous chicken farmers, as shown in equation 3:

$$K_1 = f(V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_8, V_9, V_{10}, V_{11}, V_{12}, e) \quad (3)$$

where: K_1 – risk attitude of the IC farmer (continuous value ranging 0–1); V_1 – gender of household head (male = 1, otherwise = 0); V_2 – age of farmers (years); V_3 – educational status (years); V_4 – main occupation (farming and other income generating activities = 1, otherwise = 0); V_5 – size of land (acres); V_6 – household size (numbers); V_7 – farming experience (years); V_8 – flock size (numbers); V_9 – production objective (commercial = 1, otherwise = 0); V_{10} – production system (semi intensive = 1, otherwise = 0); V_{12} – total cost on drugs (Kshs); V_{13} – total cost on depreciation (Kshs); V_{14} – household total expenditure (Kshs); and e = error term.

The risk attitude of the IC farmers was estimated using the safety-first principle (Mose et al., 2018a). This principle assumes that the individual's objective is to minimize the probability of experiencing variability (a shortfall) in output or income below a certain initial level (specified levels of disaster) (Moscardi and De Janvry, 1977).

Estimation of the effect of risk attitude on IC productivity

A two-stage least square (2SLS) regression analysis was used in the estimation of the effect of risk attitude on IC

productivity. In this study, productivity, which was the dependent variable, was taken to be the net profit from the sale of IC and its products per 50 birds. Net Profit was obtained by subtracting the total cost incurred in the production of IC from the total income from sales. The original regression equations were given as:

$$\ln Y = \ln a + b_1K_1 + b_2Z_1 + b_3Z_2 + b_4Z_3 + b_5Z_4 + b_6Z_5 + b_7Z_6 + b_8Z_7 + b_9Z_8 + b_{10}Z_9 + b_{11}Z_{10} + b_{12}\ln X_1 + b_{13}\ln X_2 + b_{14}\ln X_3 + b_{15}\ln X_4 + b_{15}\ln X_5 + e \quad (4)$$

where: Y – is IC productivity; K_1 – risk attitude (continuous value ranging 0–1); Z_1 – gender; Z_2 – age (years); Z_3 – level of education (years); Z_4 – main occupation (farming and other income generating activities = 1, otherwise = 0); Z_5 – total land size (acres); Z_6 – family size (numbers); Z_7 – experience (years); Z_8 – number of IC birds (numbers); Z_9 – objective of the farmer (commercial = 1, otherwise = 0); Z_{10} – total household expenditure; X_1 – average cost of feed per month in Kenya shillings; X_2 – average cost of the flock (birds) in Kenya shillings; X_3 – average labor cost in Kenya shillings; X_4 – average cost of drugs, veterinary services, and chemicals in Kenya shillings; X_5 – capital input in Kenya shillings (depreciated values of poultry equipment and structures); b's – partial regression coefficients; and e – error term.

Estimation of the above equation using the ordinary least squares (OLS) would lead to biased estimators because the error term in equation 3 is correlated with the error term in equation 4. The risk attitude was a problematic causal variable i.e., it was an endogenous variable whose error term was correlated with IC productivity. A common way to correct for endogeneity is by use of instrumental variable (IV) estimators (Angrist et al., 1996; Greene, 2012).

The first stage of the analysis involved identifying the instrumental variable and using the instrumental variable to create a new variable of risk attitude. The study identified at least one instrumental variable that was correlated with the treatment variable (risk) but uncorrelated with chicken productivity. The study tested various instruments until one was found to fulfill all the instrument validity requirements. The instrument that was used in this study was a dummy that indicated whether the IC farmer had ever bought any kind of insurance. Having taken any kind of insurance, the IC farmer can negatively or positively impact the farmers' attitude towards risk. At the same time, this variable is not correlated with chicken productivity. The study tested the correlation of the instrument with chicken productivity and found that the correlation coefficient was small in absolute terms and was statistically insignificant. Therefore, the study concluded that the instrument was valid, and equation 4 was estimated with treatment effect IV estimators.

