Journal of Development and Agricultural Economics

Volume 5 Number 10 October 2013
ISSN 2006-9774

Academic Journals

ABOUT JDAE

The **Journal of Development and Agricultural Economics (JDAE)** (ISSN:2006-9774) is an open access journal that provides rapid publication (monthly) of articles in all areas of the subject such as The determinants of cassava productivity and price under the farmers' collaboration with the emerging cassava processors, Economics of wetland rice production technology in the savannah region, Programming, efficiency and management of tobacco farms, review of the declining role of agriculture for economic diversity etc.
The Journal welcomes the submission of manuscripts that meet the general criteria of significance and scientific excellence. Papers will be published shortly after acceptance. All articles published in JDAE are peer-reviewed.

Journal of Development and Agricultural Economics (JDAE) (ISSN: 2006-9774) is published monthly (one volume per year) by Academic Journals.

Submission of Manuscript

Submit manuscripts as an e-mail attachment to the editorial office at: jdae@academicjournals.org. A manuscript number will be mailed to the corresponding author shortly after submission.

The Journal of Development and Agricultural Economics will only accept manuscripts submitted as e-mail attachments.

Please read the **Instructions for Authors** before submitting your manuscript. The manuscript files should be given the last name of the first author.

Editors

Instructions for Author

Electronic submission of manuscripts is strongly encouraged, provided that the text, tables, and figures are included in a single Microsoft Word file (preferably in Arial font).

The **cover letter** should include the corresponding author's full address and telephone/fax numbers and should be in an e-mail message sent to the Editor, with the file, whose name should begin with the first author's surname, as an attachment.

Article Types

Three types of manuscripts may be submitted:

Regular articles: These should describe new and carefully confirmed findings, and experimental procedures should be given in sufficient detail for others to verify the work. The length of a full paper should be the minimum required to describe and interpret the work clearly.

Short Communications: A Short Communication is suitable for recording the results of complete small investigations or giving details of new models or hypotheses, innovative methods, techniques or apparatus. The style of main sections need not conform to that of full-length papers. Short communications are 2 to 4 printed pages (about 6 to 12 manuscript pages) in length.

Reviews: Submissions of reviews and perspectives covering topics of current interest are welcome and encouraged. Reviews should be concise and no longer than 4-6 printed pages (about 12 to 18 manuscript pages). Reviews are also peer-reviewed.

Review Process

All manuscripts are reviewed by an editor and members of the Editorial Board or qualified outside reviewers. Authors cannot nominate reviewers. Only reviewers randomly selected from our database with specialization in the subject area will be contacted to evaluate the manuscripts. The process will be blind review.

Decisions will be made as rapidly as possible, and the journal strives to return reviewers' comments to authors as fast as possible. The editorial board will re-review manuscripts that are accepted pending revision. It is the goal of the JDAE to publish manuscripts within weeks after submission.

Regular articles

All portions of the manuscript must be typed double-spaced and all pages numbered starting from the title page.

The Title should be a brief phrase describing the contents of the paper. The Title Page should include the authors' full names and affiliations, the name of the corresponding author along with phone, fax and E-mail information. Present addresses of authors should appear as a footnote.

The Abstract should be informative and completely self-explanatory, briefly present the topic, state the scope of the experiments, indicate significant data, and point out major findings and conclusions. The Abstract should be 100 to 200 words in length.. Complete sentences, active verbs, and the third person should be used, and the abstract should be written in the past tense. Standard nomenclature should be used and abbreviations should be avoided. No literature should be cited.

Following the abstract, about 3 to 10 key words that will provide indexing references should be listed.

A list of non-standard **Abbreviations** should be added. In general, non-standard abbreviations should be used only when the full term is very long and used often. Each abbreviation should be spelled out and introduced in parentheses the first time it is used in the text. Only recommended SI units should be used. Authors should use the solidus presentation (mg/ml). Standard abbreviations (such as ATP and DNA) need not be defined.

The Introduction should provide a clear statement of the problem, the relevant literature on the subject, and the proposed approach or solution. It should be understandable to colleagues from a broad range of scientific disciplines.

Materials and methods should be complete enough to allow experiments to be reproduced. However, only truly new procedures should be described in detail; previously published procedures should be cited, and important modifications of published procedures should be mentioned briefly. Capitalize trade names and include the manufacturer's name and address. Subheadings should be used. Methods in general use need not be described in detail.

Results should be presented with clarity and precision. The results should be written in the past tense when describing findings in the authors' experiments. Previously published findings should be written in the present tense. Results should be explained, but largely without referring to the literature. Discussion, speculation and detailed interpretation of data should not be included in the Results but should be put into the Discussion section.

The Discussion should interpret the findings in view of the results obtained in this and in past studies on this topic. State the conclusions in a few sentences at the end of the paper. The Results and Discussion sections can include subheadings, and when appropriate, both sections can be combined.

The Acknowledgments of people, grants, funds, etc should be brief.

Tables should be kept to a minimum and be designed to be as simple as possible. Tables are to be typed double-spaced throughout, including headings and footnotes. Each table should be on a separate page, numbered consecutively in Arabic numerals and supplied with a heading and a legend. Tables should be self-explanatory without reference to the text. The details of the methods used in the experiments should preferably be described in the legend instead of in the text. The same data should not be presented in both table and graph form or repeated in the text.

Figure legends should be typed in numerical order on a separate sheet. Graphics should be prepared using applications capable of generating high resolution GIF, TIFF, JPEG or PowerPoint before pasting in the Microsoft Word manuscript file. Tables should be prepared in Microsoft Word. Use Arabic numerals to designate figures and upper case letters for their parts (Figure 1). Begin each legend with a title and include sufficient description so that the figure is understandable without reading the text of the manuscript. Information given in legends should not be repeated in the text.

References: In the text, a reference identified by means of an author‘s name should be followed by the date of the reference in parentheses. When there are more than two authors, only the first author‘s name should be mentioned, followed by ’et al‘. In the event that an author cited has had two or more works published during the same year, the reference, both in the text and in the reference list, should be identified by a lower case letter like ’a‘ and ’b‘ after the date to distinguish the works.

Examples:

Abayomi (2000), Agindotan et al. (2003), (Kelebeni, 1983), (Usman and Smith, 1992), (Chege, 1998; 1987a,b; Tijani, 1993,1995), (Kumasi et al., 2001)

References should be listed at the end of the paper in alphabetical order. Articles in preparation or articles submitted for publication, unpublished observations, personal communications, etc. should not be included in the reference list but should only be mentioned in the article text (e.g., A. Kingori, University of Nairobi, Kenya, personal communication). Journal names are abbreviated according to Chemical Abstracts. Authors are fully responsible for the accuracy of the references.

Examples:

Chikere CB, Omoni VT and Chikere BO (2008). Distribution of potential nosocomial pathogens in a hospital environment. Afr. J. Biotechnol. 7: 3535-3539.

Moran GJ, Amii RN, Abrahamian FM, Talan DA (2005). Methicillinresistant Staphylococcus aureus in community-acquired skin infections. Emerg. Infect. Dis. 11: 928-930.

Pitout JDD, Church DL, Gregson DB, Chow BL, McCracken M, Mulvey M, Laupland KB (2007). Molecular epidemiology of CTXM-producing Escherichia coli in the Calgary Health Region: emergence of CTX-M-15-producing isolates. Antimicrob. Agents Chemother. 51: 1281-1286.

Pelczar JR, Harley JP, Klein DA (1993). Microbiology: Concepts and Applications. McGraw-Hill Inc., New York, pp. 591-603.

Short Communications

Short Communications are limited to a maximum of two figures and one table. They should present a complete study that is more limited in scope than is found in full-length papers. The items of manuscript preparation listed above apply to Short Communications with the following differences: (1) Abstracts are limited to 100 words; (2) instead of a separate Materials and Methods section, experimental procedures may be incorporated into Figure Legends and Table footnotes; (3) Results and Discussion should be combined into a single section.

Proofs and Reprints: Electronic proofs will be sent (e-mail attachment) to the corresponding author as a PDF file. Page proofs are considered to be the final version of the manuscript. With the exception of typographical or minor clerical errors, no changes will be made in the manuscript at the proof stage.

Fees and Charges: Authors are required to pay a $550 handling fee. Publication of an article in the Journal of Development and Agricultural Economics is not contingent upon the author's ability to pay the charges. Neither is acceptance to pay the handling fee a guarantee that the paper will be accepted for publication. Authors may still request (in advance) that the editorial office waive some of the handling fee under special circumstances.

Submission of a manuscript implies: that the work described has not been published before (except in the form of an abstract or as part of a published lecture, or thesis) that it is not under consideration for publication elsewhere; that if and when the manuscript is accepted for publication, the authors agree to automatic transfer of the copyright to the publisher.

Journal of Development and Agricultural Economics

Table of Contents: Volume 5 Number 10 October 2013

ARTICLES

Research Articles

academicJournals

Vol. 5(10), pp. 382-389, October, 2013
DOI 10.5897/JDAE12.065
ISSN 2006-9774 ©2013 Academic Journals
http://www.academicjournals.org/JDAE

Journal of Development and Agricultural Economics

Full Length Research Paper

Effects of property rights on agricultural production: The Nigerian experience

A. A. Akinola* and R. Adeyemo

Department of Agricultural Economics, Obafemi Awolowo University, Ile- Ife, Osun State, Nigeria.

30 Accepted July, 2013

The study was conducted to examine the effects of property rights and other factors on the outputs of maize, yam and cassava in three zones of Osun State in Nigeria. This study employed a multi-stage sampling technique to select 105 farmers involving growers of maize, yam and cassava in the study area. Data were analyzed with the aid of descriptive statistics, budgetary techniques and a multiple linear regression model. The results of budgetary analysis showed that variable cost was highest in yam production. The average revenues per hectare for maize, yam and cassava were (N is Nigerian currency equivalent to about $0.0067) N104, 487.50, N583, 846.20 and N438, 208.50, respectively. However, the average net incomes were N19, 908.40, N432, 079.00 and N96, 543.90 for maize, yam and cassava, respectively. Based on the rates of returns, N1 invested in each of maize, yam and cassava production yielded N1.2, N3.4 and N3.1, respectively implying that yam was the most profitable crop in the study area. The result of the multiple regression model revealed that farm size significantly affect the outputs of the three crops. Land rights type (having either use right/use and transfer right) and security of land defined by duration of land use affected maize output while duration and ownership type affected yam output, whereas, duration only affect cassava output. There is therefore the need to review the land distribution and administration policies based on the identified significant factors affecting each crops.

Key words: Nigeria, Osun State, crops, maize, yam, cassava, land rights.

INTRODUCTION

Land is probably the most important factor of production. The unique feature of land is its fixed nature and this has generated a lot of policies administration in its use rights and transfer. The rights to land are an international issue with dynamisms depending on individual country's tenure arrangement. Property rights will determine land ownership related factors affecting the application of technologies for agricultural and natural resource management. Secured property rights give sufficient incentives to the farmers to increase their efficiencies in terms of productivity and ensure environmental sustainability. It is natural that without secured property rights, farmers do not feel emotional attachment to the land they cultivate, do not invest in land development and will not use inputs efficiently (Tenaw et al., 2009). There is broad agreement in the literature that secure individual land rights will increase incentives to undertake productivity enhancing land related investments. More secure property rights could affect productivity by improving household's security of tenure and thus their ability and readiness to make investments; providing better access to credit; and reducing the transaction

*Corresponding author. E-mail: aakinola2000@yahoo.com.

costs associated with land transfers (Tenaw et al., 2009). Besley (1995) revealed that having more secure tenure to a plot increased the probability that individuals would plant trees, and undertake a wide range of other investments such as drainage, irrigation, mulching, etc. that would enhance better yield.

Fajemirokun (2000) indicated the need for secure ownership rights over a sufficiently long time horizon which needs not necessarily be a formal title to facilitate improvements emerges from most African countries.

Land policies and reforms in Nigeria

In Nigeria, reform has often sought to transform customary tenure land into state property or individualized private property. This was contained in the promulgation Land Use Act (LUA) of Nigeria, 1978. This brought about a fundamental change in land tenure systems through the abolition of private ownership of land (Fajemirokun, 2000). According to the Act, all land comprised in the territory of a State is vested in the State Governor who holds in trust for the use and common benefit of all Nigerians. Under this uniform system of land tenure, the highest interest in land is a right of occupancy. This can either be a statutory right of occupancy, which is granted by the State Governor in respect of land in both urban and non-urban areas and a customary right of occupancy, which is granted by a Local Government in respect of land in a non-urban area. Designation of urban and non-urban areas of a State is the exclusive responsibility of the State Government. During privatization, men (and particularly male heads of household) acquire complete and legal ownership of land (Davison, 1988). Individualized and private ownership transfers the few rights, such as cultivation rights, that women and minority groups may have land under customary rules to those men who are able to claim all rights to land (Lastarria-Cornhiel, 1997). More recently, there is the trend to recognize the previously existing customary tenure and land authorities which is still a problem to farmers especially the crop farmers. Rarely, however, has the effect of property rights on crops production been discussed in Nigeria and strong empirical evidence to test its effect and impact has been scarce and scattered due to paucity of literature. Several studies (Afeikhena, 2000; Besley, 1995; Feder et al., 1988) emphasized the effect of property rights on land conservation investment.

In Nigeria and other sub-Sahara countries, traditional land tenure system of ownership is still predominant. According to Deininger and Binswanger (1999), undefined property rights could affect economic growth in the following ways; Firstly, secure property rights will increase the incentives of households and individuals to invest, and often will provide them with better credit access, something that will not only help them make such investments, but will also provide and assurance substitute in the event of shocks. Secondly, it has long been known that in traditional agriculture, the operational distribution of land affects output, implying that a highly unequal land distribution will reduce productivity. Even though the ability to make productive use of land will depend on policies in areas beyond land policy that may warrant separate attention, secure and well-defined land rights are key for household asset ownership, productive development and factor market functioning. Based on the afore-mentioned assertions, the situation of land tenure system and property rights prevalent in most of developing countries in sub-Saharan Africa, Nigeria inclusive is similar in many respects as long as the agricultural production output remains low (Tenaw et al., 2009). They stressed that the changing climatic conditions in many developing countries have impacts on agricultural production at local and country level. This is an important issue, which is worth paying attention to in order to prevent problems that may affect the population. Insecure land right or the lack of land ownership also restricts the farmers' access to credit that are necessary for improved agricultural land practices for better yield (Feder et al., 1988). This non-access to credit predisposed farmers to go for traditional land-use practices which will eventually generate poor yield (Bamire and Fabiyi, 2002). The traditional institutions in the country allow various land acquisition types such as rent, share cropping and lease hold systems. These rights are non-definite, non-directional and insecure. There is therefore the need to get empirical evidence of the effects of land rights on crop outputs. Our study, therefore, intends to examine the socio-economic characteristics of the respondents; the nature, ownership and distribution of property rights in land and how they are acquired; determine the costs and returns to maize, yam and cocoa and also examine the effect of property rights on the output of these crops.

The importance of this study lies in providing information on the effect of property rights on crops output to assist policymakers where such rights are practiced in promoting right accessibility that would enhance better farmers yield.

METHODOLOGY

Area of study

The study was conducted in Osun state of Nigeria. Osun state is located in the south-western part of the country. It covers an area of approximately 14,875 square kilometers, with an estimated croppable land area of 8,822.55 square kilometers. It shares common boundaries with Kwara, Ogun, Ekiti, Ondo and Oyo states. The indigenes of the state belong to the Yoruba tribe but non-indigene from all parts of Nigeria and foreigners also reside in the state. The major crops grown in the state are cassava, maize, vegetables, cocoa, oil palm, tomatoes etc. This implies that the climate in the state favours both arable and non-arable crops. The states experiences two major seasons, the dry and rainy seasons

with August break during the rainy season. The annual temperature varies from 21.1 to 31.1°C, while annual rainfall is within the range of 800 mm in the dry savannah agro-ecology to 1500 mm in the rain forest belt. Traditional land tenure arrangement is still predominant in the state. Rent, share cropping and short term lease arrangements which are often non-legal are popular in Nigeria and some West African Countries.

Data and sampling technique

A multi stage sampling technique was employed in selecting respondents for this study. In the first stage, Osun state was stratified into three based on the state's Agricultural Development Programme (ADP) classification, namely Ife/Ijesha, Iwo Ikire and Osogbo zones. In the second stage, a local government area (LGA) was selected from each of the zones based on the predominance of agricultural practices. In the third stage, three villages were randomly selected from each of the LGA. In the final stage, a minimum of ten respondents were selected per villages. In all, 105 respondents were selected. Data were collected with the aid of structured questionnaire. Data were collected on the socio-economic characteristics of the respondents such as sex, age, level of education and land factors and tenure arrangement such as land size, land ownership type, duration of tenure among others. Data collected were analyzed using the descriptive statistics, budgetary techniques and multiple linear regression technique. Descriptive statistics uses frequency count and percentage to describe the socio-economic variables of respondents in the study area. A total farm budget approach was undertaken to estimate costs and returns accruing to maize, yam and cocoa enterprises in the study area.

Since a budget is the quantitative expression of total farm plan summarizing the income, cost and profit -a residue of total cost from total revenue (Alimi and Manyong, 2002). Gross margin which is the difference between total revenue and total variable cost were analyzed. The total cost component is expressed as:

TC= TFC + TVC

Where: TC = Total cost; TVC = total variable cost; TFC = total fixed cost.

Gross margin = (TR) - (VC)
TVC = TC - TFC
TFC = TC - TVC
TR = Total revenue = price × quantity that is, PQ
VC = Variable cost
Profit = TR - TC
Labour efficiency = Total output/amount of labour used

The efficiency ratios that were analyzed were fixed cost ratios, variable to total cost ratio, labour efficiency amongst others. These were computed to indicate the performance of each of the enterprises. The data collected were analyzed using multiple linear regression models. This model was employed to examine the effects of socio-economic and land tenure factors on the outputs of maize, yam and cocoa. For each of the crops, the dependent variable of the regression model is the output (kg). The postulated model assumed a relationship between the output of the crops and factors affecting crop output(s). The general empirical model is:

$$\gamma = \alpha + \beta_i x_i$$

Where α = constant /intercept; β_i = coefficient of independent variables x_i.

The regression model for each of the production is modeled as:

$$\gamma = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \mu$$

Where γ_i is the quantity of individual crop produced in kilogram.

x_1 - x_{10} = explanatory variables
$\propto$ = constant (intercept)

The fitness of the model was based on the coefficient of multiple determinations (R^2), adjusted R^2 and significance of regression coefficient at a specific level (1, 5 or 10%).

x_1 = Age of the respondent (AGERES) in years
x_2 = Marital status (MARISTAT); (1 if married and 0 otherwise)
x_3 = Farming experience (FARMEXP) in year
x_4 = Household size (HHSIZE)
x_5 =Duration of land use (DURLNDU) in years
x_6 =Land right type (RIGHTYP); (use right only = 0; use and transfer right = 0)
x_7 = Land ownership type (*LNDOWSIP*); 1 if owned and 2 otherwise
x_8= Total farm size (FARMSIZ) in hectare
x_9 = Level of education (LEVEDU) in years
x_{10} = Extension visit (EXTVIT); 1 if visited and 0 otherwise
µi = error term.

