Asian Economic and Financial Review, 2016, 6(8): 490-498

Asian Economic and Financial Review
ISSN(e): 2222-6737/ISSN(p): 2305-2147

URL: www.aessweb.com

# ANALYSIS OF RISK MANAGEMENT PRACTICES AMONG MAIZE BASED FARMERS IN ABIA STATE, NIGERIA

**Nto Philips .O.O**[1]
[1]*Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria*

## ABSTRACT

*The study analyzed risk management practices among maize based farmers in Abia State of Nigeria. The specific objectives included (a) the Categorization of input variables associated with risk in maize farming into factors; (b) determination of the level of influence of loaded variables on risk and (c) examination of risk reducing practices adopted by maize farmers in the area. Multistage sampling technique was adopted in selecting 120 maize based farmers from three zones in the study area. Well-structured and pretested questionnaires were used in the collection of data. The data were analyzed using factor analysis, censored regression analysis and descriptive statistics. The result of the censored regression analysis indicates that variables like diseases and pests, invasion by cow, policy inconsistency and lack of improved varieties were positively significant at various probability levels. It was recommended that government should ensure availability of improved varieties and pesticides at subsidized rate as well as provide paddock for cow grazing. Farmers were also encouraged to adopt measures that will reduce cow invasion like fencing of farmland.*



**Keywords:** Risk, Management, Maize based, Farmer, Abia State, Nigeria.

**Received:** 9 February 2016/ **Revised:** 2 May 2016/ **Accepted:** 24 May 2016/ **Published:** 27 May 2016

## 1. INTRODUCTION

Maize (Zea mays) which is a global staple food is an important cereal being cultivated in all agricultural zones of Nigeria. The production has risen from subsistence level to commercial owing to its use as raw material by agro based industries such as beverage, soap and pharmaceuticals (Aye and Mungatana, 2012). According to Ohajianya *et al.* (2010) the vegetable part is also used in making silage for ruminants while the crop residue forms useful source of feed for cattle during dry season, even as the grain is a major component of poultry and pig ration (Opaluwa *et al.*, 2014).

Despite the importance of maize in Nigeria highlighted above, Aye and Mungatana (2012) noted that the production is still low as the supply cannot meet with the demand. Current production is about 8 million tonnes with average yield per hectare of 1.5 tonnes (Olarinde *et al.* (2007); Nto and Mbanasor (2008)). This is low especially when compared with world average of 4.3 tonnes per hectare. A close look at countries like South Africa (2.5 tonnes per hectare), Maritus (5.8 tonnes per hectare) and Egypt (7.1 tonnes per hectare) reveals that Nigeria's production is still unimaginably low given the large expanse of arable land, large population of small scale maize based farmers



DOI: 10.18488/journal.aefr/2016.6.8/102.8.490.498
*ISSN(e): 2222-6737/ISSN(p): 2305-2147*

(i.e. those who cultivate the crop in mix cropping system) and the encouragements the farmers receive from Government (Renuson, 2005; Nto *et al.*, 2013).

According to Ohajianya *et al.* (2010) government at various levels in Nigeria and Abia State in particular have formulated and implemented several policies aimed at increasing maize yield. Such policies include fertilizer distribution at highly subsidized rate, distribution of improved varieties of seed, provision of tractor hiring services at low cost, regular extension visits, provision of micro credit to farmer at low interest rate etc. However, these policies have not yielded the desired output given the extreme demand - supply gap which is evidenced by frequent increase in price, use and consumption of imported maize products as well as growing food crisis in Nigeria (Nto and Mbanasor, 2008; Etim and Okon, 2013).

Olarinde *et al.* (2007) and Nto *et al.* (2013) observed that the low output in maize from 4.3 tonnes per hectare global average to 1.5 obtained in Nigeria could be attributed to poor risk management practices among maize based farmers in Nigeria and Abia State in particular. Nto and Mbanasor (2008) opined that not much emphasis is given to risk management practices by farmers and policy makers in Nigeria hence the obvious consequences that are negatively impacting on the yield of maize. Nto *et al.* (2011); Alimi and Ayanwale (2005); Olarinde *et al.* (2007) reported that poor production yield will continue to be observed in crops like maize in Abia State and Nigeria in general, considering the dependency of farmers on changes in production environment and natural conditions. Such social, economic, technical and financial ambiences are not factored into decision making process of maize based farmers so as to enhance maize yield through adequate risk management strategies. In view of this, the study is designed to: (a) categorize input variables associated with risk in maize farming; (b) estimate the level of influence of loaded variables on risk and (c) examine adequate risk reducing practices among maize farmers in the area.