In the second stage, the model-estimated values from stage one were then used in place of the actual values of the problematic variable to compute an OLS model for IC productivity. The final model was as follows:

$$\ln Y = \ln a + b_1\hat{k_1} + b_2Z_1 + b_3Z_2 + b_4Z_3 + b_5Z_4 + b_6Z_5 + b_7Z_6 + b_8Z_7 + b_9Z_8 + b_{10}Z_9 + b_{11}Z_{10} + b_{12}\ln X_1 + b_{13}\ln X_2 + b_{14}\ln X_3 + b_{15}\ln X_4 + b_{15}\ln X_5 + u_i \quad (5)$$

$\hat{k_1}$ – estimated value of risk attitude and Z_1–Z_{10}, X_1–X_{10} remain as explained in the original models. u_i is a composite error term uncorrelated with the independent variables.

RESULTS AND DISCUSSIONS

Determinants of risk attitudes of the indigenous chicken farmers

Results of the risk attitude of indigenous chicken farmers (the dependent variable) are presented in Mose et al. (2018a). Table 2 presents estimates of the socioeconomic factors that influence IC farmers' risk attitude. The VIF (test for multicollinearity) was less than 10, which is considered acceptable. This indicated that multicollinearity among variables was not present. The value of R Square was 52.4%. This implied that 52.4% of the variation in K_1 (risk attitude) was explained by the independent variables (the socio-economic characteristics of the IC farmers). The adjusted R square was (49.6%).

The main occupation of the household head and household expenditure contributed positively to risk aversion and were significant ($P < 0.05$). The occupation and household expenditure had a positive and significant effect on risk aversion. The indigenous chicken farmers were engaged in other economic activities such as rearing other livestock, crop production, operating businesses, and casual and salaried employment apart from rearing the IC as an alternative source of income (Mose et al., 2018a). It is worth noting that mixed farming (farming of crops and livestock) was practiced in a study area as a traditional practice. This implies that

Table 2. Determinants of IC farmers' attitudes towards risk

Variable	Coefficient	s.e.	*t*-values
Gender	-5.168×10^{-5}	0.000	–0.172
Age	-1.238×10^{-5}	0.000	–1.158
Level of education	0.001	0.000	1.427
Occupation	0.001**	0.000	2.265
Total land size	0.001**	0.000	2.151
household size	0.002***	0.000	3.343
Experience	-6.560×10^{-5}**	0.000	–1.959
flock size	-6.551×10^{-6}***	0.000	–5.151
production objective	0.001	0.001	0.874
Production system	0.000	0.000	1.143
Total cost of Drugs	-7.416×10^{-7}	0.000	–1.277
Total cost of depreciation on poultry structures and equipment	-4.204×10^{-6}***	0.000	–5.336***
Total household expenditure	1.112×10^{-8}**	0.000	2.451**
Constant	0.588***	0.001	412.210***
R^2	0.524		
Adjusted R^2	0.496		
F – value	19.108		
No. of observation	240		

s.e. – standard errors.
***, **, * – coefficients are significant at 1%, 5%, and 10% level respectively.

the tendency of the IC farmers to be more risk-averse increased with an increase in household income from non-IC activities. This could be because the household off-farm and other on-farm enterprises were considered less risky and income generation through these alternatives was more stable. The finding contradicts with the results of Ullah et al. (2015) and Iqbal et al. (2016), as they documented that an increase in off-farm income reduces risk aversion. This is because higher off-farm incomes may indicate a greater risk-bearing capacity, allowing farmers to enhance their financial resilience and invest in risk reduction strategies, ultimately leading to reduced risk aversion.

The greater the total household expenditure, the more risk-averse the IC farmers become. The total land size had a positive and significant relationship with the risk-averse behavior of the farmer ($P < 0.05$), implying that IC farmers who had bigger sizes of land were more risk-averse than those with smaller sizes of land. Larger landholdings led to the increased area under crop and livestock production, resulting in increased production and spreading the risk, hence, impacting positively on the risk-averse attitude of the IC farmer. Total land size is also a proxy for wealth. Consequently, the wealthier IC farmers had larger land sizes and were more risk averse. These results agree with the findings of Lucas and Pabuayon (2011) and Ullah et al. (2015), who found a positive effect of farm size on the risk-averse attitude of the farmers. Income and proxies for wealth such as per capita household expenditure and the number of rooms in the homestead are positively associated with risk aversion (Cohen and Einav, 2007; Ihli et al., 2013).