A priori expectation signs of the coefficients

The multiple independent variables included socio-economic and tenural factors that may influence crop output. These variables include age (AGE) of respondents in years, marital status (MARISTAT), farming experience (FARMEXP), household size (HHSIZE), duration of land use (DURLNDU), land rights type (RIGHTYP), land ownership type (LNDOWSIP), farm size (FARMSIZ), level of education (LEVEDU) and extension visit (EXTVIT). The rationale for inclusion of these variables was based on *a* priori expectation of factors influencing agricultural output. The effect of age (AGERES) on the output may be positive or negative. Previous study shows that the age of individuals affects their output in several ways. Younger farmers have been found to be more agile and would be ready to take on new practices that could improve crop yield. The older the farmer, the less likely may be his output from crops (Amos, 2007). Marital status (MARISTAT) of respondents may have influence on respondents output positively. It is expected that the married individuals have greater number of labour which may increase output. Farming experience is a measure of the number of years a respondent has farmed. We hypothesized that farming experience will positively influence farmers output. It is expected that the more the experience, the greater the resource use and hence the better the output (Amos, 2007; Akinola and Adeyemo, 2008).

Household size (HHSIZE) determines the supplementary man days' of labour that could be produced by the family (Amos, 2007; Yang and Zhang, 1999). We then hypothesized that household with larger size have higher probabilities to acquire more output than smaller household size because the larger the household size, the greater the man power, hence, more labour to work on the farm. Duration of use (DURLNDU) of land is a measure of the length in years that the land would be used. The longer the time period the greater the likelihood those farmers would adopt soil enhancing technology that would increase crop yield (Tenaw et al., 2009). It is expected that the longer the length of use, the greater the tendency that the land occupiers owns to land and the greater the probability of investing in land enhancing technology that would enhance greater (Ogedengbe and Akinbile, 2004). The type of right (RIGHTYP)

individual is having over a parcel of land may have positive or negative influence on production. Individual with use right only may not adopt land improving technology and hence, low output while individual with both use and transfer right can adopt new and hence, greater output (Ogedengbe and Akinbile, 2004; Clay, 2008). The Ownership type (LNDOWSIP) defined the land ownership type, which is whether land is owned or otherwise. It is expected that ownership type will influence the rights to hold a parcel of land because the more your income the larger the amount of land you can purchase (Clay, 2008).

Farm size (FARMSIZE), the total farm size owned by respondents is expected to positively influence crop output. The larger the farm size owned, the greater the area that will be put under cultivation and the more the expected output (Clay, 2008). Level of education (LEVEDU) is expected to positively influence crop output. Extension visit (EXTVIT): It is hypothesized that the greater the land allocated for permanent crops, the greater the output from permanent and the less the available land for arable and hence, the lower the yield from arable.

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents

Table 1 showed the socio-economic characteristics of the respondents. The analysis revealed that 75.2% of the respondents were male while 24.8 were female. This implies that farming in the study area were male dominant. The analysis further showed that 57% of the respondents fell between the ages of 41 to 50 years, while about 28.6% of the respondents have age of 51 years and above. This implies that most of the farmers in the study area are still in their active age. The farmers in the area are experience. Analysis revealed that 57 and 22% of the respondents were having 5 to 10 years and 11 to 15 years of experience, respectively. On the duration of land use, 66.7% of the respondents has maximum of 5 years of duration, while just about 33.32% has 6 years duration and above. This implies that the farmers in the area will be reluctant to adopt soil enhancing technology that would improve crop yield. Also, 63.8 and 36.2% of the respondents indicated that they have use rights and transfer rights, respectively. Majority of the respondents (62.9%) do not own land while just 37.1% of the respondents owned land. Majority of the respondents are relatively educated. 39.4 and 48.8% of the respondents finished from primary and secondary schools, respectively. The respondents in the area do not have access to extension service. Analysis revealed 93.3% of the respondents indicated that they do not have access to extension services.

Budgetary analysis for maize, yam and cassava

Results of the budgetary analysis revealed that the average gross revenue for maize, yam and cassava were N104, 875, N583, 846.2 and N438, 208.5, respectively (Table 2). The average variable costs incurred in maize, yam and cassava were N43, 814.9, N107, 414.9 and N96, 543.9, respectively. The higher cost incurred in yam may probably due to extra cultural practices like staking and mulching involved in yam production. Gross margin values were N60,672.6, N476,431 and N341,664.1 (N is Nigerian currency equivalent to about $0.0067) for maize, yam and cassava, respectively. The rate of returns for maize, yam and cassava were 1.2, 3.4 and 3.1, respectively (Table 3). This implies a better viability of yam enterprise in the study area.

The multiple linear regression result

The results of the multiple linear regressions shown in Tables 4, 5 and 6 revealed that R-square values for maize, yam and cassava were 79.6, 70.7 and 86.6%, respectively, while the adjusted R-squared were 68.3, 56.3 and 76.2, respectively. This implies that 68.3, 56.3 and 76.2% changes in the outputs of maize, yam and cassava were accounted for by the independent variable. The result (Table 4) showed that household size, right type, ownership type, total farm size used for farming and level of education were statistically significant affect the output of maize at 10, 10, 10, 1 and 5%, respectively. This implies that household size, right type, ownership type, total farm size used for farming and level of education were significant determinants of maize production in the study area. The significance of rights type and ownership type indicated the land tenure arrangements (rights) have significant effects in maize production in the area. The result of Table 5 revealed that farming experience, duration of land use, ownership type and total farm size were significant determinants of output of yam in the area. They were significant at 10, 10, 5 and 10%, respectively. This implies that the greater the duration a plot of land, the greater the tendency that farmers output will increase. Also, those who owned land will have better output as the will be willing to adopt output enhancing technology. The result of Table 6 revealed that duration of land use, total farm size and level of education were significant determinants of output of cassava in the area. They were significant at 5, 1 and 5%, respectively. This implies that the greater the duration a plot of land, the greater the tendency that farmers output will increase because he will be willing to adopt output enhancing technologies.

Also, those with larger farm size will have better output as they will enjoy economics of large scale production. It could be seen that land rights have significant effects on the outputs of crops in the study area.

Conclusion

Farmers in the study area were mostly married, middle aged with majority having formal education. The analysis revealed that farming activities in the study area is male dominant as 75.2% of the respondents were male while

Table 1. Socio-economic, demographic and farm characteristics of respondents.

Variable	Frequency	Percentage
Sex		
Male	79	75.2
Female	26	24.8
Total	105	100
Age		
≤30	7	6.7
31-40	11	10.5
41-50	57	54.3
51-60	13	12.4
>60	17	16.2
Marital status		
Single	11	10.5
Married	78	74.3
Others	16	15.2
Total	105	100
Level of experience		
< 5 17	16.2	
5-10 57	54.3	
11-15 22	21	
16 and above 9	8.6	
Total	105	100
Household size		
1-2	43	41
3-4	41	39.5
5-6	9	8.6
7-9	8	7.6
10 and above	4	3.8
Total	105	100
Duration of land use in years		
<2	23	21.9
3-5	47	44.8
6-8	8	7.62
>8	27	25.7
Total	105	100
Right type		
Use right only	67	63.8
Use and transfer right	38	36.2
Land ownership		
Owned	39	37.1
Otherwise	66	62.9
Total	105	100
Farm size		
<1	67	63.8
1.1-2.0	19	18.1
2.1-3.0	11	10.5
3.1 and above	8	7.6

Table 1. Contd.

Total	105	100
Level of education		
None	11	10.5
Primary	41	39.4
Secondary	46	48.8
Tertiary	7	6.7
Total		105
Extension visit		
None	98	93.3
Regular	1	0.95
Occasional	6	5.7
Total	105	100

Source: Field survey (2011).

Table 2. Budgetary analysis for maize, cassava and cassava enterprises.

Items	Maize	Yam	Cassava
(A) Gross revenue (₦)	204,487.5	583,846.2	438,208.5
(B) Variable cost (₦)			
Land clearing	15041.5	22,041.5	21,220.5
Labor (harrowing, ridging)	15,857.9	49357.1	44,543.8
Weeding	19,551.8	23951.8	21,320.5
Harvesting	5,364.5	11,064.5	6,006.7
Haulage	3,000.1	4,000	3,452.4
Planting material	12,470.4	13,670.9	11,665.8
Total variable cost (₦)	66,284.3	114,085.8	96,543.9
(C) Fixed cost (₦)			
Rent	28,681.7	30,681.3	31,223.5
(D) Total fixed cost (₦)	41,151.7	44,351.7	42,889.3
E) Total cost (B+C) (₦)	84,966.6	151,766	139,433.2
(F) Net farm income (₦)	119,908.4	432,079	298,775.3

Source: Field survey (2011).

Table 3. Profitability and efficiency measures for maize, cassava and cocoa enterprise.

Description	Maize	Yam	Cassava
Profit (₦)	19,908.4	432,079	298,775.3
Gross margin (GM) (₦)	60,672.6	476,431	341,664.6
Rate of return (₦)	1.2	3.4	3.1
Cost ratio	1.1	2.4	2.2

just 24.8% farmers in the area are well experienced. Analysis revealed that 57 and 22% of the respondents were having 5 to 10 and 11 to 15 years of experience, respectively. Majority has short duration of land use. About 66.7% of the respondents has maximum of 5 years of duration, while just about 33.32% has 6 years duration and above. Also, 63.8 and 36.2% of the respondents indicated that they have use rights and transfer rights, respectively. Majority of the respondents (62.9%) do not own land while just 37.1% owned land. Budgetary analysis

Table 4. Result for linear regression for production of maize.

Variable	Coefficients	Standard error	T-ratio
Age	116.261	241.887	0.762
Marital status	-942.137	1684.930	0.481
Farming experience	35.15	148.832	0.236
Household size	-2254.999	1078.482	-2.091*
Duration of land use	-4080.7087	3375.907	-1.209
Right type	16139.234	8491.657	1.901*
Ownership type	3928.653	2025.114	1.940*
Total farm size	1799.067	325.348	5.530***
Level of education	1388.818	443.899	3.129**
Extension visit	-440.207	668.776	-0.658
Constant	9703.072	12737.720	0.762

*** = significant at 1%, ** = significant at 5% and * = significant at 10%, R square 79.6; adjusted R square 68.3. Sources: Survey data (2011).

Table 5. Result for linear regression for production of yam.

Variable	Coefficients	Standard error	T-ratio
Age	-68.841	271.870	-0.253
Marital status	629.863	1659.655	.380
Farming experience	290.228	139.932	2.074*
Household size	-1938.522	1159.615	-1.672
Duration of land use	7006.879	3752.936	1.867*
Right type	-6450.729	8504.342	-0.759
Ownership type	3285.376	2337.540	1.405**
Total farm size	549.199	300.935	1.825*
Level of education	195.062	418.985	0.466
Extension visit	-581.645	600.349	-0.969
Constant	24049.714	13769.053	1.747

*= significant at 10%, R square 70.7; Adjusted R square 56.3. Sources: Survey data (2011).

Table 6. Result for linear regression for production of cassava.

Variable	Coefficients	Standard error	T-ratio
Age	101.163	228.776	0.442
Marital status	-1571.179	1552.849	-1.012
Farming experience	-171.979	145.846	-1.179
Household size	-1254.575	1048.515	-1.197
Duration of land use	8194.197	3005.352	2.727**
Right type	-7248.648	10502.295	-0.690
Ownership type	-352.914	2151.264	-0.164
Total farm size	1634.392	297.457	5.495***
Level of education	1085.750	406.419	2.672**
Extension	-544.257	691.718	-0.787
Constant	31171.665	13209.550	2.360

*** = significant at 1%, ** = significant at 5%, R square 86.6; Adjusted R square 76.2. Sources: Survey data (2011).

revealed highest values of gross margin and net income were recorded for yam compared to other enterprises. The average total revenue for yam, cassava and maize were 583,846.2, 438,208.5 and 104,875, respectively.

The average total cost incurred in yam, cassava and maize enterprises were 151,766, 139,433.2 and 84,966.6, respectively. The rate of returns to investments for yam, cassava and maize were 3.4, 3.1 and 1.2, respectively. The result of the multiple linear regression model and its implications revealed that household size, right type, ownership type, farm size and level of education significantly influence maize output. This implies that farmers with defined rights and owned land would have better output. The analysis further revealed that farming experience, duration of land use and ownership also affects yam output. This implies that farmers that owned land can adopt output enhancing technology than those who rent or engage in share cropping. Regression analysis on the factors influencing maize cassava output revealed that duration of land use, farm size and level of education significantly affect cassava output. This implies that the longer the duration, the larger the size and the more educated a farmer is, the greater the output. Therefore, government at all levels and her agencies should put machineries in place that would formulate policies and programmes that would enhance land distribution and ownership in this part of the country and in other regions where the same practices operate.

REFERENCES

Afeikhena J (2000). Land Rights and Investment Incentives in Western Nigeria A paper Presentated at the Beijer Research Seminar on Property Rights Structures and Environmental Management, South Africa.

Akinola AA, Adeyemo R (2008). Adoption and Productivity of Improved Rice Varieties in Osun State, Nigeria". Ife J. Agric. 23(1):104-116.

Alimi T, Manyong VM (2000). Partial Budget Analysis for on-farm Research.

Amos TT (2007). Resource Use in Tilapia production among Small Scale Tilapia Farmers in the Savanna Zone of Northern Nigeria. J. Fish. Int. 2(1):42-47. (missing the dot)

Bamire AS, Fabiyi YL (2002). Adoption pattern of fertilizer technology among farmers in the ecological zones of South-Western Nigeria: A Tobit analysis. Aust. J. Agric. Res. 53:901-910.

Besley T (1995). Property Rights and Investment Incentives: Theory and Evidence from Ghana. J. Polit. Econ. 103(5):903-937.

Clay K (2008). Property Rights and Agricultural Production. H. John Heinz III School of Public Policy and Management Carnegie Mellon University Pittsburgh.

Davison J (1988). "Agriculture, Women, and Land" The African Experience. Boulder, Colorado (USA): (ed.) West view Press. pp. 74-75.

Deininger K, Binswanger H (1999). "The Evolution of the World Bank's and Land policy: Principles, Experience and future challenges. World Bank Res. Obser. 14:247- 276.

Fajemirokun B (2000). Land and Resource Rights: Issues of Public Participation And Access to Land in Nigeria. Potential decentralization models are discussed in C. Toulmin, "Decentralization and Land Tenure" in C. Toulmin & J. Quan (eds.), Evolving Land Rights, Policy and Tenure in Africa, (London,). pp. 229-245.

Feder G, Ohdaan T, Chalaniwong Y, Hongladaron C (1988). "Land Policy and Farm Productivity in Thailand". Baltimore: Johns Hopkins University press.

Lastarria-Cornhiel S (1997). "Impact of Privatization on Gender and Property Rights in Africa". World Dev. 25(8):1317-1333.

Ogedengbe K, Akinbile CO (2004). Determination of Consumptive Water Use of *Corchorus oliforius (ewedu)* Using Blaney-Morin Simulation Model. J. Sci. Eng. Technol. 11(3):5653-5663.

Tenaw SKM, Zahidul I, Parviainen T (2009). Effects of land tenure and property rights on agricultural productivity in Ethiopia, Namibia and Bangladesh. University of Helsinki Department of Economics and Management Discussion Papers no 33 Helsinki 2009.

academicJournals

Vol. 5(10), pp. 390-402, October, 2013
DOI 10.5897/JDAE12.162
ISSN 2006-9774 ©2013 Academic Journals
http://www.academicjournals.org/JDAE

Journal of Development and Agricultural Economics

Full Length Research Paper

Determinants of productivity in Africa: The role of economic freedom

Cephas Naanwaab* and Osei-Agyeman Yeboah

L.C. Cooper Jr. International Trade Center, North Carolina A&T State University, 1601 East Market Street, Greensboro, NC 27411, USA.

Accepted 27 July, 2013

This paper examines the determinants of multifactor productivity in a cross-country study of 33 African countries. Among others, we specifically focus on the role of economic freedom, and its sub-components, as defined by the Heritage Foundation/Wall Street Journal Economic Freedom Index (EFI). The empirical results show that the economic freedom index (and most of its components) has a positive and statistically significant impact on the productivity of African nations. The components of economic freedom that are critically important to enhancing productivity of African countries are: Business freedom, investment freedom, financial freedom, property rights freedom and freedom from corruption. We also investigate 'bivariate granger-causality' between economic freedom and total productivity. The results show that economic freedom granger-causes total factor productivity in most of these countries, but the other way around is not true.

Key words: Africa, economic freedom, granger-causality, productivity.

*Corresponding author. E-mail: cbnaanwa@ncat.edu. Tel: +1 336 285 4730.

INTRODUCTION

Productivity analysis has received a considerable attention among development and agricultural economists over the course of the last five decades. The focus of much of this body of growing literature is on uncovering the sources of productivity growth, with the ultimate aim of explaining the differences in productivity across countries and regions of the world (Fare et al., 1994; Coelli and Rao, 2003). Fare et al. (1994) presents an in-depth analysis of productivity growth among 17 OECD countries, by constructing Malmquist productivity indexes, which they decompose into technical change and efficiency change. Coelli and Rao (2003) study the determinants of agricultural total factor productivity growth among 93 countries of the world, including 26 African countries (Appendix 1), and some 40 other developing countries from Asia and South-Central America. These studies and others have found evidence in support of convergence of productivity growth of developing countries to the level of developed countries.[1] Productivity growth, which embodies technological advancement, is the source of economic growth, and can offer a path to sustained poverty reduction, job creation and higher wages (Isaksson, 2007). The importance of productivity growth, especially in the case of African countries, is best underscored by Blinder and Baumol. "...over long periods of time, small differences in rates of productivity growth compound, like interest in a bank account, and can make an enormous difference to a society's prosperity. Nothing contributes more to the reduction of poverty, to increases in leisure, and to the country's ability to finance education and public health " (Blinder and Baumol 1993:778).

[1]Examples of studies that found evidence for convergence are Baumol (1986), Barro and Sala-i-Martin (1992, 1995), Bernard and Durlauf (1995), Tsangarides (2001) and Lee and McAleer (2004).