Several literatures were consulted but none delved into risk management practices among farmers in Abia State of Nigeria. However, such studies include Olarinde *et al.* (2007) which applied econometric analysis to quantitatively determine the individual risk attitudes of sampled maize farmers in the dry savannah zone of Nigeria. The result shows that about 8%, 42% and 50% of the farmers are respectively lowly, intermediately and highly averse to risk associated with maize production. The study further revealed that the risk factors affecting maize production in the area were natural risk (with 73% and 63% of the respondents highlighting drought and diseases/pests as its input variables respectively). The study also observed that 58% and 65.8% of the respondents were of the view that theft and invasion by cows are major social risks that affect maize output in their study area. Also, 73% identified price fluctuation as major economic risk while technical risk was also recorded as another group of risk with major component being insufficient and untimely supply of inorganic fertilizer (84%).

In another development, Nto *et al.* (2013) in a study conducted to evaluate risk management practices in rice production in Abia State, Nigeria using data analysed with w-statistics and Pearson criterion indicated that the highest risk sources to rice production were technical and political risk with mean rank of 1.29 and 2.29 respectively, having high w-statistics of 0.674 at 1% probability level. This implies that the concordance of rice producers' judgement should be regarded as satisfactory hence can be used for policy formulation. The result further indicated that the major component of technical risk that affected rice productions in the area were pests/diseases (96.67%) and flood (86.67%) while high preference for imported rice which is a component of market risk were identified by 65% of the respondents. Also, political and social risks were policy inconsistency (68.34%) and boundary/civil disturbance (41.67%) respectively. The study also depicted that the 78.34% of the respondents pointed at low access to credit as the major financial risk.

No doubt, the above studies offered useful guide in organising this study but they cannot be used for policy formulation in Abia State aimed at helping maize farmers in risk management practices. This is in view of methodology question.

However, studies like Panneerselvam (2013); Kaolhari and Garg (2014); Gujarati and Sangeetha (2007) suggested factor analysis as a more robust model that could estimate the various variable inputs that determine risk factors in a study of this nature. Previous studies consulted on analysis of risk in maize farming explored other estimation models which may not provide robust policy platform as intended in this research work. This study originates new formula that takes into consideration various categories of risk and their latent input-variable components.

Factor analysis is a multivariate technique applicable when there is a systematic interdependence among a set of observed variables while the researcher is interested in finding out something more fundamental or latent which creates this commonality. It is totally dependent on linear correlation between variables that aim to eliminate multi-collinearity amongst them thus establishing a small set of variables that are relatively independent of one another called risk factor (Ikem and Amusa, 2004; Olarinde, 2011; Green, 2012).

For instance, factor analysis investigates whether a number of variables of interest $X_1X_{2\ldots\ldots}X_i$ are linearly related to a small number of unobserved factor $F_{1,}F_2\ldots\ldots F_k$. The model can be algebraically written as:

$$F_k = W_{1k}\, X_1 + W_{2k}X_2 + W_{3k}X_3 + \ldots + W_{ik}X_i + W_{nk}X_n + e_k \ldots\ldots\ldots \text{ equation 1}$$

Where $W_{1k}$is the weight of the original variable $X_i$ in the linear composite of the factor K, in the case of n variable in the model thus n factors. Each factor say K is represented by a linear composite. If $F_k$ be the linear composite of the factor K as represented in equation I it means

$$Fk = \sum_{L=1}^{n} Wik\ Xi, \quad for\ K = 1, 2, 3 \ldots n \ldots \ldots \ldots \ldots . equation\ 2$$

Hence, equation 2 above finds the factor loading or score of each set of observation for the factor K by substituting the values of $X_i$ and i = 1, 2, 3…n in it. Where $e_i$ in equation 1 is the part of variables $X_i$ that cannot be explained by the factors (Tryfos, 1997; Gurrett-Mayer, 2006; Cornith, 2007; Panneerselvam, 2013; Kaolhari and Garg, 2014; Torres-Reyna, 2015).