Family size was statistically significant and positively related to the farmers' risk attitude ($P < 0.01$). The larger the family size, the greater the total consumption needs, hence, a positive contribution to the risk-averse behavior of the farmer. However, it is worth noting that IC farmers used both family and hired labor in IC production. This study is consistent with Chinwendu et al., (2012) on poultry farmers in Nigeria. This study contradicts the findings of Dadzie and Acquah (2012) and Ullah et al. (2015), who found a negative relationship between family size and the risk attitude of the farmers. This was because a larger family size also augments the farm's total labor supply, thereby enhancing income-generating potential and reducing farmers' risk aversion.

Farming experience had a significant inverse relationship with risk aversion ($P < 0.05$). Farmers with higher farming experience were less risk-averse compared with those with less farming experience. Farming experience had an inverse relationship with risk aversion. Farming experience enables the IC farmers to understand the various sources of risks and strategies to cope with the risks. According to Aye and Oji (2005), the more experience farmers have, the less risk-averse they are. This result is in line with Ayinde (2008), who reported a negative relationship between farming experience with the level of risk aversion.

The number of the IC had an inverse relationship with risk aversion. The number of IC kept by the farmers was a significant determinant of risk aversion ($P < 0.01$). The total number of IC kept had a negative and significant effect on risk aversion. Farmers having more birds enjoy economies of scale and feel more secure from various risks, leading to a decrease in their level of risk aversion. Additionally, IC farmers with more birds have invested in market intelligence and infrastructure and have better perspectives of the future. Therefore, they are less risk-averse. According to Jing et al. (2001), size of business, higher gross sales, and a higher number of employees are often wealthier and are therefore assumed to be less risk-averse. Farm or business size was found to be inversely related to risk aversion (Jing et al., 2001; Meuwissen et al., 2001; Flaten et al., 2005).

The total cost of depreciation on poultry structures and equipment negatively affected risk aversion ($P < 0.01$). The cost of depreciation had a negative and significant effect on risk aversion. The majority of the farmers provided shelter to birds to minimize production risks; therefore, they got high returns, leading to a decrease in their level of risk aversion. According to Ajetomobi and Binuomote (2006), the cost of depreciation had a significant effect on the risk aversion of the poultry egg farmers.

The production objective and the production system of the IC farmers had positive and insignificant effects on the risk attitude of the IC farmers. Most of the IC farmers (97.8%) were rearing the IC for commercial purposes (Mose et al., 2018a). The commercial orientation of the farmers largely informed the reason for keeping the IC under a semi-intensive production system (Mose et al., 2018a).

Effect of farmers' risk attitudes on the chicken productivity

The results of the analysis of the effect of risk attitude on chicken productivity are presented in Table 3. A test of multicollinearity gave a VIF of less than 10, implying that there was no multicollinearity between the variables. The value of R Square indicated that 64.6% of the variation in chicken productivity was explained by the independent variables. The model estimated was a true reflection of the equations, as it had *F*-values that were highly significant at 99%. The risk attitude of the farmer was a negative and significant determinant ($P < 0.01$) of IC productivity. An increase in the risk aversion coefficient led to a decrease in productivity. One percent increase in risk coefficient led to around 49 percent decrease in IC productivity. Cost of feeds and cost of labor were positive and significant determinants of IC productivity ($P < 0.01$), as presented in Table 3. The number of IC kept by the farmer was positive and significant ($P < 0.01$). The main objective of the farmer keeping IC was negative and significant ($P < 0.05$).