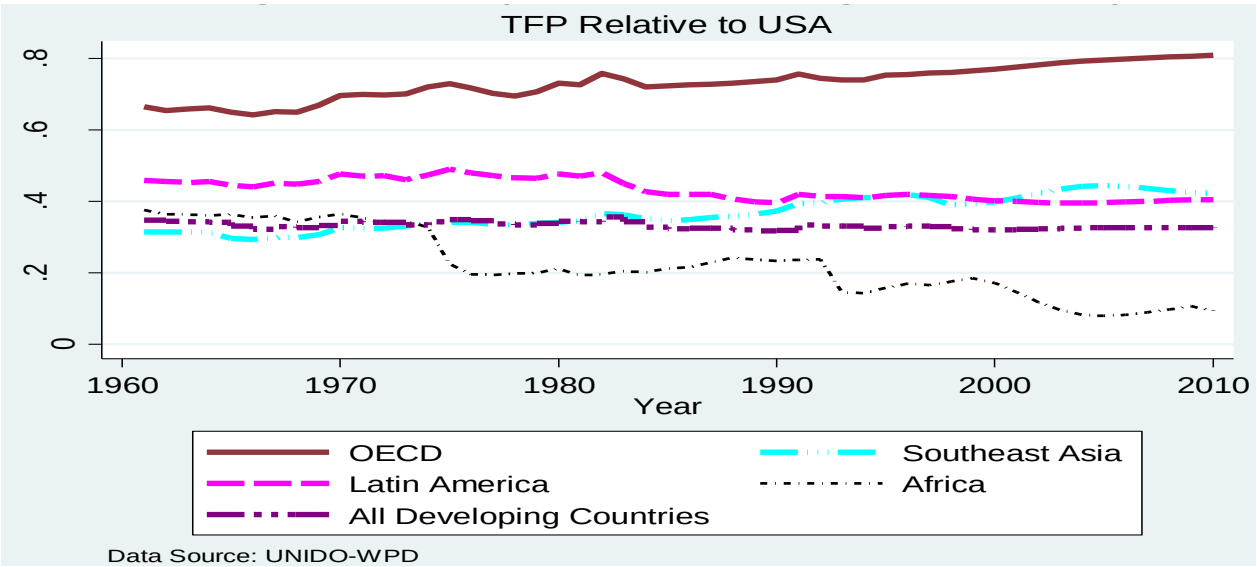


Figure 1. Comparison of average productivity.

Figure 1 shows that average productivity among African countries has typically been low in comparison with other developing countries in Southeast Asia and Latin America. What is more intriguing is that, rather than increasing, productivity actually seems to be falling among African countries while productivity of their counterparts in Southeast Asia is increasing (Figure 1). The fortunes of too many poor people, particularly in Africa, and the developing world at large, could very well depend on the ability of their countries to put in place policies and institutional structures that promote productivity growth. Mbaku (2003) states that the real problem (with Africa) is not lack of resources, ignorance, or incompetence, but rather weak institutions and perverse incentives. What Africa needs is economic freedom and limited government if it is to realize its full potential. An understanding of how economic freedom impacts productivity is therefore paramount, in view of the fact that productivity growth spurs economic growth. This paper contributes to the literature by exploring the factors that lead to increases in productivity, by focusing exclusively on economic freedom.

The Heritage Foundation's 2012 index of economic freedom has classified nearly 40 African countries as either repressed or mostly un-free (HFI, 2012). The Fraser Institute's Economic Freedom of the World (EFW) 2011 report also classified more than half of African countries as least free or falling below the third quartile on the EFW index (Gwartney et al., 2011). The authors of the EFW found that the economies of countries with more economic freedom tend to grow more rapidly. Moreover, income per capita, educational quality, quality of health care, literacy rates, and life expectancy tend to increase with more economic freedom (Gwartney et al., 2011). On the other hand, countries with less economic freedom tend to have extreme poverty rates. The objectives of the present paper are twofold; firstly, we investigate the presence of statistical relationship between economic freedom and productivity. To this end, we test for granger-causality between economic freedom and productivity. Secondly, the study seeks to determine which sub-components of economic freedom affect productivity.

LITERATURE REVIEW

Productivity can be defined in various ways, depending on whether one is looking at firm-level, industry level or economy-wide productivity. Broadly defined, productivity refers to the ratio of output of goods (and services) to an index of total inputs used in producing that output (Griliches, 1979). At the firm- or industry-level, productivity may be used, simplistically, to refer to labor productivity (output per worker or output per hour). When it comes to national or aggregate productivity however, a more comprehensive measure, such as total factor productivity is often desirable, and this should include not only labor and capital inputs, but also land, natural resources and all other inputs (Diewert and Lawrence, 1999). At the macro-level, therefore, multi-factor productivity (or more appropriately, total factor productivity) may be defined as the ratio of aggregate output produced to aggregate input used.

OECD (2001) defined productivity as the ratio of a volume measure of output to a volume measure of input use, and distinguishes between two broad types of productivity: single-factor productivity, which refers to single input - single output relationship, and multi-factor productivity (total factor productivity), which relates

multiple outputs to multiple inputs.

Wolf (2007) presents an empirical investigation of factors determining productivity growth in Africa. Labor productivity is found to be affected by, among others, economic incentives index, educational attainment, innovation, and access to foreign technology through FDI. Democracy and infrastructure did not appear to significantly affect productivity. GDP per capita was omitted from the analysis due to high correlation with other included explanatory variables. Isaksson and Ng (2006) discussed factors that inhibit TFP growth in selected African countries. Specifically, they identified low investments in human capital, infrastructure, R&D, and weak institutions as the major constraints to TFP growth. Pires and Garcia (2011) studied TFP of 75 countries using stochastic frontier analysis to decompose productivity change. They found that differences in productivity are largely responsible for differences in economic growth between developed and developing countries.

Economic freedom and productivity

A number of empirical studies have been undertaken on the relationship between economic freedom and growth. Most of these studies (Ayal and Karras, 1998; Gwartney et al., 1999; Heckelman, 2000; De Haan and Sturm, 2000; Dawson, 1998, 2003) have reached conclusions that economic freedom- as measured by limited government interference, enforcement of private property rights, personal choice and freedom of enterprise- promotes economic growth. In countries where economic freedom is entrenched, the market, as opposed to the state, is the main mechanism by which resources are allocated, and the government only plays the role of enacting and enforcing legal structures, as well as providing an enabling environment and institutions that facilitate free exchange (Mbaku, 2003). The central tenets of an economically free society are personal choice, freedom of exchange and protection of private property (Gwartney and Lawson, 1997). Caudill et al. (2000) performed factor and principal component analyses on popular measures of economic freedom. Their study revealed that economic freedom is not a one-dimensional concept and thus advocated for the use of several measures in ranking countries rather than using an overall index which mis-represents the economic freedom rankings of many developing countries. In their comparative study of three different economic freedom indices, provided by the Fraser Institute, Heritage Foundation/Wall Street Journal, and Heritage and Freedom House, they concluded that all three performed fairly well against a statistical best single index. The idea that economic freedom is multi-dimensional is supported by the findings of Ayal and Karras (1998), in which they determined that six out of thirteen components of economic freedom measures were statistically significant in determining multifactor productivity and growth.

All other things remaining the same, countries with high economic freedom have higher productivity and higher income per capita. The EFW index (Gwartney and Lawson, 2002) is highly correlated with income per capita and economic growth. Looking at Figure 2, it is clear that countries that have put in place strong economic institutions, such as Botswana and South Africa, are also the ones that are performing well economically. This is clear indication that in the case of African countries, a positive relationship exists between economic freedom and productivity. Figure 3, which shows per capita GDP growth rates against economic freedom index, indicates that the top quintile of economically free countries tend to have higher growth rate (2.56% on average), while countries at the bottom fifth of the economic freedom index experienced negative growth rate averaging about -0.85% (Gwartney and Lawson, 2002). Berggren (2003) provides a good review of empirical literature on the relationship between economic freedom and growth. Many of these studies express economic growth, defined by growth of GDP per capita, as a function of economic freedom or its components. Since GDP per capita may also be interpreted as a proxy for productivity, these studies are implicitly concerned with uncovering the impact of economic freedom on productivity. For example, Hanke and Walters (1997) found a positive and significant relationship between GDP per capita and the economic freedom index. Goldsmith (1997) show, in a cross-country analysis, that developing countries that provide their citizens greater protection of economic rights tend to grow faster, have higher per capita incomes, and generally higher living standards.

It is equally important to be able to explain the mechanisms through which economic freedom affects growth and productivity of countries. In pursuit of this goal, Dawson (1998) found empirical evidence from a cross-country study that economic freedom, or cross-country differences in institutional arrangements, affects growth in two ways; through its direct effect on total factor productivity, and indirectly, through its effect on investment. Ayal and Karras (1998) hypothesized that economic freedom promotes multifactor productivity by enhancing the efficiency with which productive resources are converted into outputs.

MATERIALS AND METHODS

Data

We use a balanced panel dataset consisting of 33 African countries covering years 1995 to 2010. The dataset is limited to 33 African countries because these have complete data on the most important variables under consideration. The economic freedom index comes from the Heritage Foundation (HFI) Economic Freedom database. The HFI 'Index of Economic Freedom' is developed by the Heritage Foundation, in collaboration with the Wall Street Journal, and

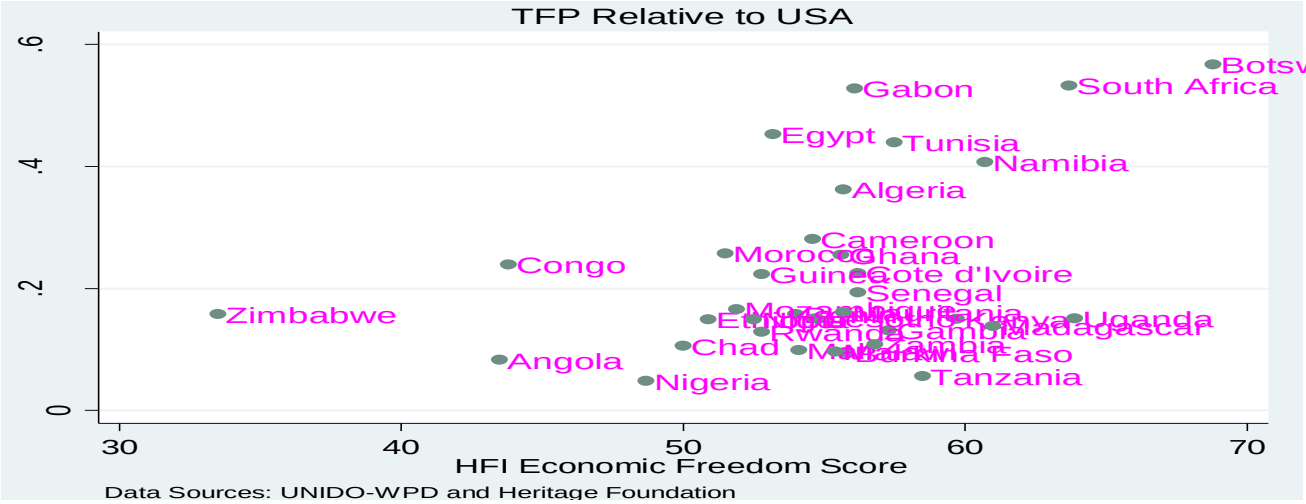


Figure 2. Economic freedom and productivity in Africa.

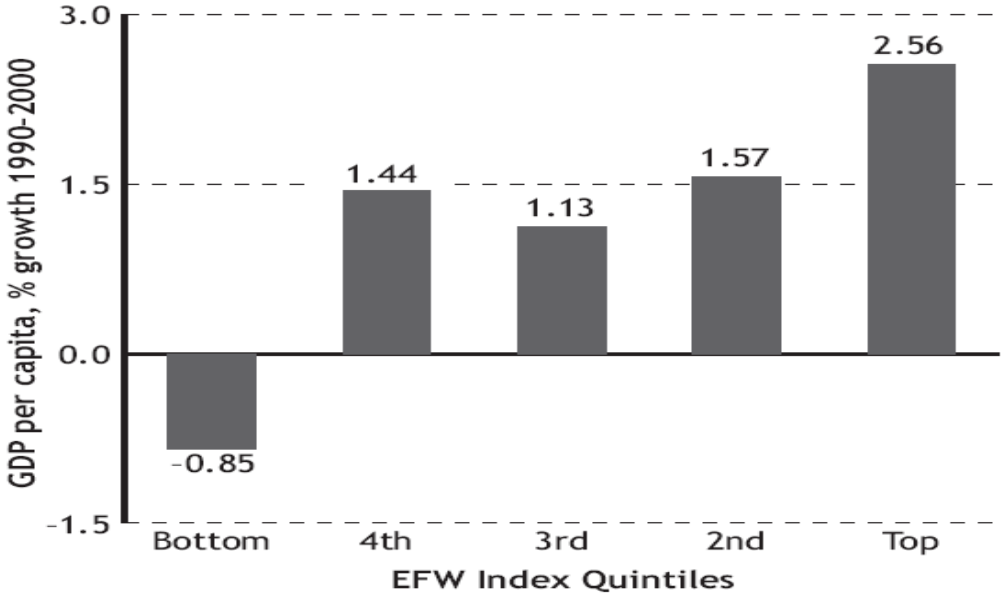


Figure 3. Economic freedom and economic growth. Source: Gwartney et al. (2000).

published annually for all countries in the world. The index is computed as a weighted average of 10 components of economic freedom.[2] A comparable measure of economic freedom is the Fraser Institute's Economic Freedom of the World (EFW).[3] The HFI is more consistent in its measurement of the components over the years while the EFW changes both the measures and types of freedoms covered over time. Moreover, the HFI is more broad-based in coverage: the index is based on 10 sub-components while the EFW consists of five sub-components. Thus, it was preferable for us to use the HFI index.

The economic freedom index (EFI) variable consists of scores on this index for the African countries included in the study. Each component of the HFI index receives a score on a scale of 0 to 100 (Appendix 2). Each country's score on the ten sub-components are equally weighted to derive an overall score of economic freedom. These 10 sub-components, given equal weight in the computation of the freedom index, are grouped under four pillars (Table 1). Pillar 1 is rule of law and its components are property rights and freedom from corruption. The property rights component measures how each country's laws protect private property, and the extent to which its government enforces such laws. The freedom from corruption component is constructed from the Transparency International's Corruption Perceptions Index (CPI). Pillar 2, limited government, is a composite measure of the size of government. This is comprised of two sub-components, fiscal freedom and government spending. Pillar 3, regulatory efficiency, comprises

[2] See Beach and Kane (2008) for detailed description of the methodology used to derive the Index of Economic Freedom. The database is available at http://www.heritage.org/index

[3] Gwartney et al. (2011), for details on construction of the index and database http://www.freetheworld.com

Table 1. Components of the Heritage Foundation Economic Freedom Index.

Pillar	Sub-components
1. Rule of law	1. Property rights freedom 2. Freedom from corruption
2. Limited government	3. Fiscal freedom 4. Government spending
3. Regulatory efficiency	5. Business freedom 6. Labor freedom 7. Monetary freedom
4. Open markets	8. Trade freedom 9. Investment freedom 10. Financial freedom

business freedom, labor freedom and monetary freedom. Business freedom is computed from ten other factors, some of which are procedures, days, and costs of starting a business, obtaining a license, and closing a business.

Pillar 4, open markets, consists of trade freedom, investment freedom and financial freedom. Productivity data are obtained from the UNIDO World Productivity Database (Isaksson, 2007). The UNIDO-WPD calculates aggregate total factor productivity (TFP) for 112 countries from 1960 to 2000, and forecasts TFP for 2001 to 2010. By employing different methods and functional forms, the WPD offers a comprehensive measure of productivity that also includes the effects of schooling and health. For a technical description of the methodology used in the TFP computation observed by Isaksson (2007); we also obtained data on technical change and technical efficiency change from the WPD. Productivity data are available through 2010, but data on technical change and technical efficiency change are available up until 2000 from the WPD. In order to extend the dataset to 2010 for the other variables, we forecast these series for 2001 to 2010 using the WPD data from 1960 to 2000. The forecast method employed is Holt's exponential smoothing.

Other data are culled from the World Development Indicators of the World Bank. These include foreign direct investment (inflows), net official development assistance, trade openness, birth rate (per 1000 people), mobile cellular subscriptions (per 100 people) and labor force.

Analytical model

A fixed effects panel model is specified to describe the relationship between productivity and economic freedom, controlling for other possible determinants of productivity. In econometric modeling, we often hope that the set of independent variables included in the model explain all of the variability in the dependent variable. This is, however, not always the case, as there are instances of unobserved heterogeneity, that is, factors specific to the individual units that cannot be controlled for, but which nonetheless affect the outcome variable. These tend to be absorbed in the error term, causing potential correlation between the error terms and the included independent variables, a violation of the fundamental Gauss-Markov assumptions underlying least squares estimation (Wooldrigde, 2006). The result of estimating such econometric equations by traditional OLS methods is biased coefficients.[4] Fixed effects panel models take into account this unobserved heterogeneity between individuals, firms, cities, states, or countries by giving every unit in the study a unique intercept, referred to as the individual or fixed effect (Wooldrigde, 2006). This fixed effect, α_i, is best thought of like including dummy variables for N-1 observational units.

Equation (1) shows the specification of one-way fixed effects (spatial variation) model while Equation 2 shows the two-way fixed effects (spatial and temporal variation) model:

$$y_{it} = \sum_{j=1}^{k} x_{it,j}\beta_j + \alpha_i + \varepsilon_{it} \quad (1)$$

$$y_{it} = \sum_{j=1}^{k} x_{it,j}\beta_j + \alpha_i + \gamma_t + \varepsilon_{it} \quad (2)$$

Where α_i and γ_t account for cross-sectional (individual-specific) and temporal (time-specific) variations, respectively. Employing these fixed effects models, we account for certain country-and time-specific factors that are important in explaining the differences in productivity across countries. The empirical model is specified as:

$$lnTFP_{it} = \alpha_i + \gamma_t + \theta lnTFP_{it-1} + \sum_{l=0}^{n}\beta_l lnEFI_{it-l} + \sum_{l=0}^{n}\delta_l lnTC_{it-l} + \sum_{l=0}^{n}\varphi_l lnTEC_{it-l} + \tau_1 lnBR_{it} + \tau_2 lnTR_{it} + \tau_3 lnODA_{it} + \tau_4 lnFDI_{it} + \tau_5 lnMOB_{it} + \varepsilon_{it}$$

Where *ln* denotes the natural log operator, *TFP* is total factor productivity (an aggregate measure of economy-wide productivity), *EFI* is the economic freedom index, *TC* is technical change (captures technological improvement), *TEC* is technical efficiency change (measures improvement in productive efficiency), *BR* is birth rate (per 1,000 people), *TR* is the volume of trade as a percent of gross domestic product, *ODA* is net official development assistance received per worker, *FDI* is net inflows of foreign direct investments per worker, and *MOB* is mobile cellular subscriptions per 100 people.

The included right hand side variables are presumed to be productivity-enhancing or productivity-limiting. For example FDI and ODA could be considered as proxies for investments per-worker. In countries where the rate of investment is higher, worker productivity tends to increase, which in this case can be interpreted as productivity-enhancing investments. MOB (mobile phone subscriptions per 100 people) is a proxy for ease of communication and transacting business, which is hypothesized to increase worker productivity. The birth rate variable (BR) is included to proxy for fertility rate, and accounts for the importance of female labor productivity. Higher fertility rates are consistent with lower female labor force participation rates, and thus, it is postulated that this variable negatively correlates with total factor productivity in a given country. It is also worthwhile to investigate which sub-components of the Economic Freedom Index are more important determinants of productivity. Thus, in Equation 4, we replace the EFI variable with 9 sub-components of the EFI index for which we have complete data (labor freedom not included because it has a lot of missing data). But before doing that, it is important to ensure that there is no high collinearity among these sub-components. The correlation matrix of these economic freedom components is shown in Table 2. We realize that the highest correlation among them is 0.507 between freedom of property rights and freedom of investment. That means that countries that score highly on freedom of property rights also tend to have high freedom of investment. The other correlations are insignificant, which signals that multi-collinearity may not pose a

[4] Tsangarides (2002) addresses the twin problems of omitted variable bias and endogeneity bias in the context of cross-sectional and panel data. A GMM estimator that corrects for both biases is discussed.