This model is most suitable for this study as it creates opportunity and platform for identifying group (risk factors) that allows selection of one variable to represent many. This, according to Panneerselvam (2013) is highly adequate in many real-life applications where the number of independent input variables used in predicting a response variable (risk factor) as in the case of this study will be too many. So, each risk factor will account for one or more input variables.

## 2. METHODOLOGY

The study was conducted in Abia State of Nigeria. The State is located between latitude $5^0 10^1$ and $6^0 35^1$ North of the equator and longitudes $6^0\ 35^1$ and $7^0\ 31^1$ East of the Greenwich meridian. It lies in the tropical rainforest zone with two distinct seasons i.e the rainy and dry season (Nto and Mbanasor, 2008; Ohajianya *et al.*, 2010; Etim and Okon, 2013). The State which has 17 Local Government Areas (LGA) divided into three agricultural zones namely Ohafia, Umuahia and Aba has agriculture as the major occupation of the people. The farmers cultivate crops like maize, yam, cassava, cocoyam, melon and other cash crops. These arable crops are most often inter/mix cropped.

In the data collection, multistage sampling technique was employed in selecting 120 maize based farmers. The first stage was the stratification of the study area into three zones following the already existing agricultural zones viz Ohafia, Umuahia and Aba.

The second stage was the purposive selection of two local government areas from each of the agricultural zones. The local government areas were Bende and Isiukwuato; In Ohafia Zone; Isiala Ngwa North and Isiala Ngwa South in Umuahia Zone while Ugwunagbo and Obingwa were selected from Aba zone. The purposive selection of the six

LGAs was based on the list maintained by Abia State Ministry of Agriculture and Abia State Agricultural Development Project (ADP) on their maize performance index. Secondly, proximity to each other was also taken into consideration as this reduced cost and time of collecting data.

In the third stage, a community was purposively chosen from each of the six local government areas following the lists obtained from the Departments of Agriculture in the Local Government Secretariats. The lists indicated those with greater potential in maize farming.

The last stage was the selection of twenty maize based farmers from each of the six communities. The farmers were purposively selected from lists of serious maize farmers obtained from each community head. On the overall, 40 maize based farmers were selected from each cluster thus given a total sample size of 120 farmers. Data were collected with structured and pretested questionnaire administered by three survey teams, each including a supervisor and five enumerators for each of the three zones. Data collected were on socio-economic profile of the farmers, maize farming activities such as inputs used, output and revenue generated for 2014 farming season, other crops cultivated, variables that cause variation in expected maize production target etc.

In the data analysis, objective (a) was realised using factor analysis. The procedure of factor analysis used in this study is principal component. This method ensures that a set of observations of possibly correlated variables are converted into a set of values of linearly uncorrelated variables. Principal Component is preferred above other methods because it seeks to maximize the sum of squared loadings of each factor extracted in turn. The factor also accounts for the larger variability in the data (Kaolhari and Garg, 2014). The model is stated thus:

$P_1 = a_{11} X_1 + a_{12} X_2 + \ldots a_{1k} X_k$ - - - - equation 3

$P_2 = a_{21} X_1 + a_{22} X_2 + \ldots a_{2k} X_k$ - - - equation 4

$P_3 = a_{31} X_1 + a_{32} X_2 + \ldots a_{3k} X_k$ - - - equation 5

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$P_k = a_{k1} X_1 + a_{k2} X_2 + \ldots a_{kk} X_k$ - - - equation 6

Where $P_1$, $P_2$, $P_3$ ……….$P_k$ are factors which are linear combinations of the $X_s$ while $X_1$, $X_2$, $X_3$ ………$X_k$ are the observed variables which cause variation in the output of maize. The $a_s$ are called the factor loading. In this study, factor loading of 0.33 was used. Therefore, variables with factor loading of less than 0.33 and variables that loaded in more than one factor were discarded (Ashley *et al.*, 2006; Panneerselvam, 2013).