The IC farmers were risk-averse; therefore, they kept the birds under extensive and semi-intensive production systems. The two production systems are usually characterized by low input and operate on a cost minimization strategy. As a result, producers are more content with maintaining a stable level of production than increasing productivity, which would come with more risks (Hurley, 2010). This consequently results in low productivity as presented in Table 3. These results contradict the studies by Antle and Crissman (1990) and Haneishi et al. (2014), which suggest that the higher the degree of farmers' aversion, the higher the output they achieve. These studies measured productivity in terms of quantity produced, while our study considered

Table 3. Influence of farmers' risk attitudes on chicken productivity

Variable	Ba	s.e	t-values
LNK_1	–49.142***	15.383	–3.361
Gender	–0.043	0.081	–0.534
Age	–0.003	0.003	–1.145
Education	–0.058	0.083	–0.698
Occupation	–0.009	0.085	–0.107
Land size	0.031	0.025	1.247
Family size	–0.02	0.015	–1.352
Experience	0.009	0.009	0.932
No. of IC	.001***	0	2.873
F. objective	–0.380**	0.178	–2.128
Expenditure	2.036×	0	1.668
LNTCFS	0.354***	0.074	4.802
LNTCFD	0.043	0.047	0.926
LNTCL	0.521***	0.101	5.15
LNTDEPR	0.067**	0.034	1.967
(Constant)	–70.305***	16.515	–4.257
R^2	0.646		
Adj. R^2	0.623		
F-value	27.306***		
No. of Obs.	240		

s.e. – standard errors; β – the coefficient.
***, **, * – coefficients are significant at 1%, 5%, and 10% level, respectively.

productivity in terms of income from the sale of IC and its products.

Socioeconomic factors were important in determining the risk aversion of the IC farmers. Occupation, total land size, family size, and total household expenditure had a positive and significant effect on the risk aversion behavior of the farmer. Farming experience, number of IC birds, and cost of depreciation had a negative impact on risk aversion.

Emphasis should also be laid on the need to consider the risk attitudes and socioeconomic characteristics of the IC farmers to serve as a guide to formulating and implementing policy on risk management that will improve the IC sector.

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DATA AVAILABILITY

The datasets generated during and /or analysed during the current study are not publicly available due to Maseno University policy but are available from the corresponding author or reasonable request.

REFERENCES

Ajetomobi, J.O., and Binuomote, S.O. (2006). Risk Aversion among Poultry Egg Producers in South-Wester Nigeria. Int. J. Poul. Sci., 5(6), 52–565. https://dx.doi.org/10.3923/ijps.2006.562.565

Andreev, P., Heart, T., Maoz, H., Pliskin, N. (2009). Validating Formative Partial Least Squares (PLS) Models: Methodological Review and Empirical Illustration. Thirtieth International Conference on Information Systems. Phoenix, Arizona, ICIS 2009 Proceedings. Retrieved from: https://core.ac.uk/reader/301344380#:~:text=.%20193.,http%3A//ai,AIS%20Electronic%20Library%20(AISeL),-Thirtieth%20International%20Conference

Angrist, J.D., Imbens, G.W., Rubin, D.B. (1996). Identification of causal effects: using instrumental variables. J. Am. Stat. Assoc., 91(434), 444–455. Retrieved from: https://www.nber.org/system/files/working_papers/t0136/t0136.pdf

Antle, J.M., Crissman, C.C. (1990). Risk, efficiency, and the adoption of modern crop varieties: Evidence from the Philippines. Econ. Dev. Cult. Change, 38(3),517-38 https://econpapers.repec.org/scripts/redir.pf?u=http%3A%2F%2Fdx.doi.org%2F10.1086%2F451813;h=repec:ucp:ecdecc:v:38:y:1990:i:3:p:517-37

Aye, G.C., Oji, K.O. (2005). Effect of poverty on risk attitudes of farmers in Benue State, Nigeria. University of Nigeria, Nsukka. Econ. Fin Rev., 47(2), 89–104. Retrieved from: https://dc.cbn.gov.ng/cgi/viewcontent.cgi?article=1848&context=efr

Ayinde, O.E. (2008). Effect of socio-economic factors on risk behavior of farming households: empirical evidence of

small-scale crop producers in Kwara State, Nigeria. Agric. J., 3(6), 447–453. Retrieved from: https://medwelljournals.com/abstract/?doi=aj.2008.447.453

Brauw, A.D., Eozenou, P. (2014). Measuring risk attitudes among Mozambican farmers. J. Dev. Econ., 111, 61–74. https://doi.org/10.1016/j.jdeveco.2014.08.002