Table 2. Correlation matrix of components of economic freedom.

	Business	Trade	Fiscal	Government	Monetary	Investment	Financial	Property rights	Corruption
Business	1								
Trade	-0.136	1							
Fiscal	0.005	0.331	1						
Government	-0.116	-0.044	-0.064	1					
Money	0.144	-0.023	-0.065	0.155	1				
Invest	0.318	0.064	0.172	0.014	0.281	1			
Finance	0.164	0.182	0.166	-0.009	0.18	0.466	1		
Property	0.489	0.029	0.138	-0.175	0.092	**0.507**	0.461	1	
Corruption	0.377	-0.016	0.148	-0.265	-0.005	0.299	0.317	0.374	1

problem, thus, allowing us to re-estimate Equation (3) as

$$lnTFP_{it} = \alpha_i + \gamma_t + \theta lnTFP_{it-1} + \sum_{j=1}^{9} \alpha_j lnEFI_{it-1,j} + \sum_{l=0}^{n} \delta_l lnTC_{it-l} + \sum_{l=0}^{n} \varphi_l lnTEC_{it-l} + \tau_1 lnBR_{it} + \tau_2 lnTR_{it} + \tau_3 lnODA_{it} + \tau_4 lnFDI_{it} + \tau_5 lnMOB_{it} + \varepsilon_{it} \quad (4)$$

Where *EFI* (j = 1, 2,..., 9) are the sub-components of the Heritage Foundation Index of economic freedom (Table 1).

Bivariate Granger-causality test

We test the working hypothesis that economic freedom "Granger-causes" productivity in Africa. Bivariate Granger Causality (Granger, 1969; Sims, 1972) is used to test whether past values of the economic freedom index contain information that could possibly predict values of productivity in subsequent years, accounting for the history of the latter. We posit that granger causality runs uni-directionally from economic freedom to total factor productivity. While this serves as a working hypothesis, we acknowledge that feedback or reverse causation is possible, and thus consideration is also given to the instance where granger-causality is bi-directional. Granger-causality may not necessarily indicate the presence of a causal effect; as such care should be exercised in its interpretation, lest one commits a post-hoc-ergo propter hoc error. A vector autoregressive (VAR) model, Equation 5 provides a natural way of testing granger causality when there are many variables:

$$Y_t = A(L, q)Y_{t-1} + U_t \quad (5)$$

Where Y_t is a vector of endogenous variables, A is a matrix of coefficients on the lagged (exogenous) variables, (L, q) refers to q polynomials in the lag operator L, and U_t is the vector of error terms.

For a two-variable case, Granger's test may be expressed by the following two equations:

$$y_t = c_1 + \sum_{i=1}^{p} \alpha_i y_{t-i} + \sum_{i=1}^{q} \beta_i x_{t-i} + u_t \quad (6)$$

$$x_t = d_1 + \sum_{i=1}^{m} \gamma_i x_{t-i} + \sum_{i=1}^{n} \tau_i y_{t-i} + u_t \quad (7)$$

After estimating these equations, we conduct a chi-squared test on the following null hypotheses. This chi-squared test has been proven to be asymptotically more efficient than the standard F-test in the presence of lagged dependent variables (Hamilton, 1994):

$$H_{01}: \sum_{i=1}^{q} \beta_i = 0 \quad (8)$$

$$H_{02}: \sum_{i=1}^{n} \tau_i = 0 \quad (9)$$

Rejection of either one of these null hypotheses signifies unidirectional Granger-causality, and rejection of both means there is bi-directional (feed-back) Granger-causality. Assuming that x refers to economic freedom and y refers to productivity, it follows then, that if $\sum_{i=1}^{q} \beta_i \neq 0$ and $\sum_{i=1}^{q} \tau_i = 0$, then there is a unidirectional Granger-causality from economic freedom to productivity. On the other hand, if $\sum_{i=1}^{n} \tau_i \neq 0$ and $\sum_{i=1}^{q} \beta_i = 0$, there is an unidirectional Granger-causality from productivity to economic freedom. Finally, if $\sum_{i=1}^{q} \beta_i \neq 0$ and $\sum_{i=1}^{n} \tau_i \neq 0$, then Granger-causality is bi-directional, so that economic freedom can predict productivity just as productivity can predict economic freedom. Dawson (2003) studied the causality between economic freedom and economic growth by developing Granger-causality tests of freedom versus growth and the disaggregated components of freedom versus growth. Heckelman (2000) also used Granger-causality to test the relationship between economic freedom and growth. It must be pointed out that Heckelman's study also uses the Heritage Freedom Index as its measure of economic freedom. Farr et al. (1998) used the Economic Freedom of the World (EFW) by the Fraser Institute to study causal relationship between freedom and living standards.

EMPIRICAL FINDINGS

Table 3 presents the results of estimating Equation 3, while the results for model with disaggregated components of economic freedom are shown in Table 4. In Table 3, we compare one-way fixed effects model esults with that of two-way fixed effects[5]. Both the one-way and two-way fixed effects estimates show that economic freedom does have a positive and statistically significant effect on productivity in Africa. All three lagged

[5] We have compared fixed effects and random effects in the estimated models. Hausman tests showed that the fixed effects model is preferred. Thus, we chose to report results of the fixed effects model.

Table 3. Panel regression results, dependent variable is LnTFP.

Variable	One-way fixed effects		Two-way fixed effects	
	Estimate	Standard error	Estimate	Standard error
lnTFP_lag1	0.319***	0.030	0.321***	0.031
lnEFI	0.256**	0.126	0.257*	0.131
lnEFI_ lag1	0.085	0.151	0.073	0.155
lnEFI_ lag2	-0.081	0.138	-0.063	0.144
lnEFI_ lag3	-0.031	0.113	-0.042	0.117
lnTC	0.596*	0.305	0.611	0.378
lnTC_ lag1	0.169	0.317	0.147	0.398
lnTC_ lag2	-0.057	0.274	-0.272	0.340
lnTC_ lag3	0.688***	0.210	0.812***	0.264
lnTEC	0.345*	0.195	0.393*	0.201
lnTEC_ lag1	0.171	0.192	0.191	0.197
lnTEC_ lag2	0.225	0.157	0.243	0.161
lnTEC_ lag3	0.453***	0.138	0.434***	0.143
lnFDI	-0.003	0.006	8.3e4	0.007
lnODA	-0.013	0.011	-0.017	0.013
lnTR	-0.066	0.041	-0.060	0.043
lnBR	0.159	0.204	0.140	0.240
lnMOB	-0.0003	0.004	-0.005	0.011
Constant	-2.443**	0.936	-2.305***	1.088
No. Cross Sec	29		29	
Time length	15		15	
R-squared	0.77		0.79	
F[a]	17.73	p<0.0001	16.25	p<0.0001

[a] F-statistic for testing H_0: No fixed effects, Note: *** p<0.01, ** p<0.05, * p<0.1. Maximum lag of 3 was chosen based on AIC/BIC criteria.

economic freedom index variables are not statistically significant but the contemporaneous effect is very strongly significant. This may suggest that there is a contemporaneous or short run effect but no long run effect in the relationship between economic freedom and productivity. The short run effect on total factor productivity as a result of 1% increase in the economic freedom index is 0.25%. Dawson (1998) in a cross-country study, covering some 85 countries, also found empirical evidence that economic freedom positively affects total factor productivity. In line with the postulates of the endogenous growth theory, we find evidence that technological improvement, through its direct effect on increasing productivity, may lead to growth. Both technical change and technical efficiency change in our models are strong determinants of total factor productivity in Africa. Contrary to expectations, we do not find empirical evidence that net official development, foreign direct investment, and mobile cellular usage increase productivity. The advent of the cellular phone in Africa reduced communication problems greatly, and as such it was expected that businesses and other transactions can be carried out much more quickly and efficiently, than decades ago when low telephone connectivity meant people necessarily had to travel longer distances to undertake simple transactions (Lee and Gardner, 2011; Jesen, 2007; Qiang et al., 2009).

Quite to the contrary, our models show that mobile telephone usage reduces productivity. It might be the case that while cellular phone usage is certainly good for the individual as a communication tool; it does not translate into increased productivity at the work place. The Official Development Assistance (ODA) received per capita does not increase productivity as would be expected. The birth rate, foreign direct investment, and the volume of trade do not significantly affect the level of productivity. In Table 4, we show results of estimating Equation 4, where the focus is on looking at the effect of individual sub-components of the freedom index on productivity. Invoking the assumption that these sub-components are orthogonal to each other (Table 2), Equation 4 was estimated, and the results indicate that three of these freedoms (business, monetary and investment freedoms) are positively associated with productivity. Again, the lagged effects of these sub-components are insignificant, except for monetary freedom, where both the first and second lags are negative.

Table 4. Effects of sub-components: Dependent variable: lnTFP.

Variable	Fixed effects				
	Estimate	Standard error	Variable	Estimate	Standard error
lnTFP_lag	0.299***	0.031	lnpropertyf	-0.041	0.031
lnbusinessf	0.184***	0.053	lnpropf_lag1	0.047	0.035
lnbusinessf_lag1	-0.094	0.061	lnpropf_lag2	0.011	0.029
lnbusinessf_lag2	-0.034	0.054	lncorrupf	0.013	0.022
lntradef	-0.025	0.025	lncorrupf_lag1	-0.015	0.023
lntradef_lag1	0.009	0.023	lncorrupf_lag2	0.013	0.019
lntradef_lag2	0.0003	0.020	lnTC	-0.117	0.272
lnfiscalf	0.083	0.088	lnTC_lag1	0.054	0.284
lnfiscalf_lag1	0.032	0.092	lnTC_lag2	0.525	0.206
lnfiscalf_lag2	-0.081	0.071	lnTEC	-0.138	0.178
lngovsf	0.047	0.038	lnTEC_lag1	0.007	0.174
lngovsf_lag1	0.037	0.037	lnTEC_lag2	0.441***	0.137
lngovsf_lag2	-0.035	0.034	lnFDI	-0.006	0.005
lnmoneyf	0.218***	0.042	lnODA	0.016	0.011
lnmoneyf_lag1	-.096**	0.046	lnTR	-0.074**	0.039
lnmoneyf_lag2	-.069*	0.041	lnBR	0.027	0.197
lninvestmentf	0.104***	0.034	lnMOB	-0.0002	0.005
lninvestmentf_lag1	-0.041	0.037	Constant	-2.022**	0.977
lninvestmentf_lag2	-0.037	0.031			
lnfinancialf	-0.001	0.028			
lnfinancialf_lag1	0.007	0.032			
lnfinancialf_lag2	-0.033	0.027			
No. groups	29				
R-squared	0.84				
F[a]	18.99	p<0.0001			

[a] F-statistic for testing. H_0: No fixed effects. Note: *** p<0.01, ** p<0.05, * p<0.1. Maximum lag of 2 was chosen based on AIC/BIC criteria.

Economic freedom granger-causes productivity

We conducted bivariate granger causality tests between economic freedom and total factor productivity for all countries in the sample. Equations 6 and 7 were estimated for each of the countries, using two lags. The maximum lag length of 2 was chosen following the general to specific rule, that is, we start with an arbitrarily large number of lags (say p) and drop insignificant lags until all remaining lags are significant. Granger-causality results are presented in Table 5. Column two presents results of testing the null hypotheses in Equations 8 and 9. These two null hypotheses are tested for each country: Economic freedom does not granger-cause productivity (EFI $\nrightarrow$ TFP) and productivity does not granger-cause economic freedom (TFP $\nrightarrow$ EFI). Thus, in column two "$\rightarrow$"indicates rejection of the null hypothesis and $\nrightarrow$ Indicates no rejection. Columns three and four present the chi-squared statistics and p-values for the rejection rules of the null hypotheses. The tests show that granger causality is mostly uni-directional for most of the countries, running from economic freedom to productivity. In 17 of 34 African countries we find evidence that economic freedom granger-causes productivity (Appendix 1). Only in four cases do we have feed-back or bi-directional causation (Mali, Mauritania, Guinea and Niger).

CONCLUSION AND POLICY IMPLICATIONS

In this paper, we have presented empirical evidence that economic freedom does matter for productivity in the context of African countries. We go further to show that this relationship is not just mere correlation. Granger causality tests reveal that economic freedom precedes productivity in most of these African countries. There is little evidence of reverse granger causality from productivity to economic freedom. Goldsmith (1997) using a large cross-country dataset found that developing countries that scored higher in protecting economic rights of their citizens also tended to grow faster, and scored higher on human development. Gwartney et al. (2011) corroborates this, noting that economic freedom leads to

Table 5. Granger causality tests.

Country	EFI ⇏ TFP TFP ⇏ EFI	χ^2	p-value
Algeria	→	9.9	0.007
	↛	0.01	0.936
Angola	↛	2.52	0.284
	↛	0.1	0.749
Benin	→	41.84	0.000
	↛	0.42	0.519
Botswana	→	28.7	0.000
	↛	0.56	0.456
Burkina Faso	→	23.24	0.000
	↛	0.27	0.606
Cameroon	→	31.06	0.000
	↛	2.54	0.111
Chad	↛	1.45	0.000
	↛	2.83	0.092
Congo	→	12.84	0.000
	↛	2.29	0.131
Cote d'Ivoire	↛	1.57	0.210
	→	27.83	0.000
Egypt	↛	0.83	0.368
	↛	1.71	0.191
Ethiopia	↛	5.88	0.053
	↛	3.67	0.055
Gabon	↛	3.57	0.167
	↛	0.58	0.456
Gambia	→	11.49	0.003
	↛	0.71	0.398
Ghana	↛	5.21	0.074
	↛	0.41	0.520
Guinea*	→	8.23	0.016
	→	10.7	0.001
Kenya	→	12.84	0.000
	↛	0.14	0.706
Lesotho	→	11	0.004
	↛	0.71	0.399
Madagasca	↛	1.92	0.383
	→	4.49	0.034

Table 5. Contd.

Malawi	↛	3.64	0.162
	→	4.37	0.037
Mali*	↛	31.77	0.000
	↛	24.28	0.000
Mauritani*	↛	8.25	0.016
	→	9.24	0.002
Morocco	→	0.55	0.761
	↛	3.06	0.080
Mozambique	↛	9.97	0.007
	→	1.04	0.307
Namibia	↛	5.3	0.071
	→	3.93	0.047
Niger*	↛	9.18	0.002
	→	6.88	0.008
Nigeria	↛	3.83	0.147
	→	0.26	0.609
Rwanda	→	22.01	0.000
	↛	0.26	0.608
Senegal	↛	5.87	0.053
	→	1.44	0.231
South Africa	↛	1.78	0.415
	→	0.18	0.67
Tanzania	↛	1.48	0.477
	↛	0.63	0.426
Tunisia	↛	27.88	0.000
	↛	0.04	0.841
Uganda	↛	12.98	0.000
	↛	0.08	0.782
Zambia	↛	4.4	0.111
	↛	0.21	0.644
Zimbabwe	↛	4.23	0.121
	↛	4.11	0.128

EFI ↛TFP: reads as EFI does not granger-cause TFP. TFP↛ EFI: reads as TFP does not granger-cause EFI; → Means "granger cause" ↛means "no granger. Causation", * indicates bi-directional causation.

more investment, higher per capita incomes and growth rates. We also specifically delineate four sub-components of economic freedom which have the most impactful effect on productivity. These most influential sub-

components are: business freedom, investment freedom, fiscal freedom and monetary freedom. The first three constitute regulatory freedoms, or to put it bluntly, the extent of government involvement in private transactions. Business freedom is a measure of the ease of starting, operating and closing a business.

Investment freedom means that private entities can freely engage in, and move resources into activities, across different sectors and borders of the country. A number of policy recommendations can be drawn from this study. First of all, African governments can and should promote economic freedom. Most of the recent top performers on the continent- the likes of Botswana, Mauritius, South Africa, Ghana and Rwanda- have shown that this can be done. African governments must promote free markets and strong institutions that will unleash the entrepreneurial abilities of their people. Second, and most importantly, African governments must make the right investments-in human capital development (education, nutrition and health care), infrastructure development (roads, electricity, ports, water and sanitation) and R&D. The growth of productivity and living standards will depend to a great extent on how well African countries educate and train their workforce.

REFERENCES

Ayal EB, Karras G (1998). Components of Economic Freedom and Growth: An Empirical Study, J. Develop. Areas 32(3):327-338.

Beach W, Kane T (2008). Methodology: Measuring the 10 Economic Freedoms" Index of Economic Freedom. Retrieved, http://www.heritage.org/index/.

Bernard AB, Durlauf SN (1995). Convergence in International Output, J. Appl. Econom, 10(2):97-108.

Berggren N (2003). The Benefits of Economic Freedom: A Survey, The Independ. Rev. 7(2):193-211.

Baumol WJ (1986). Productivity Growth, Convergence, and Welfare: What the Long-run Data Show, Am. Econ. Rev, 76 (5):1072-1085.

Barro RJ, Sala-i-Martin X (1992). Convergence, J. Political Econ. 100(2):223-251.

Barro RJ, Sala-i-Martin X (1995). Convergence Across States and Regions, Brookings Papers on Economic Activity 1:107-182.

Blinder A, Baumol W (1993). Economics: Principles and Policy,Harcourt Brace Jovanovich, San Diego, P. 778.

Caudill SB, Zanella FC, Mixon FG (2000). Is Economic Freedom One Dimensional? A Factor Analysis of Some Common Measures of Economic Freedom, J. Econ. Develop. 25(1):17-40.

Coelli TJ, Rao DSP (2003). Total Factor Productivity Growth in Agriculture: A Malmquist Index Analysis of 93 Countries, 1980-2000. CEPA Working Paper Series No.02/2003.

Coelli TJ, Rao DSP, O' Donnell CJ, Battese GE (2005). An Introduction to Efficiency and Productivity Analysis, 2nd Ed. pp 41-84. Springer.

Dawson JW (1998). Institutions, Investment, and Growth: New Cross-Country and Panel Data Evidence, Economic Inquiry, 36:603-619.

De Haan J, Sturm JE (2000). On the Relationship between Economic Freedom and Economic Growth, European J. Political Econ. 16:215-241.

Fare R, Grosskopf S, Norris M, Zhang Z (1994). Productivity Growth, Technical Progress, and Efficiency Change in Industrialized Countries,The Am. Econ. Rev. 84(1):66-83.

Farr WK, Lord RA, Wolfenbarger JL (1998). Economic Freedom, Political Freedom, and Econ. Well-being, Cato J. 18:247-262.

Goldsmith AA (1997). Economic Rights and Government in Developing Countries: Cross-national Evidence on Growth and Development, *Studies in* Comparative Internat. Develop, 32(2):29-44.

Granger CWJ (1969). Investigating Causal Relations by Econometric Methods and Cross-Spectral Methods, *Econometrica,* 34:424-438.

Griliches Z (1979). Issues in Assessing the Contribution of Research and Development to Productivity Growth, J. *Econ.* 10(1):92-116.

Gwartney JD, Lawson RA (1997). Economic Freedom of the World: 1997 Annual Report. The Fraser Institute, Vancouver, B.C.

Gwartney JD, Lawson RA, Holcombe RG (1999). Economic Freedom and the Environment for Economic Growth, J. Institut. Theoret. Econ. 155:643-663.