Hence the set of variables considered were:

$X_1$ = Drought

$X_2$ = Flood

$X_3$ = Wind and storm

$X_4$ = Diseases and pest

$X_5$ = Soil fertility

$X_6$ = Theft of maize

$X_7$ = Bush fire

$X_8$ = Invasion by cow

$X_9$ = Low output price

$X_{10}$ = High market glut

$X_{11}$ = Poor storage system

$X_{12}$ = High price of input

$X_{13}$ = Decay in public infrastructure

$X_{14}$ = Policy inconsistency

$X_{15}$ = Weak government institution

$X_{16}$ = Boundary/Civil disturbance

$X_{17}$ = High interest rate

$X_{18}$ = Difficulty in accessing credit

$X_{19}$ = Poor farm technology

$X_{20}$ = lack of improved variety

Objective (b) was analysed with Centroid regression analysis. The model is explicitly stated as: $Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \ldots \beta_{20i}X_{20i} + ɥ_i$ ……….. equation 7

Where $Y_i$ = risk (variation) between expected revenue from maize and realised revenue from maize by respondent i. $X_{1i} – X_{20i}$ = vector significant input variables that loaded above 0.33 in the factor analysis in objective (a). $\beta_1 – \beta_{20}$ are the vector of coefficients of each variable while $ɥ_i$ is the error term, which is assumed to be independent normally distributed : $\sum_I \sim N(O, \delta^2)$ following (Olagunju and Ajiboye, 2010); Gujarati and Sangeetha (2007). Variables that do not load up to 0.33 were not subjected to further analysis under the centroid regression model. Objective (c) was realized using Descriptive Statistics.

## 3. RESULTS AND DISCUSSION

Result of the factor analysis was summarized and presented in Table 1. According to the table, the varimax rotated factors of the input variables which constitute the risk in the production of maize in Abia State were grouped into three factors, following Nto *et al.* (2011) and Nto *et al.* (2013). The three factors are technical, socio-political and financial.

**Table-1.** Varimax-rotated Factors Militating against Risk Management Practices among the Rice Farmers.

| Variables | 1 | 2 | 3 |
|---|---|---|---|
| $X_1$ Drought | 0.66294* | 0.03339 | -0.35070* |
| $X_2$ Flood | 0.72559* | -0.05479 | -0.34195* |
| $X_3$ Wind and Storm | 0.57596* | -0.00278 | -0.39078* |
| $X_4$ Diseases and Pests | 0.23970 | 0.66821* | -0.15093 |
| $X_5$ Soil Fertility | 0.07993 | 0.41222* | 0.45105* |
| $X_6$ Theft of Maize | 0.46065* | -0.02887 | 0.42774* |
| $X_7$ Bush Fire | 0.48298* | 0.11989 | -0.00155 |
| $X_8$ Invasion by Cow | 0.38179* | -0.13342 | -0.17305 |
| $X_9$ Low Output Price | 0.42967* | 0.52510* | 0.11210 |
| $X_{10}$ High Market Glut | -0.00697 | -0.15665 | 0.24124 |
| $X_{11}$ Poor Storage Facilities | 0.59365* | -0.17647 | 0.28945 |
| $X_{12}$ High Price of Input | 0.47304* | -0.33346* | -0.00410 |
| $X_{13}$ Decay in Public Infrastructure | 0.45097* | -0.46120* | 0.32510* |
| $X_{14}$ Policy Inconsistency | 0.79764* | -0.17696 | -0.11509 |
| $X_{15}$ Weak Government Institution | 0.68974* | -0.09582 | 0.07708 |
| $X_{16}$ Boundary/Civil Disturbance | 0.24589 | -0.60156* | 0.33253* |
| $X_{17}$ High Interest Rate | 0.50716* | 0.26856 | 0.19799 |
| $X_{18}$ Difficulty in Accessing Credit | 0.05274 | 0.36438* | 0.44678* |
| $X_{19}$ Poor Farm Technology | 0.55984* | 0.35424* | 0.07137 |
| $X_{20}$ Lack of Improved Variety | 0.14434 | 0.53788* | 0.03835 |

Calculated from Field Survey Data, 2015

*Variables that loaded above 0.33

In line with the methodology, only variables with factor loading of 0.33 and above at 10% over lapping variance (Ashley *et al.*, 2006) were used in grouping the factors. Variables that loaded in more than one factor were discarded hence drought ($X_1$), flood ($X_2$), wind and storm ($X_3$), soil fertility ($X_5$), theft of maize ($X_6$), low output price ($X_9$), high price of input ($X_{12}$), decay in public infrastructure ($X_{13}$), boundary/civil disturbance ($X_{16}$), difficulty in accessing credit ($X_{18}$), poor farm technology ($X_{19}$) were eliminated from further analysis. Also, variables like high market glut was discarded because of low loaded score, following Panneerselvam (2013).