Bett, H.K., Bett, R.C., Peters, K.J., Kahi, A.K., Bokelmann, W. (2012). Linking utilisation and conservation of indigenous chicken genetic resources to value chains. J. Anim. Prod. Adv., 2(1), 33–51. Retrieved from: http://erepository.uonbi.ac.ke/handle/11295/14659

Chinwendu, A., Chukwukere, A.O., Remigus, M. (2012). Risk attitude and insurance: A causal analysis. Am. J. Econ., 2(3), 26–32. 10.5923/j.economics.20120203.01

Chuma, F. (2019). Modeling the dynamics, control and economic loss of Newcastle disease in village chicken: a case of Pwani region in Tanzania (Doctoral dissertation). Retrieved from: https://scholar.google.com/scholar?q=Chuma+F.+Modeling+the+dynamics,+control+and+economic+loss+of+Newcastle+disease+in+village+chicken:+a+case+of+Pwani+region+in+Tanzania+PhD+Dissertation+2019+Nelson+Mandela+African+Institution+of+Science+and+Technology+Arusha,+Tanzania+

Cohen, A., Einav, L. (2007). Estimating risk preferences from deductible choice. Am. Econ. Rev., 97, 745–788. Retrieved from: https://econpapers.repec.org/scripts/redir.pf?u=http%3A%2F%2Fwww.aeaweb.org%2Farticles.php%3Fdoi%3D10.1257%2Faer.97.3.745;h=repec:aea:aecrev:v:97:y:2007:i:3:p:745-788

Dadzie, S.K.N., Acquah, H.D. (2012). Attitudes toward risk and coping responses: The case of food crop farmers at Agona Duakwa in Agona East District of Ghana. Int. J. Agric. Forest, 2(2), 29–37. https://doi.org/10.5923/J.IJAF.20120202.06

Flaten, O., Lien, G., Koesling, M., Valle, P.S., Ebbesvik, M. (2005). Comparing risk perceptions and risk management in organic and conventional dairy farming: empirical results from Norway. Livest. Prod. Sci., 95(1), 11–25. https://doi.org/10.1016/j.livprodsci.2004.10.014

Greene, W.H. (2012). Econometric analysis (7th ed.). Prentice-Hall, USA.

Gujarati, D.N., Porter, D.C., Gunasekar, S. (2013). Basic Econometrics (5th ed.). Tata McGraw-Hill Education.

Haneishi, Y., Maruyama, A., Takagaki, M., Kikuchi, M. (2014). Farmers risk attitudes to influence the productivity and planting decision: A case of rice and maize cultivation in rural Uganda. Afr. J. Agric. Res. Econ., 9(4). https://ideas.repec.org/a/ags/afjare/197018.html#:~:text=DOI%3A%2010.22004/ag.econ.197018

Hurley, T.M. (2010). A review of agricultural production risk in the developing world. Technical Report. International Food Policy Research Institute (IFPRI). http://dx.doi.org/10.22004/ag.econ.188476

Huong, N.T.L., Bo, Y.S., Fahad, S. (2018). Economic impact of climate change on agriculture using Ricardian approach: A case of northwest Vietnam. J. Saudi Soc. Agric. Sci., 18(4), 449–457. https://doi.org/10.1016/j.jssas.2018.02.006

Ihli, H., Chiputwa, B., Bauermeister, G., Musshoff, O. (2013). Measuring risk attitudes of smallholder farmers in Uganda: How consistent are results of different methods? Paper Presented at the Second International Agricultural Risk, Finance, and Insurance Conference (IARFIC), Vancouver, British Columbia, Canada, June, 16-18. Retrieved from: https://api.semanticscholar.org/CorpusID:55780009

Iqbal, M.A., Ping, Q., Abid, M., Kazmi, A.M.S., Muhammad, R. (2016). Assessing risk perceptions and attitude among cotton farmers: A case of Punjab province, Pakistan. Int. J. Disast. Risk Reduct., 16, 68–74. https://doi.org/10.1016/j.ijdrr.2016.01.009

Jing, X.J., Alhabeeb, M.J., Gong-Soog, H., Haynes, G.W. (2001). Attitude toward risk and risk-taking behavior of business-owning families. The Journal of Consumer Affairs, 35, 307–325. https://doi.org/10.1111/j.1745-6606.2001.tb00116.x