Gwartney JD, Lawson RA, Samida D (2000). Economic Freedom of the world: 2000 annual Report. The Fraser Institute, Vancouver, B.C. http://www.freetheworld.com

Gwartney JD, Lawson RA (2002). Economic Freedom of the World: 2002 Annual Report. The Fraser Institute, Vancouver, B.C. http://www.freetheworld.com.

Gwartney JD, Lawson RA, Hall J (2011). Economic Freedom of the World, 2011 Annual Report, The Fraser Institute, Vancouver, B.C. Retrieved Jan. 31, 2012: http://www.freetheworld.com/datasets_efw.html.

Hamilton JD (1994). Times Series Analysis. Princeton Univ. Press, Princeton, NJ.

Hanke SH, Walters JK (1997). Economic Freedom, Prosperity, and Equality: A Survey, Cato J. 17(2):117-46.

Heckelman JC (2000). Economic Freedom and Economic Growth: A Short-Run Causal Investigation, J. Appl. Econ. 3:71-91.

Isaksson A (2007). World Productivity Database: A Technical Description. Research and Statistics Branch Staff Working Paper *10*/2007 Vienna: UNIDO. http://www.unido.org/data1/wpd/Index.cfm

Isaksson A, Ng TH (2006). Determinants of Total Factor Productivity: Cross-Country Analysis and Country Case Studies. Research and Statistics branch Staff Working 01/2006 Vienna: UNIDO.

Jesen R (2007). The Digital Provide: Information (Technology), Market Performance and Welfare in the South Indian Fisheries Sector, Quarterly J. Econ. 122(3):879-924.

Lee KL, McAleer M (2004). Convergence and Catching Up in the ASEAN: A Comparative Analysis, Appl. Econ, 36 (2):137-153.

Lee SH, Gardner LK (2011). Does the Spread of Mobile Phones Promote Economic Development? Empirical Evidence from South Asia and Sub-Saharan Africa Regions, Southwestern Econ. Rev, 38(1):15-26.

Mbaku JM (2003). Entrenching Economic Freedom in Africa, Cato J. 23(2):217-225.

OECD (Organization for Economic Co-operation and Development) (2001). OECD productivity Manual: Measurement of Aggregate and Industry-level Productivity Growth. OECD, Paris.

Pires JO, Garcia F (2011). Productivity of nations: A Stochastic Frontier Approach to TFP Decomposition, Economics Research International, Article ID 584869, doi:10.1155/2012/584869.

Qiang C, Rossotto C, Kimura K (2009). Chapter 3 Economic Impacts of Broadband, In Information and Communications for Development 2009: Extending Research and Increasing Impact, The World Bank,Washington, D.C.

Sims C (1972). Money, Income and Causality, Am. Econ. Rev, 62:540-552.

Tsangarides CG (2002). On Cross Country Growth and Convergence: Evidence from Africa and OECD Countries, J. Afri. Econ. 10(4):355-389.

The Heritage Foundation (2012). 2012 Index of Economic Freedom. Washington, D.C.

Wolf S (2007). Encouraging Innovation for Productivity Growth in Africa. African Trade Policy Center of the Economic Commission for Africa. ATPC Work in Progress P. 54.

Wooldrigde JM (2006). Introductory Econometrics: A Modern Approach. 3rd ed., Thomson South-Western, pp. 50-485.

APPENDIX

Appendix 1. Productivity growth by country.

Country	2000	2005	2010
Algeria	1	-0.793	1.205
Angola	0.947	-4.117	6.659
Benin	1.02	-1.172	0.538
Botswana	1.025	-2.878	-0.42
Burkina Faso	0.974	-3.918	-1.614
Cameroon	1.046	3.601	-1.206
Chad	0.969	1.153	-0.313
Congo	1.078	1.713	-1.85
Cote d'Ivoire	0.964	1.382	0.334
Egypt	1.01	-0.784	0.523
Ethiopia	1.072	-2.66	-0.19
Gabon	1.008	0.472	-0.447
Gambia	1.056	-5.193	4.352
Ghana	1.086	2.25	-4.939
Guinea	1.003	-2.792	-1.226
Kenya	0.995	0.404	-0.317
Lesotho	1.016	3.21	0.699
Madagascar	0.996	-2.778	1.259
Malawi	1.017	-1.979	1.133
Mali	1.007	-6.035	2.719
Mauritania	1.063	-6.33	6.194
Morocco	0.972	-2.927	0.278
Mozambique	1.004	-0.941	0.489
Namibia	1.004	0.182	-0.096
Niger	1.072	-0.285	-1.931
Nigeria	0.772	4.573	8.791
Rwanda	1.036	-2.957	2.075
Senegal	1.023	-1.498	0.691
South Africa	1.018	-0.486	0.035
Tanzania	1.034	-2.388	0.32
Tunisia	1.01	-1.918	-0.174
Uganda	0.951	-1.988	1.459
Zambia	1.017	-0.848	0.309
Zimbabwe	0.957	-1.962	0.34

Source: World productivity database (Isaksson, 2007).

Appendix 2. Economic freedom score (0-100).

Country	2000	2005	2010
Algeria	56.8	53.2	56.9
Angola	24.3	-	48.4
Benin	61.5	52.3	55.4
Botswana	65.8	69.3	70.3
Burkina Faso	55.7	56.6	59.4
Cameroon	49.9	53	52.3
Chad	46.8	52.1	47.5
Congo	40.6	46.2	43.2
Cote d'Ivoire	50.2	56.6	54.1
Egypt	51.7	55.8	59

Appendix 2. Contd.

Ethiopia	50.2	51.1	51.2
Gabon	58.2	54.8	55.4
Gambia	52.7	56.5	55.1
Ghana	58.1	56.5	60.2
Guinea	58.2	57.4	51.8
Kenya	59.7	57.9	57.5
Lesotho	48.4	53.9	48.1
Madagascar	54.4	63.1	63.2
Malawi	57.4	53.6	54.1
Mali	60.3	57.3	55.6
Mauritania	46	59.4	52
Morocco	63.2	52.2	59.2
Mozambique	52.2	54.6	56
Namibia	66.7	61.4	62.2
Niger	45.9	54.1	52.9
Nigeria	53.1	48.4	56.8
Rwanda	42.3	51.7	59.1
Senegal	58.9	57.9	54.6
South Africa	63.7	62.9	62.8
Tanzania	56	56.3	58.3
Tunisia	61.3	55.4	58.9
Uganda	58.2	62.9	62.2
Zambia	62.8	55	58
Zimbabwe	48.7	35.2	21.4

Source: The Heritage Foundation/Wall Street Journal Index of Economic Freedom.

academicJournals

Vol. 5(10), pp. 403-410, October, 2013
DOI 10.5897/JDAE2013.003
ISSN 2006-9774 © 2013 Academic Journals
http://www.academicjournals.org/JDAE

Journal of Development and Agricultural Economics

Full Length Research Paper

Assessment of effect of climate change on the livelihood of pastoralists in Kwara State, Nigeria

I. F. Ayanda

Department of Agricultural Economics and Extension Services, Kwara State University, Malete, Nigeria.

Accepted 27 July, 2013

The study examined socio-economic characteristics of pastoralists, investigated perceived effects of climate change on grazing land, herd's performance and changes in livelihood of the pastoralists. Through a multi-stage sampling technique, 140 pastoralists were randomly selected. Data were collected using interview scheduled and analyzed by percentages, frequency, tables and Chi square statistical tools. The result of the study showed that respondents were with an average age of 49.7 years. 10.8 and 5% of the pastoralists had primary and secondary education, respectively. Furthermore, 67.5% of the pastoralists strongly agreed that pattern of rainfall in recent time affects pasture availability while 47.5 and 52.5% reported a decline in milk production and an increase in herd mortality respectively. Pastoralists advanced diminishing land for cattle grazing, poor quality pasture, inadequate income and a decline in cattle productivity as reasons for diversifying into crop production and other enterprises. A significance relationship was established between herd's milk production and factor of climate change (calculated x^2 = 52.00, tabulated x^2 = 7.8147, p≤0.00). It was concluded that climate change adversely affected livestock performance. Pastoralists should be encouraged through extension services to diversify production while livestock rearing is not compromised. This in turn will fast track Nigeria's strive for self-sufficiency in food production and employment generation.

Key words: Irregular rainfall pattern, declining grazing land, low herd production, income, crop, other enterprises.

INTRODUCTION

Transhumance pastoralism was originally a way of life among communities whose lives and livelihood are inseparably intertwined with cattle, goats, sheep and other ruminant species that depend on natural rangeland for grazing resources. In spite of the advent of monetized economy, pastoralism has remained a veritable source of livelihood and food security as cattle, goats and sheep perform economic, as well as traditional, social and exchange functions. However, the world is witnessing the adverse effects of climate change which include frequency and intensity of storm, thunder, flood, drought, hurricanes, increased frequency of fire, poverty, reduced agriculture productivities, adverse effects on grazing land and pasture quality. It had a cumulative effect on natural resources and disruption of eco-system. The impact of climate change can be vast. In Nigeria, this means that some stable ecosystems such as the Sahel Savanna may become vulnerable because warming will reinforce existing patterns of water scarcity, increasing the risk of drought in Nigeria and most countries in West Africa. It is obvious from the definition that climate change is an inherent attribute of climate, which is caused by both

E-mail: iayanda@yahoo.com. Tel: +234(0)8033737391.

human activities (anthropogenic) and natural processes (bio-geographic) (IPCC, 1996). As a result of climate change, the pastoralists migrated from the northern parts of the country to southern parts in search of pasture and water. The migration increases pressure on land use. Climate change also influences the existing vegetation type which favours cattle production in many southern parts of Nigeria. Presently, some of the land-use practice of the pastoral Fulanis such as seasonal bush burning along the grazing orbits for regeneration of pasture, periodic movement of the huts or dwelling place within the settlement areas, intensification of land use, shifting cultivation with short fallow periods and lack of commitment to investment in long-term land improvement initiatives such as incorporation of leguminous species into pasture or grazing land cover, loss of bio-diversity is capable of compromising the integrity and resilience of the ecosystem (Ayoade, 2004) and are plausible reasons for the ubiquitous face off between crop farmers and pastoralists.

Climate change as suggested by some researchers could impact the economic viability of livestock production systems worldwide. Surrounding environmental conditions directly affect mechanisms and rates of heat gain or loss by all animals (NRC, 2002). Lack of prior conditioning of livestock to weather events often results to catastrophic losses in the domestic livestock industry. It also affects the feed intake of the animal because ingestion of food is directly related to heat production, any change in feed intake and /or energy density of the diet will change the amount of heat produced by the animal. The ambient temperature has the greatest influence on voluntary feed intake. The ever growing pressure on land in the past few years has been described by many experts as a clear manifestation of the impact of climate change across Nigeria with most states in the far North being the worst affected by these changes. This has put the pastoralists in a state of dilemma (Omotayo, 2010). The pastoral Fulani believes that animal reproduction does not depend on the fecundity of the breed but rather on proper nutrition. Current efforts to combat global warming focus on reducing the emission of heat-trapping gases, but do not fully address the substantial contribution of land use to climate change, since even small changes of 100^2 km in urban development or deforestation can change local rainfall patterns and trigger other climate disruptions (BNRCC, 2008).

Problem statement

The bulk of locally produced meat and milk in Nigeria are through transhumance pastoralists. The dwindling pastoral and water resources such as open rangelands, wetlands (Fadama land), watercourses and rivers present a new challenge to pastoralism (Adamu, 2008). This could be held responsible for the low productivity of their cattle over the years. The situation is aggravated by climate change which exposed the pastoralists and their herds to tougher weather situations especially drought, poor quality pasture, risk of contacting diseases, pests, conflict between the pastoralists and crop producers over land use. The ever growing pressure on land in the past few years arising from population explosion, industrialization and institutional development has been described by many experts as a clear manifestation of the impact of climate change across Nigeria (Heinrich Boll Foundation, 2000). The problem of the pastoralists is further compounded with various agricultural development programmes which made pumps available for agricultural production in fadama area. Increasingly, however, pastoralists discovered that the rivers where they grazed their animals are now blocked off by farms and gardens. The problematic issues of customary tenure surfaces once again.

In Kwara State, farmers tend to farm in the designated grazing reserves because the land is particularly fertile. This marked the beginning of conflict in Bankubu, Baruten Local Government Area of the state. Today, there is increasing number of conflicts in many parts of Kwara State and the country at large (Joseph, 2012; Ademola, 2012) which resulted in huge losses in lives and properties.

In recent times, drought and flood are unpredictable and are more frequently occurring. This had a cumulative effect on natural resources and disruption of eco-system. Climate change reduced available land for livestock production purposes because of desert encroachment currently moving at 600 m/annum (or 350,000 ha per annum) (IPCC, 2007b, Oyetade, 2007). Consequently, pastoralists migrated to the southern part of the country where pasture and water are better guaranteed, an action, which often results into conflict between crop farmers and pastoralists with attendant low productivity which engulfed the agricultural sector in Nigeria. This forced the government to rely mostly on food importation to the extent that in 2007 the Federal government expended a total of N78.026 on milk importation in 2008 (National Bureau of Statistics, 2009), a situation described as dangerous for the nation's economy (Olayemi, 2005).

Cattle, sheep and goat performed better (in terms of calving, growth, milk production, etc) within a temperature range between 10 and 20°C called Comfort Zone" (McDowell, 1980). The temperature range in Kwara State is between 30 and 35°C. This is above the comfort zone and is capable of predisposing the animals to thermal stress which in turn can undermine the productivity of the animals. Irregular rainfall pattern also drastically affected the availability of water and pasture. Conducive weather condition, water and food are important in the physiological processes of these animals. In Nigeria therefore, it is not out of place to assume that the

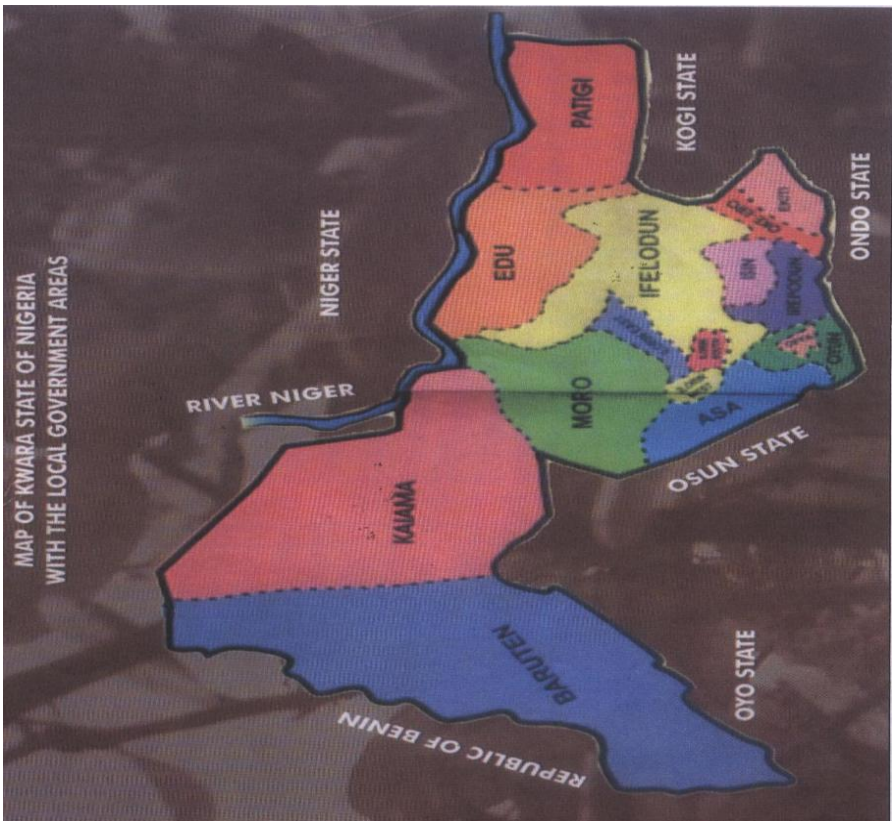


Figure 1. Map of Kwara State showing the sixteen local government areas.

prevailing environmental situations may be an eye opener for the pastoralists to look for alternative means of livelihood. These necessitate this study. The study was undertaken to provide answers to these research questions. What are the socio-economic characteristics of the pastoralists? To what extent has climate change affected grazing land? What are the perceived effects of climate change on the performance of the herds? And what are the changes in the means of livelihood of pastoralists due to climate change?

It is expected that the outcome of this study will assist the policy makers, planner, donors, public and private extension organizations to include the pastoralists in policy, programme planning and implementation relating to crop production and other enterprises aimed at increasing food production and employment generation.

Objectives of the study

The objectives of the study were to:

1) Describe the socio-economic characteristics of the pastoralists,
2) Determine perceived effects of climate change on grazing land in the study area,
3) Investigate perceived effects of climate change on herd's performance,
4) Identify changes in means of livelihood of the pastoralist due to climate change.

Hypothesis tested

The following hypotheses were tested:

1) There is no significant relationship between effect on grazing land and climate change,
2) There is no significant relationship between performances of the herd and climate change.

METHODOLOGY

The study area

The study was carried out in Kwara state, Nigeria which is located within the North Latitude 11° 2^1 and 11° 45^1. It falls between longitudes 2° 45^1 and 6° 40^1 East of Greenish meridian (Figure 1). The state is bounded in the south with Oyo, Ekiti and Osun State. It is bounded in the West by Benin Republic while in the North and the East, it is bounded by River Niger, and Kogi State, respectively. The state has a land area of $32,500^2$ km (3,250,000 ha) with a temperature range between 30 and 35°C. The vegetation in the

northern parts of the State is mainly savannah grass land while to the southern part is wooded Guinea Savannah. The rainfall pattern both in quantity (900 to 1500 mm) and distribution (6 to 7 months) and vegetation types favour production of cattle, goat, sheep and arable crops. The favourable climatic conditions are responsible for the exodus of Fulani from the northern parts of the country where adverse effects of climate change are mostly felt. The population of Kwara State is 2.3 million people (NPC, 2006). Kwara State is naturally endowed for livestock production. Crop production (rice, yam, cassava, guinea corn, maize, groundnut, sweet potato, cotton etc) is the major farming enterprise of the major tribes (Yoruba, Nupe and Baruba) in the State while livestock production is the major means of livelihood of the migrants Hausa/Fulani.

Target population

The target population for the study was the pastoralists in the sixteen local government areas (LGAs) of Kwara State. The local governments areas include Asa, Ilorin East, Ilorin West, Ilorin South (Kwara Central); Baruteen, Kaiama, Edu, Patigi and Moro (Kwara North); Irepodun, Ifelodun, Oyun, Offa, Ekiti, Oke-Ero and Isin (kwara South). There are preponderance of crop farmers and pastoralists in all the 16 LGAs in the state. The pastoralists constitute the sample frame from which the respondents were selected.

Sample size and sampling technique

The study used a multistage sampling technique. Stage one involved a random selection of seven (43.75% of the LGAs in the state) local government areas. These include Asa, Moro, Isin, Ifelodun, Kaiama, Edu and Baruteen LGAs. Stage 2 involved a random selection of five pastoralists' settlements (Gaa) in each LGA. The 'extension agents' in each LGA assisted in the compilation of the lists of the pastoralists, to the extent possible, within their areas of jurisdiction. Twenty (20) pastoralists were randomly selected from the five (5) Gaas in each LGA. Thus, a total of 140 pastoralists were selected from the seven (7) LGAs as respondents. Data were collected by means of structured interview schedule and analyzed with percentages, frequencies, tables and Chi-square statistics.