According to Table 1, only variables such as diseases and pests ($X_4$), bush fire ($X_2$), invasion by cow ($X_8$), poor storage facilities ($X_{11}$), policy inconsistency ($X_{14}$), weak government institution ($X_{15}$), high interest rate ($X_{17}$) and lack of improved varieties ($X_{20}$) had loading score of 0.33 and above in only one factor thus were subjected to further analysis.

In forming the factor Panneerselvam (2013) stated that each factor should be given a denomination based on the set of variable characteristics. This procedure was adopted in assembling $X_4$, $X_{11}$ and $X_{20}$ as technical factors while $X_7$, $X_8$, $X_{14,}$ $X_{15}$ were grouped as socio-political factor. $X_{17}$ was classified as financial factor. This result is consistent with Nto *et al.* (2013) which opined that major risks factor which affect cereal crops like rice are technical and political risk factors.

The variables were subjected to further regression analysis and the result is presented in Table 2. The essence is to determine the level of influence of the loaded variables on risk among maize based farmers in the area.

**Table-2.** Regression estimates of the determinants of risk in revenue among the maize farmers in the study area

| Variable | Linear | Exponential | Cobb-Douglas | Semi-Log |
|---|---|---|---|---|
| Constant | 52406.8 (7.19***) | 10.776 (50.13***) | 10.657 (31.73***) | 53123.59 (4.90***) |
| Diseases and Pests | 10094.44 (4.92***) | 2586611 (4.21***) | 0.9256 (3.21**) | 39367.55 (4.21***) |
| Bush fire | 131.219 (-0.09) | 0.002 (0.05) | 0.1617 (0.98) | 1023.17 (2.06*) |
| Invasion by Cows | 4516.51 (2.98**) | 0.1016 (2.27*) | 0.2277 (1.10) | -3343.45 (-0.52) |
| Poor Storage facilities | -1498.94 (-0.93) | -0.0792 (-1.67*) | -0.0717 (-0.36) | 4042.49 (0.63) |
| Policy Inconsistency | 11397.74 (5.83***) | -0.2349 (-4.07***) | 0.7386 (3.57***) | -30581.63 (-4.55**) |
| Weak Govt Institutions | 4306.53 (2.21*) | 0.0903 (1.57) | 0.5673 (2.27*) | 31259.38 (3.88***) |
| High Interest Rate | -1519.223 (-0.90) | -0.0655 (-1.33) | -0.0451 (-0.31) | -467.247 (-0.10) |
| Lack of Improved Varieties | 9532.75 (5.48***) | 0.2080 (3.98***) | 0.5769 (3.36**) | 53123.59 (4.90***) |
| $R^2$ | 0.5210 | 0.4004 | 0.3737 | 0.4823 |
| R square adjusted | 0.4865 | 0.3564 | 0.3069 | 0.4285 |
| F-Value | 15.09*** | 9.10*** | 5.60** | 8.97*** |

**Source:** STATA 4A

Figures in parentheses are t-values

*, ** and *** is significant at 10%, 5% and 1% level of probability respectively.

The coefficient for diseases and pests was positively related to risk and highly significant at 1% level of probability. This implies that any increase in diseases and pests infestation will lead to a corresponding increase in the variation of revenue generated from maize among the farmers in the study area. This is in line with Nto *et al.* (2013)

where about 97% of respondents identified pests/diseases as risk affecting cereal production in Abia State of Nigeria. Also Olarinde *et al.* (2007) confirmed that major risk variables in maize production are diseases and pests.

The coefficient for invasion by cows was also positively related to risk and significant at 5% level of probability. This implies that any increase in invasion of maize farms by cows will lead to a corresponding increase in the variation in revenue generation from maize among the farmers in the study area. This is consistent with a priori expectation following the alarming rate of clash between farmers and cattle rearers (Fulani Headsmen as they are called in Nigeria) in the area. In recent times, there has been regular clash between itinerant cattle rearers (Fulani Headsmen) and crop farmers over invasion of farms by cow, which has always attracted government attention.