Kahneman, D., Tversky, A. (1979). Prospect theory: An analysis of choice under Risk. Econometrica, 47(2), 263–291. https://doi.org/10.2307/1914185

Komarek, A.M., De Pinto, A., Smith, V.H. (2020). A review of types of risks in agriculture: what we know and what we need to know. Agric. Syst., 178, 102738 https://doi.org/10.1016/j.agsy.2019.102738

Korir, L.K. (2011). Risk management among agricultural households and the role of off-farm investment in Uasin Gishu County, Kenya. (Unpublished Master's thesis). Department of Agricultural and Applied Economics. Egerton, University. 10.22004/ag.econ.117806

Kyule, N.M., Mwangi, J.P., Nkurumwa, O.A. (2014). Indigenous chicken marketing channels among small scale farmers in Mau Narok division in Nakuru County, Kenya. Int. J. Soc. Sci. Entrep., 1(9). https://api.semanticscholar.org/CorpusID:54869599

Lucas, M.P., Pabuayon, I.M. (2011). Risk perceptions, attitudes, and influential factors of rainfed lowland rice farmer's in Ilocos Norte, Philippines. Asian J. Agric. Dev., 8, 61. http://dx.doi.org/10.22004/ag.econ.199327

Magothe, T.M., Okeno, T.O., W.B. Muhuyi, W.B., Kahi, A.K. (2012). Indigenous chicken production in Kenya: I. Current status, World. Poul. Sci. J., 68(1), 119–132, https://doi.org/10.1017/S0043933912000128

McNeil, A.J., Frey, R., Embrechts, P. (2015). Quantitative risk management: Concepts, techniques, and tools: revised edition. Princeton University Press.

Meuwissen, M.P.M., Huirne, R.B.M., Hardake, J.B. (2001). Risk and risk management: an empirical analysis of Dutch livestock farmers. Livest. Prod. Sci., 69(1), 43–53. https://doi.org/10.1016/S0301-6226(00)00247-5

MOLD (2008). Provincial summaries of livestock population statistics for 2008. Animal Production Division/Livestock Breeding Services Division, Ministry of Livestock Development.

Moscardi, E., de Janvry, A. (1977). Attitude toward risk among peasants: An Econometric application approach. Am. J. Agric. Econ., 59. Retrieved from: https://econpapers.repec.org/scripts/redir.pf?u=http%3A%2F%2Fhdl.handle.net%2F10.2307%2F1239398;h=repec:oup:ajagec:v:59:y:1977:i:4:p:710-716

Mose, P.B., Wasike, C.B., Owuor, O.B., Kipsat, M.J. (2018a). Farmers' attitude towards risk on indigenous chicken in Nyanza Region. J. Agric. Econ. Rural Dev., 4(2), 469–476. Retrieved from: https://www.researchgate.net/publication/326606418_Farmers%27_Attitude_Towards_Risk_on_Indigenous_Chicken_in_Nyanza_Region

Mose, P.B., Wasike, C.B., Owuor O.B., Kipsat, M.J. (2018b). Attitude of the Indigenous Chicken Farmers towards agricultural insurance in Nyanza, Kenya. J. Dev. Agric. Econ., 10(5), 146–151. https://doi.org/10.5897/JDAE2017.0853

Murray-Webster, R., Hillson, D. (2008). Managing group risk attitude. Gower Publishing Ltd.

Musser, W.N., Patrick, G.F. (2002). How much does risk really matter to farmers? In: R.E. Just, R.D. Pope (Eds.), A comprehensive assessment of the role of risk in U.S. Agriculture. Kluwer: Boston. https://doi.org/10.1007/978-1-4757-3583-3_24

Ngongolo, K., Chota, A. (2021b). Chicken production, flock size, management systems, and challenges in the Dodoma region in Tanzania. Poul. Sci., 100(6), 101136. https://doi.org/10.1016/j.psj.2021.101136

Ngongolo, K., Omary, K., Andrew, C. (2021). Social-economic impact of chicken production on resource-constrained communities in Dodoma, Tanzania. Poul. Sci., 100(3), 100921. https://doi.org/10.1016%2Fj.psj.2020.12.019