RESULTS AND DISCUSSION

Socio-economic characteristics of the pastoralists

The result of the study as shown in Table 1 indicated that 46.4% of the respondents were in the age range of 51 to 60 while the mean age of the respondents was 49.7 years. At this age, Ismaila et al. (2010) reported that farmers are incapable of handling tedious farming activities such as covering long distances to graze the animals. Unless the pastoralists are well-nourished, covering long distances may have implications on their health status. This can be subject of another research. However, low level (7.9%) of youth in the age bracket of 21 to 30 years was involved in transhumance pastoralism. It is possible that the youth diversified to other areas of the economy for their livelihood. Majority (90%) of the pastoralists were male. This implies that majority of the listed respondents were male; although, the roles of female in pastoralism are also important especially in processing and marketing of livestock products. About half (50.8%) of the respondent acquired quranic education suggesting that pastoralists in the study area are mostly adherent of Islamic faith. However, 10.8 and 5% had primary and secondary education respectively, a reflection of the level of formal education among the pastoralists in the study area. Educational pursuit of the youth explains the low number of pastoralists (7.9%) that fell within the age bracket of 21 to 30 years of age.

It was also revealed that 32.1% of the respondents spent 31 to 40 years with an average of 29.57 years in transhumance pastoralism. It was 35.8% of pastoralists with herd size in the range of 21 to 30 heads of cattle while the average herd size was 21. Inability to maintain larger herd size could be linked with poor quality pasture, inadequate water resulting from increasing desertification in Nigeria. This supports the findings of Brenjo (2007) that the environment can no longer support all of its occupants when hectares of grazing land turn into desert in Sudan. This increases conflict and distrust and further separates the Arabs (pastoralists) and non-Arabs (farmers) in Sudan from reaching an agreement over land use (An-Naim, 2004). Many (62.8%) of the respondents fell within the age bracket of 51 years and above. Therefore, age factor might inform the basis for diversification into crop and other enterprises that require less of wandering and favour sedentary life. The results showed that 65% of pastoralist cultivated 1 to 3 ha with an average of 1.7 ha of land for crop production. This is greater than the national average of 0.57 ha per farmer (Ingawa, 2005). It follows that if the pastoralists were integrated into the national extension services delivery systems, they could be part of national progress to achieve self-sufficiency in food production. However, pastoralists should be exposed to modern animal husbandry practices to assist in coping with the adverse effects of climate change so that livestock rearing would not be compromised as this can affect local supply of animal protein.

Perceived effects of climate change on grazing land

The results (Table 2) revealed that 67.1% of pastoralists strongly agreed that irregular pattern of rainfall in recent time affects pasture availability implying that the pastoralists would have to wander a long distance in search of pasture and water. About half (52.5%) strongly disagreed that pasture and water is readily available throughout the year in their domain while 52.1% disagreed that prevailing temperature has no effect on the pasture. In addition, altogether, 65% disagreed that drought is not a common occurrence in their localities. These agreed with the findings of BNRCC (2008) that the impact of climate change can be vast. In Nigeria, this means that some stable ecosystems such as the Sahel

Table 1. Socio-economic characteristics of the pastoralists fulanis.

Characteristics	Frequency	Percentage = 100 N = 140
Age (years)		
21-30	11	7.9
31-40	14	11.0
41-50	27	19.3
51-60	65	46.4
> 61	23	16.4
Average	49.7	
Gender		
Male	126	90.0
Female	14	10.0
Marital status		
Single	19	13.6
Married	91	65.0
Widowed	20	14.3
Divorced	10	7.1
Household size		
≤ 5	97	69.3
6-10	40	28.6
11-15	3	2.1
Average	6	
Educational level		
No formal education	39	28.4
Adult education	8	6.0
Quaranic education	71	50.8
Primary education	15	10.8
Secondary education	7	5.0
Years spent in cattle rearing		
1-10	8	5.7
11-20	13	9.4
21-30	44	31.4
31-40	45	32.1
≥ 41	30	21.4
Average	29.57	
Size of herds		
≤ 10	24	20.0
11-20	37	30.8
21-30	43	35.8
31-40	16	13.4
Average	21	
Farm size (hectares)		
<1	44	31.4
1-3	91	65.0
-6	5	3.6
Average	1.7	

Source: Field survey (2012).

Table 2. Perceived effects of climate change on grazing land.

Perceived effects of climate change	SA	A	U	D	SD
Irregular pattern of rainfall in recent time affected pasture availability	94 (67.1)	33 (23.6)	4 (2.5)	5 (3.3)	4 (2.5)
Prevailing temperature has no effect on the pasture	7 (5)	29 (20.7)	0 (0)	73 (52.1)	31 (22.2)
Flood occurrence hinder pasture growth	35 (25.0)	28 (20.0)	2 (1.2)	71 (51.3)	4 (2.5)
Drought is not a common occurrence in your location	18 (12.5)	24 (17.5)	7 (5.0)	35 (25.0)	56 (40.0)
Pasture is readily available throughout the year	21 (15.0)	15 (11.2)	4 (2.5)	74 (52.5)	26 (18.8)
Water is readily available throughout the year	16 (11.2)	12 (8.8)	5 (3.8)	44 (31.2)	63 (45.0)
You cover long distance to grace your animals	46	65	4	18	17

Source: Field survey (2012). Figures in parenthesis represent percentages.

Table 3. Perceived effects of climate change on performances of the herds.

	SD (%)	A (%)	UD (%)	DA (%)	SD (%)
Milk production has reduced tremendously due to noticeable change	66 (47.5)	59 (42.5)	-	11 (7.5)	4 (2.5)
Herd mortality is on the increase	74 (52.5)	51 (36.7)	-	15 (10.8)	-
New type of disease are noticed	78 (56.2)	28 (20)	4 (2.5)	25 (17.5)	5 (3.8)
Pre-calving and post calving morality increases	50 (36.2)	47 (33.8)	-	31 (22.5)	10 (7.5)
Abortion in cattle increases	38 (27.5)	46 (32.5)	-	56 (40)	-
Abortion in cattle decreases	91 (65)	33 (23.7)	-	12 (8.8)	4 (2.5)

Source: Filed Survey (2012). Figures in parenthesis represent percentages.

Savanna may become vulnerable because warming will reinforce existing patterns of water scarcity and increasing the risk of drought. This explains the migration of pastoralists to southern parts of Nigeria and thus increases pressure on land use for cattle and crop production.

Perceived effects of climate change on performances of the herds

The result (Table 3) revealed that 47.5% of the respondents strongly agreed that the herd's milk production is reducing due to changes in climatic elements. More than half (52.5%) of the respondents strongly agreed that herd mortality is on the increase while 56.2% reported the emergence of new types of diseases. Furthermore, 60% of the respondents agreed that abortion in cattle increases while 40.8% reported incidence of pre- and post calving mortalities in their herds. This might not be unconnected with the quality of existing pasture and the need to cover long distances for grazing under harsh weather conditions. The findings agreed with NRC (2002) that climate change could impact the economic viability of livestock production systems worldwide.

Livelihood strategies of pastoralists due to climate change

Table 4 summarized the enterprises undertaken by the respondents as their means of livelihood in view of prevailing adverse effects of climate change on livestock production in the study area. The result indicated that 75.5% of the pastoralists engaged in crop farming while 14.23, 15, 9.23, 7.86 and 13.57% engaged in trading, commercial transportation, farm labour, security guard and use of motor-cycle (Okada) for human transportation respectively to supplement the dwindling income from cattle production.

Pastoralists' reasons for venturing into other enterprises

Table 5 showed pastoralists reasons for venturing into other enterprises in descending order of importance. These include diminishing land for cattle grazing with a mean ranking of 5 using a five point likert- rating scale. Others include poor quality of existing pasture (4.6), inadequate income from cattle rearing to meet family requirements (4.39), land tenure system (3.57) and low cattle productivity (3.55) for diversifying into other enterprises.

These necessitated their venturing into crop production for food and to supplement their inadequate income from cattle production. It can be inferred that the planting of crops by the pastoralists might be suggestive to the farmers that the pastoralists intend to stay permanently on their land. This might be partly responsible for the constant hostilities between the two groups.

Table 4. Livelihood strategies of crop farmers and pastoralists.

Livelihood strategy	Pastoralists N=140	
	Frequency	Percentage
	106	75.5
	140	100
Trading	20	14.23
Commercial transportation	21	15
Farm labour	13	9.23
Security guard	11	7.86
	19	13.57

Source: field Survey, 2012.

Table 5. Pastoralists' reasons for venturing into other enterprises.

Reasons	SA	A	MD	D	SD	Mean
Income from cattle not adequate to meet family needs	91 (65)	33 (23.6)	2 (1.43)	8 (5.71)	6 (4.3)	4.39
Land for cattle grazing is diminishing	140 (100)	-	-	-	-	5.00
Pasture quality is becoming low	115 (82.1)	14 (10)	4 (2.9)	4 (2.9)	3 (2.1)	4.60
Low cattle productivity	97 (69.3)	29 (20.7)	2 (1.4)	7 (5)	5 (3.6)	4.14

Source: Field survey (2012). Figures in parenthesis represent percentages.

Table 6. Chi-square analysis of the relationship between the climatic factors and the performances of herds.

Variables	Degree of freedom	x^2 calculated	x^2 tabulated	Level of significance	Comments
Reduction in milk production	3	52.000	7.8147	0.000	Significant relationship exists
herd mortality is on the increase	2	20.725	5.9914	0.000	Significant relationship exists
Declining size of rangeland	3	53.500	7.8147	0.000	Significant relationship exists

Source: Field survey (2011).

Chi-square analysis of the relationship between the effects of climate change on grazing land and the performances of herds

The result of Chi square analyses (Table 6) established a significant relationship between climate change and declining size of grazing land; herd performances (milk production, x^2 = 52.00, tabulated = 7.8147, P≤0.05; herd mortality, x^2 = 20.725, tabulated = 5.9914, P≤0.05). The results confirm the findings of NRC (2002) that lack of prior conditioning of livestock to weather events such as temperature and drought often result to catastrophic losses in the domestic livestock industry. Ambient temperature has the greatest influence on voluntary feed intake. These explain the poor performances of local herds to cope with supply of animal protein required in Nigeria. This also agreed with Amogu (2009) that unfavourable environmental situations hinder livestock production in Nigeria.

CONCLUSION AND RECOMMENDATION

The study has shown that climate change has reduced grazing land, herds' milk production and increases mortality rate. The pastoralists have diversified into crop production and other enterprises to supplement their income from declining herd population. It was recommended that pastoralists should be encouraged, through extension services, to participate in crop and other enterprises as alternative ways of enhancing the dwindling income from livestock rearing. This in turn will fast track Nigeria's strive for attainment of self-sufficiency in local food production.

REFERENCES

Adamu B (2008). Keynotes address in Gefu JO, Alawa CBI, Maisamari B, (eds). The future of Transhumance Pastoralism in West and Central Africa. Strategies, dynamic, conflicts and interventions,

Proceeding of International conference on the future of transhumance pastoralism in West and Central Africa held in Abuja, Nigeria.
Ademola A (2012). When neighbours fight over cattle, farms. Nigerian Tribune, April 5, P. 27.
An-Naim AA (2004). Causes and solutions for Darfur. The San Diego Union Tribune. http//www.sigonsandiego.com/uniontrib/20040815/news_lz1e5darfur.html Retrieved 22/05/2012.
Amogu U (2009). Maximizing the animal production value addition chain in Nigeria. Invited presentation at Nigeria Institute of Animal science, Annual General Meeting, University of Calabar, July 28, 2009.
Ayoade JO (2004). Climate Change. Ibadan: Vantage Publishers. pp. 45-66.
Brenjo N (2007). Looking for water to find peace in Darfur. Alert Net blog. http://www.alertnet.org/db/t/b/06/30-100806-1htm Retrieved 22/05/2012.
Building Nigeria's Response to Climate Change (BNRCC, 2008). Vulnerability, impacts and adaptation to climate change in Nigeria. 1, Oluokun Street, Bodija, U, I. P. O. Box 22025, Ibadan, Nigeria. Email: info@nigeriaclimatechange.org.
Heinrich Boel Foundation (2000). Climate Change and Human Right. In New Perspetive quarterly, 17:14-26.
Ingawa S (2005). New Agricultural Technologies Adopted from China. Message Delivered at a Workshop for North –East and North –West. States of Nigeria. Nigerian Tribune, No 13, 714, September 1, 2005 P. 1.
Intergovernmental Panel on Climate Change (IPCC) (1996). Climate change synthesis report. www.ipcc.ch/pdf/assessment -report/a-4/pdf.
Intergovernmental Panel on Climate Change (IPCC) (2007b). Impacts, adaptation and vulnerability: The Working Group II Contribution to the Intergovernmental panel on climate change fourth assessment report. Cambridge University Press.
Ismaila U, Gana AS, Tswanya NM, Dogara D (2010). Cereals Production in Nigeria: Problems, constraints, and opportunities for betterment. Afric. J. Agric. Res. 5(12):1341-1350, 18 June 2010 Available online at http://www.academicjournals.org/AJAR. ISSN 1991-637X ©2010 Academic Journals.
Joseph O (2012). 11 killed, thousands flee Nasarawa State as Tiv, herdsmen clash. The Guardian, March 12, P. 8.
McDowell RE (1980).The influence of environment on physiological functions. In Animal Agriculture. The Biology, husbandry and use of domestic animals, Cole, H. H. and W. N. Garrett (eds.) Second Edition, Freeman and Company, San Francisco. P. 460.
National Bureau of Statistics (2009). Statistical News (http://www.nigerianstat.gov.ng). Retrieved 12/01/2013.
National Population Commission (NPC) (2006).The National Populaion Office, Ilorin Kwara State, Nigeria.
National Research Council (NRC), 2002: Abrupt climate change inevitable surprises. National Academy press, Washington, Dc. National Academy Press.
Olayemi JK (2005). Food Security in Nigeria". Research Report No 2. Development policy centre, Ibadan. 2(32):77-78.
Omotayo AM (2010). The Nigerian Farmer and Elusive Crown, 30th inaugural Lecture, Federal University of Agriculture, Abeokuta, Nigeria. P. 9.
Oyetade L (2007). Desertification in Nigeria (African Agriculture).Text of a lecture delivered at the 38th interdisciplinary research discourse, postgraduate school, University of Ibadan, 11th December, 2007.

academicJournals

Vol. 5(10), pp. 411-415, October, 2013
DOI 10.5897/JDAE2013.0478
ISSN 2006-9774 ©2013 Academic Journals
http://www.academicjournals.org/JDAE

Journal of Development and Agricultural Economics

Full Length Research Paper

Innovative development of agrifood system in Sverdlovskaya oblast of Russia

Sergey N. Polbitsyn*, Veniamin V. Drokin and Alexei S. Zhuravlev

Institute of Economy, Ural Branch of Russian Academy of Sciences Russia.

Accepted 21 August, 2013

The study examines whether the goal of food security for the population of Sverdlovskaya oblast, one of the mostly industrial northern region in Russia, aiming agricultural productivity improvement and rural poverty reduction, could be achieved by the regional authorities within post-soviet type of agricultural policy. Results show that, the current trends of agricultural production and rural social development in Sverdlovskaya oblast are degrading. To reach the goal of regional food security and to change declining trends in production it is necessary to ensure the priority of social goals over economic development, because providing higher standards of rural livelihoods will inevitably lead to the sustainable development of agricultural production. The study aims to determine the conceptual foundations of the transition of rural localities of industrial region of Russia towards sustainable development through the creation of decent living conditions and activities of the rural population in quality food production. Particular attention is focused on the mechanism of interaction and coordination among federal and regional governments, local governments and commercial organizations engaged in its food production activities in the rural areas. On the basis of theoretical propositions is the conceptual model of innovative development of rural areas in an industrial region, namely Sverdlovskaya oblast of Russia, aiming quality food production for the population of region is presented.

Key words: Agrifood system, innovation, rural development, Russia.

INTRODUCTION

Sverdlovskaya oblast is located between 56° and 60° North in Siberian part of the Urals Mountains. The climate is continental with average annual temperature 0°C and frost-free period of 100 days. The soil is mostly infertile loam, and the territorial agricultural output is quite low. The average wheat yield per acre is about 20 bu. Suitable for agriculture lands amount 13.34% of total territory. The local agricultural produce covers only 15% of local population needs in food (Sverdlovskaya oblast in 2007 to 2011).

The total population of Sverdlovsk oblast is 4307 thousand people in 2011. The share of rural population is 16%. The major native ethnic groups are Russians (90.6%), Tatars (3.5%), Ukrainians (0.9%), Bashkirs (0.8%), and Mari (0.6%). The unemployment level in the rural localities consists of 3.5%. Due to peculiarity of the Russian system of welfare most of unemployed rural people do not have any income. Regional per capita income was 24879.3 rub (approximately US$830) per month (Sverdlovskaya oblast in 2007 to 2011).

Despite the different ethnicities, most of population follow the same highly nourishing diet of northern type (Hasnulin et al., 2006), consisting mainly of proteins of animal and plant origin (approximately 80 g of animal fat

*Corresponding author: E-mail: sergey.polbitsyn@icloud.com. Tel: +7(912) 261-0053.

and 50 g of vegetable fat daily).

The political system of Russian federation inherited from Soviet time's tendency to give more power and resources to the federal government, rather than to municipal authorities, causing greater involvement of federal and regional administration into local agrifood systems. The Soviet originated regional food system aimed the only goal to provide sufficient amount of basic food for the population. Still now after the collapse of the Soviet Union, the major food security principles of Russia target the availability of basic food (Boycko et al., 1995).

However, stated principles of food availability do nothing with food quality that is, required by the population, and today more and more researchers and practitioners raise the question of food quality (Gregory, 1990). Investigating an agrifood system of industrial northern regions, it is necessary to emphasize the mandatory requirement that food must meet the wide range of needs of people living in extreme climatic conditions not only basic needs (Hasnulin, 2009).

Nowadays the existing system of food production and distribution in Russia cannot be named sufficient and prospective (Goldman, 1992). The innovative agrifood system must provide the population not only with necessary basic food but also with the whole range of variety of special types of food required by population in northern regions (Aleksandrova and Kireyeva, 2012). However, the practice of agricultural production in Russia is based on a soviet model that is, mostly suitable for southern and central regions of Russia (Anfinogentova, 2013).

Innovative model of a regional agrifood system have to be closely related to the climatic conditions of the territory and the historically developed way of life and human activity, therefore it should be built on traditions of not only of agriculture but also of food consumption (Zalivcheva, 2013).

Theoretical foundations and hypothesis

Theoretical model of regional agrifood systems, which allows the determination of the perspectives for innovative development, cannot be formed without a systematic analysis of the development of agriculture and food distribution system in the region, especially when it comes to predominantly industrial region.