The coefficient for policy inconsistency was positively signed and highly significant at 1% level of probability. This implies that increase in policy inconsistency will lead to a corresponding increase in the risk of revenue generated from maize among the farmers in the study area. This follows a priori knowledge as Nigerian government continuously change policies on cereal production such as banning and unbanning of importation of cereal products. Also, policy changes in related subsectors will have band wagon effect on maize production for instance when activities like local poultry farming receive policy boost, poultry feed sub-sector will increase and thus will lead to enhancement in maize production and revenue to the farmers.

The coefficients for weak government institutions and lack of improved varieties were also positively related and significant at 10% and 1% level of probability respectively. This implies that any increase in weak government institutions and lack of improved varieties will lead to a corresponding increase in the variation of expected revenue among the farmers in the study area. Weak government institution includes poor extension services, weak credit delivery to maize farmers etc. Also, farmers in the area find it extremely difficult to access improved maize varieties.

**Table-3.** Risk Reducing Strategies Adopted by Maize Based Farmers in the area

| Risk reducing strategies | Frequency | Percentage |
|---|---|---|
| Use of Improved Variety | 100 | 83.33 |
| Use of Manure/Fertilizer | 65 | 54.17 |
| Use of Pesticide | 80 | 66.66 |
| Fencing of Farm | 25 | 20.83 |
| Mix Cropping | 120 | 100.00 |
| Native Irrigation | 10 | 8.33 |
| Membership of Cooperative Society | 60 | 50.00 |
| Non-Farm Business | 80 | 66.66 |
| Borrowing | 60 | 50.00 |
| Savings | 60 | 50.00 |
| Native Safe Guard | 20 | 16.67 |

*Calculated from Field Survey data, 2015

*Multiple responses recorded.

Several risk reducing strategies adopted by maize based farmers were identified and presented in Table 3. According to Table 3, all the respondents used intercropping/mix-cropping to reduce risks. The farmers plant other crops like yam, cassava melon, cowpea etc in the same plot of land so as to reduce cost of cultivation of only maize. Also, about 83.33% of the respondents used improved varieties in reducing risk. The improved varieties have the potential tendency of increasing yield in maize. Table 3 further depicted that significant proportion of about 67% of the respondents adopted the use of pesticide and non-farm business respectively in reducing risk. Pesticides are used in controlling pest during farming and storage. Nto *et al.* (2013); Alimi and Ayanwale (2005) also identified the use of pesticide as appropriate risk reducing practices by rice and onions farmers respectively. Furthermore, maize farmers also engage in non-farm business activities like civil service, trading, artisan, etc. as a way to reduce pressure in the consumption of maize output.

The result further shows that reasonable proportion of the farmers (54.17%) used fertilizer in reducing risk in maize production while 50% adopted membership of cooperative society, borrowing and saving respectively as appropriate risk reducing strategies. According to Nto *et al.* (2011) membership of cooperative society enhances farmers' credit worthiness potential. It also helps members in bulk purchase of farm inputs hence cut down cost of production. Maize farmers who belong to cooperative societies take advantage of inherent economies associated with such societies such as sales control, bulk purchase of inputs, access to credit etc (Nto and Mbanasor, 2008).

## 4. CONCLUSION

The study analysed risk management practices among maize based farmers in Abia State of Nigeria. Data obtained from 120 respondents who were drawn from 3 agricultural zones of Ohafia, Umuahia and Aba were analysed with factor analysis and centroid regression analysis. Following the result of the factor analysis, input variables like diseases and pest; poor storage facilities and lack of improved varieties came as technical factors. Bush fire; invasion by cow; policy inconsistency and weak government institution were categorized under socio-political factor while high interest rate was grouped as financial factor. The major risk reducing practices adopted by maize-based farmers in the area are mixed-cropping, use of improved varieties, use of pesticides and engagement in non-farm business activities.

The popularity of the above risk management strategies among the respondents point to the fact that government should strengthen existing government institutions charged with the responsibilities of providing pesticides and improved varieties at highly subsidized rate.

Farmers are also encouraged to practice mix cropping in their farms as well as adopt measures that scare away or protect farms from cows such as fencing. Government is also advised to provide paddock for cow grazing in all the Local Government Areas of the State.

Funding: This study received no specific financial support.

Competing Interests: The author declare that there are no conflict of interests regarding the publication of this paper.

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