Nguyen, N.C. (2007). Risk management strategies and decision support tools for dryland farmers in southwest Queensland, Australia. (Unpublished doctorate thesis). The University of Queensland Gatton. Queensland. Australia. Retrieved from: https://espace.library.uq.edu.au/view/UQ:134695/Nam_Cao_Nguyen_Thesis_Final_version_25_07_07.pdf?dsi_version=ce9c32a8adfae29e37fad144ee2f3b7c

Ochieng, J., Owuor, G., Bebe, B.O. (2012). Determinants of adoption management intervention in indigenous chicken production Kenya. AfJARE (1). https://ideas.repec.org/a/ags/afjare/156977.html#:~:text=10.22004/ag.econ.156977

Okeno, T.O., Kahi, A.K., Peters, M.J. (2011). Characterization of indigenous chicken production systems in Kenya. Household flock structures, dynamics and breeding practices. Tropic. Anim. Heal. Prod., 44(3), 601–608. https://doi.org/10.1007/s11250-011-9942-x

Olwande, P.O., Ogara, W.O., Okuthe, S.O., Muchemi, G., Okoth, E., Odindo, M.O., Adhiambo, R.F. (2010). Assessing the productivity of indigenous chickens in an extensive management system in Southern Nyanza, Kenya. Tropic. Anim. Heal. Prod., 42, 283–288. https://doi.org/10.1007/s11250-009-9418-4

Olwande, P.O., Ogara, W.O., Bebora, L.C., Okuthe, S.O. (2013). Comparison of the economic impact of alternative constraint control measures in indigenous chicken production in Nyanza, Kenya. Livest. Res. Rural Dev., 25(2). Retrieved from: http://www.lrrd.org/lrrd25/2/olwa25024.html

Ogurtsov, V.A., Van Asseldonk, M.P.A.M., Huirne, R.B.M. (2008). Assessing and modeling catastrophic risk perceptions and attitudes in agriculture: a review. J. Life Sci., 56(1–2), 39–58. https://doi.org/10.1016/S1573-5214(08)80016-4

Reynaud, A., Couture, S. (2012). Stability of risk preference measures: results from a field experiment on French farmers. Theory Dec., 73(2), 203–221. https://doi.org/10.1007/s11238-012-9296-5

Senyolo, G.M., Chaminuka, P., Makhura, M.N., Belete, A. (2009). Patterns of access and utilization of output markets by emerging farmers in South Africa: Factor analysis approach. Afr. J. Agric. Res., 4(3), 208–214. Retrieved from: https://www.researchgate.net/publication/254218357

Thorton, P., Kruska, R., Henniger, N., Kristjanson, P., Atieno, F., Odero, E., Ndegwa, T. (2012). Mapping poverty and livestock in developing world. CGIAR. https://orcid.org/0000-0002-1854-0182

Tongruksawattana, S. (2014). Climate shocks and choice of an adaptation strategy for Kenyan Maize legume farmers: insights from poverty, food security, and gender perspective: Mexico, DF (Mexico). CIMMYT. 9:34. http://hdl.handle.net/10883/4147

Ullah, R., Shivakoti, G.P. (2014). Adoption of on-farm and off-farm diversification to manage agricultural risks: Are these decisions correlated? Outlook Agric., 43, 265–271. https://doi.org/10.5367%2Foa.2014.0188

Ullah, R., Shivakoti, G.P., Ali, G. (2015). Factors effecting farmers' risk attitude and risk perceptions: The case of

Khyber Pakhtunkhwa, Pakistan. Int. J. Disas. Risk Reduct., 13, 151–7. http://dx.doi.org/10.1016/j.ijdrr.2015.05.005

World Bank (2011). Weather index insurance for agriculture: Guidance for development practitioners. Agriculture and Rural Development Discussion Paper 50. http://www.worldbank.org/rural

Xaba, B.G., Masuku, M.B. (2013). Factors affecting the choice of marketing channel by vegetable farmers in Swaziland. Sust. Agric. Res., 2(1), 112–123. https://doi.org/10.5539/sar.v2n1p112

Yamane, T. (1967). Statistics: An introductory analysis (2nd ed.). NewYork: Harper and Row.