The identification and implementation of economic capacity of the northern regions of the Russian federation must be based on the analysis of both prospective and historical development of the region, therefore, historical knowledge is not only a basis for understanding the territorial model of agriculture and the prediction of its development, but also an important component in the management of territorial development, particularly in the context of food security in the region. To determine the prospective agrifood system model, we need to consider not only the economic capacity of the region but also a demographic factor, which is characterized by two trends: the declining share of rural population and a sharp increase in urban or industrial population caused by migration from other regions.

Thus, we should point out three specific underlying factors that influence the formation of the agrifood system model in the northern region:

(a) Climatic characteristics of the region
(b) Forecast for the growth of local (regional) food markets
(c) Local specific features of agriculture

It may be noted that, differences in northern regions are defined by the differences in the potency of these specific factors, and, assuming that, the regional industrial development leads to creation of new local food markets and growth of existing local markets, we should recognize that, the difference in industrial development should result in a fluctuation change of agrifood system model in the region.

Key provisions of the agro-innovation system model for the northern industrial region, to our opinion, may be formulated as follows:

(i) Nutritional needs of the population of the northern regions differ from the needs of the population of the southern regions. These needs are determined by harsh climatic conditions and demographic factors that lead to the advanced need of protein and fat components in the diet, and higher consumption rates of protein, fat, carbohydrates, vitamins, macro-and micronutrients (Hasnulin et al, 2006).
(ii) Forecast of the demand and changing needs of the population of the northern territories should be carried out within the territorial information subsystem of agrifood system. The industrial development of the region will lead to dramatic increase of population and, hence, the increase in food consumption. To predict changes in food consumption the special information system must be developed (Zalivcheva, 2013).
(iii) Major role in collecting data regarding population needs for food, information analysis and forecasting of changes in the needs of the population in food should be played by regional authorities and local authorities. Currently local authorities do not monitor population's requests for food, forecast of food needs is absent, and that can lead to food shortages.
(iv) Food supply should be divided on internal and external sources of food, because regional food security depends mostly on external sources of food. Supply from external sources of food must be monitored by the local government to avoid food shortages.
(v) Local internal food production should be focused on agricultural production, which has specific qualities that can be used to justify premium pricing and higher

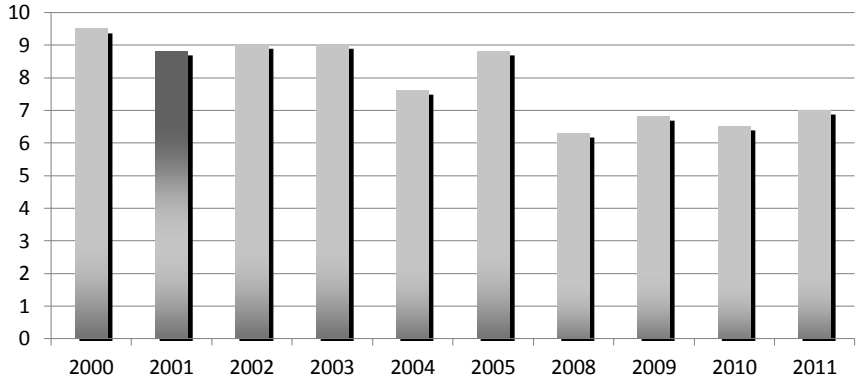


Figure 1. Deacrease of the rural population of sverdlovskaya oblast in Russia (%).

production costs.

(vi) Rural settlements in northern regions should be developed on the principle of multi-functional development, that is, agricultural production should not be the sole source of income for rural population.

(vii) Income levels and living standards of rural population must be comparable with the level of income and standards of living of the urban population that has a positive effect on the stability of socio-economic situation in rural areas.

(viii) Regional agrifood system must give social and economic benefits for all social groups of regional population. The effectiveness of agrifood system for urban population must be provided with better level of food security. The rural population must be provided with higher living standards.

In the process of agricultural development in the region local farms embed not only the new agro-technologies, but also new forms of management. The essence of the proposed approach to the creation of agrifood model system is to recognize the need for joint efforts of various participants in agricultural production and food market in order to effectively achieve the common goal of sustainable food security in the region.

Evaluation of the effectiveness of agrifood system in the region can be carried out within the framework of model based on the definition of functional relationship between the public welfare, efficiency of regional and local authorities under constraint of the limited resources available to local authorities.

Differences in the assessments of the performance of commercial organizations, government bodies and local governments arise from the difference of commercial organizations and bodies of the municipality or public authority in relation to human welfare. Considering the social welfare function (Arrow, 1950), we treat it as a set of individual utilities of all individuals constituting the population, thus, emphasizing that welfare can only be viewed as consisting of the welfare of individuals. Following this view, all actions of government bodies and local authorities should aim to achieve justice, that is, to improve or at least preserve on the same level welfare of every member of society. This problem can be represented as maximization of social welfare functions by optimizing the not detoriation or individual well-being included in this feature.

Agri-innovative system model should be viewed as a model of provision of public goods or services. Public goods or services have no value; they are consumed for free, but have a cost, because the territorial government spends a certain amount of resources at its disposal to create public goods.

METHODOLOGY

Empirical model

The major demographic problem of the Sverdlovskaya oblast in Russia is deteriorated demographic situation in the rural territories, reduction in the employment of rural population, decrease in the volumes of agricultural production, and also decrease in the standards of living in the rural territories.

The following data clearly demonstrates the reduction in the public welfare in the rural localities of Sverdlovskaya oblast. Population loss was caused by migration to urban areas for better income. Demographic situation in the rural localities of Sverdlovsk region is characterized by the natural loss of permanent population since 1991, as depicted on Figure 1.

The represented information can be treated either as a trend or as a statistical set of values, with the mean value. By treating the level of natural loss as a trend, it is possible to project the linear forecasting, with $R^2 = 0.59$. The characteristics of a statistical sample will include the deviation $\sigma = 1.1$, and the average value $\times = -8.43$. The obtained results do not show sufficient evidence of the positive tendency of the level of the natural loss of rural population, but we may suppose the statistical fluctuations around the average value. The absence of positive tendency meaning the growth of the rural population of Sverdlovskaya oblast should be considered as stimulus to work out the model of the living standards improvement for rural territories. Previously neither such programs nor models were elaborated or they failed, otherwise the reduction of draining or an increase of the population in the rural regions must be displayed.

To understand types of rural settlements, they were grouped according to the number of inhabitants as it is given in Table 1.

Table 1. Groups of the rural localities according to the number of inhabitants in 2011.

Population of rural locality	Number of rural locality	Total population of rural locality
0	138	-
1-5	134	392
6-10	71	562
11-25	140	2487
26-50	165	6119
51-100	221	16320
101-200	271	38811
201-500	324	104286
501-1000	204	146093
1001-2000	100	137306
2001-3000	33	80177
3001-5000	22	85234
More 5000	20	136037
Total	1843	753824

The depicted distribution clearly demonstrates that two types of rural settlements could be marked out. The first type of rural settlements can be described as the settlements of mainly agricultural economy; this is the prevailing type in the range from (1 to 5) to (2001 to 3000) with the peak value in the category (501 to 1000) of the total number of inhabitants. The larger populated areas can be described as settlements of mostly industrial directivity. The unemployment level in the rural localities of the first type is characterized the following negative tendencies:

(i) Persisting low level of the remuneration for labor, from one side, the expansion of demand for the labor with extremely low compensation, and with another - unwillingness of local inhabitants to work for offered salaries (about 60 euros per month)
(ii) Increasing of the informal of-the-record employment without taxes and social security
(iii) Insufficient demand for qualified workers with simultaneous scarcity of qualified labor force on the local labor markets because of the poor professional qualification of rural inhabitants and low working mobility of population
(iv) Presence on the market of the significant contingent of young people (20 to 30 years), with low general education level, that considerably complicates the problem of their job placement
(v) Increase in the tension on the labor market. Tending low competitive ability on the market of labor of the separate categories of inhabitants (young people without the practical work experience, women with young children, handicapped persons) caused by the objective stiffening of the demands of employers.

More than 25 000 people in average were permanently unemployed in rural localities during the period of 2009 to 2011, the average level of unemployment in the rural localities composed 3.5%. In spite of being increased rural unemployment, the growth of agricultural production in Sverdlovskaya oblast in 2011 comparatively to 2010 increased by 23.4% in the actual prices, and in the comparable prices increase composed 2.7%.

Two factors influenced the described increase of agricultural production: negative - an inflationary rise of the global food prices and positive - an increase of labor productivity in the agricultural organizations of the Sverdlovskaya oblast.

Sverdlovskaya oblast has the expressed industrial background of its economy with the high concentration of urban population (rural population is only 16% of the whole population, as it was noticed earlier. This situation requires the highly intensified agricultural production, mostly of that consumed in the fresh form.

According to the statistical data, the average number of workers of an industrial enterprise in the region comprises of 150 workers. For rural localities the most common type of enterprises is small and medium enterprises (SME) with the number of workers up to 100 people enterprises linked with agricultural production, and forest industry, hence in order to support rural localities economy, by regional and local authorities should be primarily support SME.
To ensure the balanced development of rural localities on the basis of the creation of worthy conditions for the life and the activity of population, it is necessary to solve the major tasks:

(i) Creation of the self-developing economic systems in rural localities.
(ii) Increase in the attractiveness of migration to rural localities.

In accordance with the Pareto condition to achieve the objective of raising the level of food security for Sverdlovskaya oblast, it was proposed to increase the welfare of rural population by social development in rural localities and economic growth of agricultural production. The suggested model presumes the attraction of the additional funding from the federal, regional, local authorities, and private investments to increase the welfare not only of the separate categories of the population of Sverdlovskaya oblast, but practically for all population groups.

The effectiveness of suggested model should be evaluated as its influence on the improvement of social and economic situation in the rural locality of Sverdlovsk region, a change in the migratory processes. The effectiveness of the model can be evaluated wider, since its realization positively influences not only rural population, but also to the urban population.

RESULTS

Results show that, the current trends of agricultural production and rural social development in Sverdlovskaya oblast are degrading. To reach the goal of regional food security and to change declining trends in production, it is necessary to ensure the priority of social goals over economic development, because providing higher standards of rural livelihoods will inevitably lead to

the sustainable development of agricultural production. The study determined the conceptual foundations of the transition of rural localities of industrial region of Russia towards sustainable development through the creation of decent living conditions and activities of the rural population in quality food production. Particular attention is focused on the mechanism of interaction and coordination among federal and regional governments, local governments, and commercial organizations engaged in its food production activities in rural areas. On the basis of theoretical propositions the conceptual model of innovative development of rural areas in an industrial region, namely Sverdlovskaya oblast of Russia, aiming quality food production for the population of region is presented.

DISCUSSION

The suggested model can be treated as a model of the agro-innovation system of the industrial northern region, since the principles, assumed as the basis of the model, can be acknowledged as fundamental for any industrial region.

The expected outcome after the realization of the agro-innovation model is the increase of food security for the population of Sverdlovskaya oblast and the increase of living standards for rural population due to realization of the following principles.

The first principle is the proposition that, the agro-innovation system must consider the interests of all social groups of industrial region; it has to be directed toward an increase in the public welfare for all groups of population of the region.

The second principle offers that, the model has to be directed toward the development of the special features of the agricultural producers of Sverdlovsk region, but not to attempt competition with the external producers.

The third principle is that, the model sets its goals not on the change of benchmarks for the development of Sverdlovskaya oblast, but to strengthen the economic growth of region due to improvement of the quality of the food supply for the population of Sverdlovskaya oblast.

The fourth principle is that, the model develops not only economic potential of rural territories, but first of all social growth. The model points out the importance of the multifunctional development of rural localities, what in turn obligatory affects the improvement of standards of living in the rural localities in Sverdlovskaya oblast.

The model of regional agro-innovation system was introduced to the regional government and it was found prospective for the realization in Sverdlovskaya oblast as a mandatory part of the regional program of innovative development of Sverdlovskaya oblast.

The weak side of the realization of the suggested model is possibly the lack of political will of the local authorities. The current political system in Russia does not give adequate authorities to municipal administrations. In order to implement this model, it is required that, municipal administrations will take political responsibility for living standards level and food security of population.

The increase of the migration to rural localities, provoking it by creating jobs in agrifood enterprises, the creation of the favorable rural society will lead to the long-term stable regional economic development. Thus, the model of agrifood system developed for Sverdlovskaya oblast, satisfies the basic conditions of the model of the agro-innovation system of the industrial region and can be disseminated to other northern industrial regions of Russian federation.

CONCLUSION AND RECOMMENDATION

The study result shows that, despite the highly centralized economic policy in Russian federation, the regional food security and rural development can be reached by active role of municipal authorities and entrepreneurs. To ensure entrepreneurial activities of rural producers the regional government must develop regional agrifood system into agro-innovation system, with information system as the core.

ACKNOWLEDGEMENTS

This publication derives from the research project #12-P-7-1001 on “New Instruments and Methods of Forecasting of Innovative and Technological Development of Regions” which was funded by the Russian Academy of Sciences as part of the program #34.

REFERENCES

Aleksandrova L, Kireyeva N (2012). Economy of supply or economy of demand? Strategy of ensuring food security of a region in the new realities. Regional Agrosystems: Economics and Sociology. 2: Retrieved from: http://iagpran.ru/journal.php?tid=281

Anfinogentova A (2013). Food security in Russia: state, challenges and conditions //Regional Agrosystems: Economics and Sociology. 1: Retrieved from: http://iagpran.ru/journal.php?tid=307

Arrow KA (1950). Difficulty in the Concept of Social Welfare//. J. Polit. Econ. 58:328-346.

Boycko M, Shleifer A, Vishny R (1995). Privatizing Russia. – Cambridge: MIT Press. P. 165.

Goldman MI (1992). Lost Opportunity: Why Economic Reforms in Russia Have Not Worked. - New York – London: W.W. Norton & Company. P. 320.

Gregory PR (1990). Restructuring the Soviet economic bureaucracy. – Cambridge: Cambridge University Press. P. 196

Hasnulin VI (2009). Health, Northern Type of Metabolism and Fish Food Requirement Allowances in the North. Retrieved from: www.iea.ras.ru/conferences/2009/medanrtho_summer_school?programme.html.

Hasnulin V, Wilhelml E, Selyatitskaya VG (2006) The Ethno-ecological Aspects of the Natives Vital. Proceedings of the 13th international congress on circumpolar health. Novosibirsk, Russia. pp. 117-118.

Sverdlovskaya oblast (2007-2011). Ekaterinburg. P. 232.

Zalivcheva O (2013) Food consumption regional differentiation //Regional Agrosystems: Economics and Sociology. 1: Retrieved from: http://iagpran.ru/journal.php?tid=309.

academicJournals

Vol. 5(10), pp. 416-424, October, 2013
DOI 10.5897/JDAE2013.0491
ISSN 2006-9774 © 2013 Academic Journals
http://www.academicjournals.org/JDAE

Journal of Development and Agricultural Economics

Full Length Research Paper

Extent and adoption determinants of floating tray technology by small holder tobacco farmers: A case of Zimbabwe

Dadirayi Manyumwa*, Never Mafuse, Munyaradzi Matovore, Joseph Musara, Vincent Tinashe Munyati, Joseph Chimvuramabwe, Godfrey Chagwiza, Emmanuel Zivenge and Violet Dudu

Department of Agricultural Economics, Education and Extension, Faculty of Agriculture and Environmental Sciences, Bindura University of Science Education, Bindura, Zimbabwe.

Accepted 30 July, 2013

The study was on the extent and adoption determinants of floating tray technology by small holder tobacco farmers in Bindura District of Mashonaland province. The objectives of the study were to determine the extent of adoption, identify adoption determinants that influence farmer's decision to take up floating trays. The study aimed also to identify challenges and opportunities of the floating trays. Questionnaires, focus group discussion and observations were used to gather data. The enumerator had face to face interviews with the farmers and clarified areas were the farmers need clarity on issues in the questionnaire. The logit regression model was used to determine the factors that influence adoption decision. Descriptive statistics was also used to analyse the challenges and opportunities. The major challenges were identified as high costs of technology and lack of capital with reduced input costs as an opportunity. Factors that influence farmers' decision to adopt floating tray technology were identified and these include training, educational status and off-farm hours. Age, training and off-farm hours were found to have significant influence on the adoption decision. Results show that training of the household head has a significant impact as shown by the marginal effect of 0.041. Since tobacco seedling using floating tray system is too costly and requires too much capital to establish, the researcher's hypothesis that there are challenges and opportunities in using floating tray system was not rejected. Recommendations made were to advocate for intervention in the provision of low cost or subsidize the floating tray system for the small holder tobacco farmers to increase the adoption of floating tray system.

Key words: Adoption, float trays, logit regression model.

INTRODUCTION

Zimbabwe is an agro based developing economy where agriculture is the vehicle to economic development prospects (GOZ, 2009). It provides employment and incomes for 70% of the population, 60% of the raw materials required by the industrial sector and 45% of total export earnings and, except in years of severe drought, sufficient food to feed the nation (FAO, 2010). Sustainable agricultural development should be ecologically sound, economically viable and socially responsible. It is through agricultural transformation that

*Corresponding author. E-mail: dadiraimanyumwa@yahoo.com.

sustainable economic growth can be achieved (Rukuni et al., 2006).

Zimbabwe is one of the major tobacco exporters in the world. Tobacco (*Nicotiana tabaccum*) is of paramount importance to the agriculture sector and the economy of Zimbabwe as it is one of the country biggest foreign currency earners (FAO, 2010). Increases in both planting areas and yields have contributed to a significant increase in output of tobacco over the past decades. Large-scale commercial farmers used to dominate tobacco production but however this trend has changed with small scale farmers now dominating production (Z.T.P., 2010). The Large scale farmers are characterized by large land holdings, use of modern machinery, and permanent wage labour as compared to their small scale counterparts who are resource constrained (FAO, 2010). Over the past decades, methyl bromide has been used to fumigate tobacco seedbeds. However, the use of this conventional method in seedling tobacco production has been observed to have negative effects to the environment (Z.T.P, 2010). There has been a global call to phase out methyl bromide by 2015. Zimbabwe has specific regulations towards attaining this. Various stakeholders including the Tobacco Research Board (TRB), Agricultural Extension and Technical Services (AGRITEX) and United Nations Industrial Organization have advocated for the use of the float tray system in seedling production as an alternative. Tobacco growers received training in the use of float tray system for tobacco fumigation and have on average invested US$353 per hectare for the trays which last up to 7 years (Mazarura, 2004). Float tray system is an option of seedling production that has been tried, tested and used successfully in many tobacco growing countries such as Brazil, Malawi and the USA (Mazarura, 2004). Besides being more eco-friendly, the float tray system produces seedlings with intact root system and result in a more uniform crop. It is also notably labour extensive and cost effective as compared to conventional seedling production.

The contribution of new technology to economic growth can only be realized when and if the new technology is widely diffused and used (Namara et al., 2007). In most settings, diffusion of agricultural innovations has been seen as the cumulative or aggregate result of a series of individual calculations that weigh the incremental benefits of adopting a new technology against the costs of change. This is often in an environment characterized by uncertainty (as to the future evolution of the technology and its benefits) and by limited information (about both the benefits and costs and even about the very existence of the technology). There has been an apparent overall slowness and the wide variations in the rates of acceptance of the float tray system by most tobacco farmers in Zimbabwe (Namara et al., 2007). Thus, understanding the workings of the diffusion process is essential to understanding how technological change actually comes about and why it may be slow at times. Exploring the determinants affecting choice is essential both for economists studying the determinants of growth and for the creators and producers of such technologies (Mansfield, 1968). For this study, this analysis will be done in the context of tobacco farmers in Bindura District.

Problem statement

Unsustainable tobacco seedling production using methyl bromide is currently used in Zimbabwe's farming communities (Mazarura, 2004). Even though the floating tray has been identified as an option to convectional tobacco seed farming to guard against ozone depletion, the uptake of this technology has been marginal in most small farming communities (Mazarura, 2004). It is therefore imperative to understand challenges and opportunities and the dynamics of adoption of floating tray system.

METHODOLOGY

Description of study area

The study was carried out in Bindura District of Mashonaland Central. Bindura is located in the Mazowe Valley about 88 km North-east of Harare. Bindura is in natural region 2b and receives high rainfall. The area experiences warm summers and cool winters. Rainfall ranges between on average 700 and 1000 mm per annum and effective rainfall is 500 to 635 mm (AREX, 2008). This is enough for intensive crop production. The main crops grown include tobacco, maize, soya beans and winter wheat. Intensive livestock production is also practiced.

Data collection techniques

Both qualitative and quantitative data were collected using a number of approaches and tools. These techniques allow the researcher to systematically collect information about objects of the study (people, objects, phenomena) and about the settings in which they occur (De Vaus, 1996). Structured questionnaires, structured interview guide and observations were used for primary data collection. The researcher also conducted one focus group discussion to triangulate data collection. Stakeholders such as AGRITEX and TRB were interviewed to get their views on the topic. The researcher took into account ethical considerations to minimize the issues of bias information by conducting focus group discussion.

Sampling procedure

Purposive sampling was initially used to identify tobacco farmers in ward 3 Bindura district where tobacco production is extensively done. The sampling frame comprised of 115 farmers of which 23 were adopters and 92 non-adopters. Proportionate random sampling was used with adoption being the stratum. From the sampling unit, 47 farmers with 5 and 42 adopters, respectively became a sampling unit. This allowed generation of a representative sample since the proportions of adopters and non-adopters were different. Snow balling sampling was also employed. The random selection meant that there were equal chances of

Table 1. Description of floating tray adoption variables.

Variable	Description	Units	Adopters		Non-adopters	
			Mean	SD	Mean	SD
Age	Age of household head	Year	32		50	
Household size	Number of family members	Number	5.4	1.3	3.8	0.8
Number of years in school	Years of schooling by household age	Number	13.8	1.7	8.1	1.5
Land size	Size of arable land	Hectare	3.3	1.2	1.9	0.7
Off farm activities	Access to off farm activities	percentages	5.1	11.9	6.7	13.8

Source: SPSS.

Table 2. Gender in tobacco farming.

Gender	Percentage
Male	66
Female	34

selection for each farmer into the sample. Farmers were free to participate and were not coerced.

Data analytical tools

Logit model

Since in this study, the dependent variable (adoption) has only two possible values for either adopting or not adopting, the logistic regression model was used. Without any loss in generality, the researcher coded these two outcomes as (Y = 1 for adoption) and (Y = 0 for not adopting) thus giving rise to a binary dependent variable. Since the response was qualitative in nature, the researcher used qualitative response model, (the logit model), which is a nonlinear model since binary dependent model ("dummy Ys") cannot be used freely in linear regression models. The aim was to find the conditional expectation of the dependent variable given more than one conditional variables. The likelihood of observing the dependent variable (P) was tested as a function of variables which include gender of household, age of household and training of the household.

$$Z_i = \text{Log}\,(P_i/1-P_i) = \alpha_0+\alpha_1X_1+\alpha_2X_2+....\alpha_nX_n+\varepsilon$$

Where: X_1 = Training, X_2 = number of years in schooling, X_3 = off farm activities, X_4 = land size, X_5 = age, X_6 = household hold size, ε = Error term.

Most of the smallholder farmers received training on how the float tray system works. The researcher was interested in the number of farmers who received training on the use of float tray system in the production of tobacco. The level of education is also a major determinant in the adoption of technology by the smallholder farmers. In theory, it is believed that those who are educated will adopted the technology faster than those farmers who are well educated. The smallholder framers are not only into the production of tobacco, there are other off farm activities which they are involved in, these off farm activities is also a major determinant on the adoption of new technologies by the smallholder farmers in Zimbabwe. Farmers will prefer a technology which will leave them with time to do other activities.

Size of the land available is another determinant of the adoption of a technology by the smallholder farmers. If the size of the land is huge, farmers would want a technology that will save them time and which does not require many labour days. The size of the arable land available will determine the adoption of technology by the smallholder farmers. The major source of labour in the smallholder sector is the family. The size of the household will also determine the level of adoption by the smallholder farmers in Zimbabwe. If the household is large then the family can adopt a labour intensive technology and if the household size is small then the family will not adopt a labour intensive technology. Household size is a major determinant of the adoption of a technology by the smallholder farmers in Zimbabwe.

RESULTS

Demographic information of small holder tobacco farmers

Most smallholder tobacco farmers in Bindura are male and they constitute more than half of the farmers in the district (AREX, 2012). A range of about 40 and above years is dominating smallholder tobacco farming in the district. The results show that most farmers at least attended ordinary level of education (Tables 1 and 2).

The results in Figure 1 indicate that 66% and 34% were trained and untrained on using the floating tray system respectively. Therefore, there has been increased awareness among farmers of this environmentally friendly method of raising tobacco seedlings instead of using methyl bromide.

Despite the training exposed to farmers (Figure 1) to gain knowledge on the use of float tray system Figure 2 clearly show the low uptake of this system of raising tobacco seedlings. Therefore, the research needed to explore the determinants affecting float tray system adoption.

Adoption determinants

From Table 3, variables were captured and among them number of year in school, size of the household, training and farm size have valid marginal effect on the decision

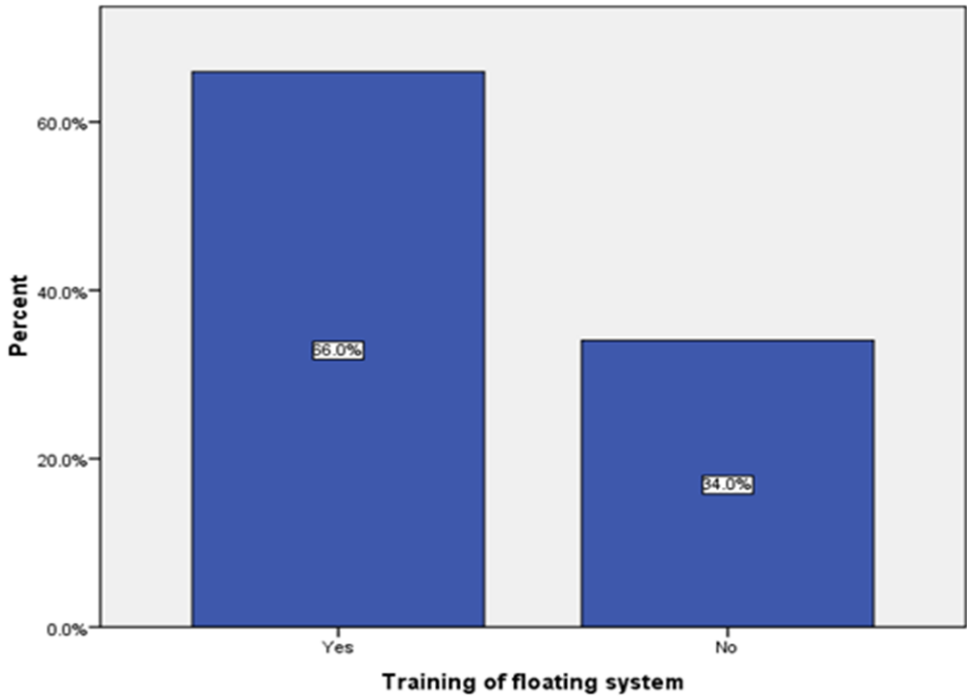


Figure 1. Training of floating trays of farmers in Bindura District, ward 3.

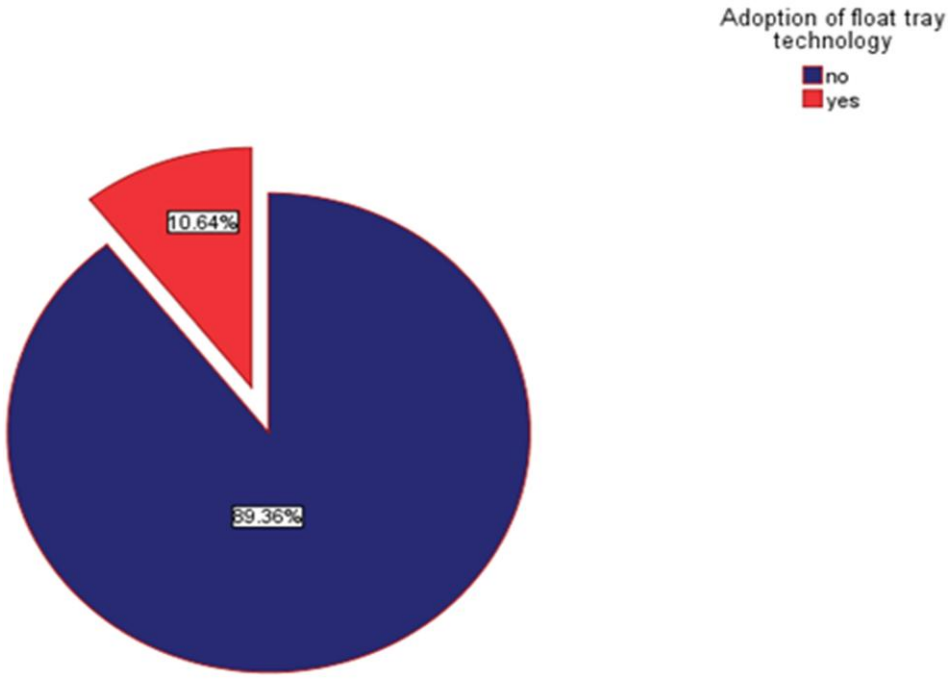


Figure 2. The percentage of adopters and non-adopters of floating tray system in small scale tobacco production.

of a farmer to adopt floating tray system. The t-ratio and the coefficient of variables help to explain and interpret the significance of the variables.

The research (Figure 3) showed that the float tray system uptake by farmers has been quite low because cost of the technology is high therefore the smallholder

Table 3. Effect of factors affecting floating tray system adoption.

Variable	Coefficient	T-ratio	Marginal effect
Age	-0.0034	-0.0029[a]	-0.084
Dependency ratio	0.0091	-0.178	-0.0012
Size of household	0.555	1.562[b]	0.173
Gender	0.026	0.012	-0.0048
Education level	-0.355	1.127[b]	0.041
Training	2.121	1.892	0.4333
Farm size	0.733	1.969[b]	0.0913
Duration	0.0812	1.591[a]	0.0066
Off farm hours	-1.611	0.065[a]	0.0012
Constant	-8.29	1.391	-0.7013
Log likelihood		-60.774	
X^2 (d.f.)	115[b](46)		

Notes: [a] significant at 10%, [b] significant at 5%; The significance is based on p-value, (sig); P-value of the whole model= -2.669; The dependent variable is log (probability of the "adopter"); R^2 = 0.76; Adjusted R^2 = 0.66.

farmers lack initial capital to establish the technology. In addition, the farmers also found the technology to be too technical and complex. Other factors include, lack of knowledge, lack of training, input costs and lack of information.

DISCUSSION

Extent and adoption determinants

Training has shown a valid marginal effect (0.43) in the model meaning that it has great impact in the decision of a farmer to take an innovation. On average, untrained farmers are less likely to participate in float tray seed production as most of them are conservative.

The other factor that affects adoption of the innovation is the level of income a household has. As the farmers' access to income from off farm and non-farm sources increases, the likelihood of participation increases up to some point (Namara et al., 2007). This can mean that an increase in off-farm income, farmers will not willing to adopt new innovations in agricultural productivity as they have the marginal effect of 0.0012. This shows the importance of cash (for leverage in the initial participation decision of farmers). However, at higher levels of off-farm and non-farm income, the farmers are less likely to participate in float tray technology because they have enough money to finance their farming activities and still remain with enough for contingencies. This means that farmers have other sources of income that can be used to cope up with other livelihood option which might be from other enterprises such as soya bean and maize production.

Duration in agricultural activities significantly influences the farmers' decision to use float trays in tobacco seedling. In the context of the studies such as conservation and sustainability, most farmers had on average five seasons under contract. This is constructed in the social dynamics of the communities under review where there are observable trends of dependency on agriculture for survival.

Farmer's age had the expected negative and significant influence on the chances of farmers to use float tray system in tobacco farming. The negative sign for the age variable (-0.0029) could be understood from the commonly observed negative correlation between the age and adoption decision for most technologies in dynamic economic environments. In other words, younger farmers tend to be more willing to adopt than their older counterparts. In most adoption studies, old farmers constitute most of the laggards as much as technology or innovation adoption is concerned. With increase in age farmers tend to shun new farming practices for less demanding procedures and technical skills with low transactional cost associated with them.

Furthermore, older farmers tend to be risk adverse and may avoid innovations in an attempt to avoid risk associated with the initiative. This is because some of the technologies to be used, sunk costs have to be incurred. For example, float tray technology requires more capital to establish as compared to the conventional system, but said to be less costly with time of their use (Mazarura, 2004). So this might discourage older or even some the younger farmers to take up new technologies or innovations .This idea is supported by Rukuni et al. (2006) who argued, that being older creates a conservative feeling among farmers and hence resistance to change. In this study, Baudron (2001) however observed that chances of participation in conservation farming increased with age because youths have little appreciation on the importance of agricultural

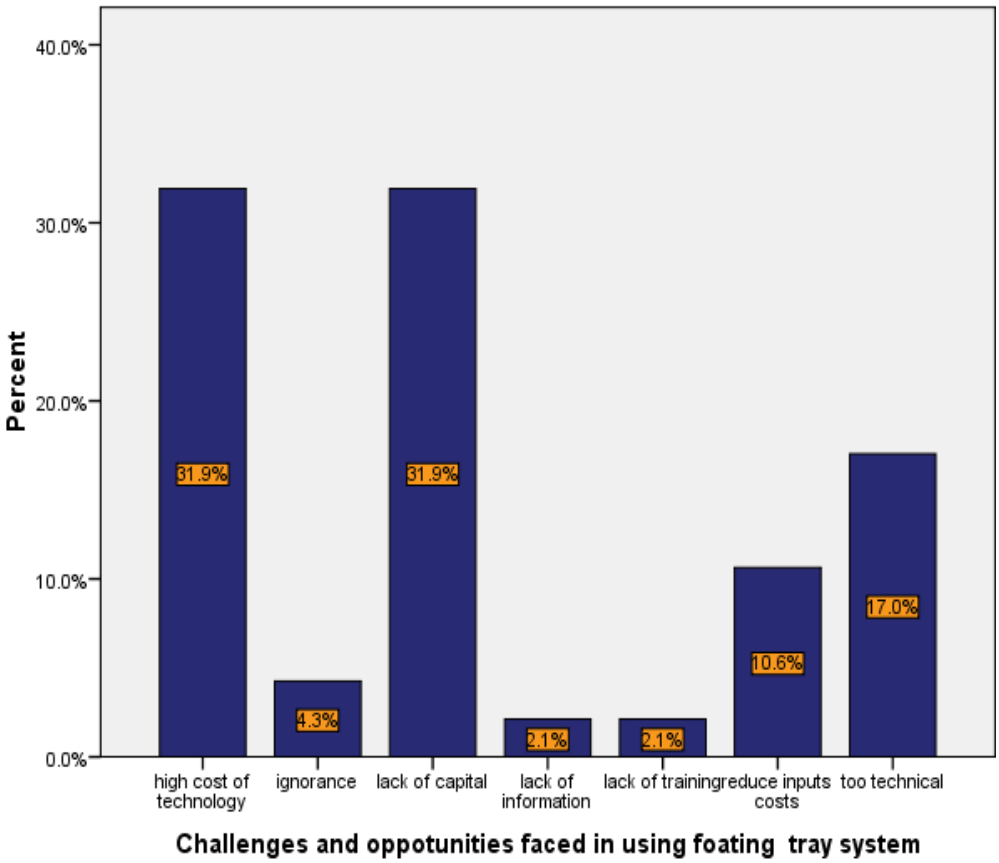


Figure 3. Challenges and opportunities faced by farmers in using the float tray system.

activities in most rural set ups and will take marginal effort to expand these activities. This becomes very relative and similar to those farmers doing tobacco farming.

Education level (as measured by the number of years of schooling by household head) significantly influence farmers' participation but with more years in schooling probability of participation tends to decrease (0.041). A possible explanation to this is that educated people tend to shun agriculture for white colour jobs in Bindura Town and surrounding areas. Some households are more concerned with time value of money and will prefer projects with quick return and profitable like broiler production. However, Thomlow (2007) asserted that education influences household to process information and causes farmers to have better access to understanding and interpretation of information. This tends to differ from what the researcher observed in the field, Ward 3, Bindura district. The researcher observed that farmers who have most number of years in education are not taking up the technology. This may be due to the reason that they have more income generating sources. These farmers tend not to be more concerned about the floating tray system than their little educated counterparts.

Land size significantly influenced farmer decision to use float tray system in tobacco production. A possible explanation to this could be that farmers with large arable land size have the opportunity to spare some sections to try out new practices at less risk. Rogers (1995) supported this by stating that the size of the land is important because the transactional costs are largely fixed cost that are spread across more potential output on large farms. There are also observable indications that highlighted that an increase in participation in tobacco production using floating trays seed is a function of land productivity. Large land size also implies that farmers can use both the conventional and floating tray systems in tobacco seedlings and reduce the inherent risk that is in agricultural tobacco production. This may because some of the farmers want first to try the technology before implementing it as a normal practice in the production. Dependency ratio (that is, the proportion of family members whose ages are less than 14 or more than 65), was introduced into the model as a surrogate for household size to indicate the status of labour availability in the household.

The variable had a positive and insignificant effect on the participation decision. The higher the effective labour available the more likely the household is to participate

since chances of labour shortages during peak times are low. This enhances the chances of favourable seedlings. In most households, adoption of new innovations might be due to avoid labour shortages, since innovations are believed to demand few labour requirements. As household size increases, farmers' chances to adopt new innovations will be reduced.

Gender also has a strong bearing on the adoption decision and women who do much of the farming in the communal setup always tend to opt for less labour intensive farming methods. In the study, results show that young female farmers have higher chances of adopting micro irrigation as compared to older males.

Challenges and opportunities faced by tobacco farmers

Major challenges that faced smallholder tobacco farmers are high cost of technology and lack of capital. Most of the farmers did not adopt the float tray systems because of high costs of the innovation. This may be due to very high entry costs of the innovation. Economic theory suggests that a reduction in price of a good or service can result in more of it being demanded. Therefore, adoption can be expected to be dependent on cost of a technology and on whether farmers possess the required resources. The farmers may not understand that floating tray system is associated with sunk costs. This can be contributed by the age of a farmer who, most of them think that new innovations are very expensive before they even tested it. As supported by Khanna (2001). Technologies that are capital-intensive are only affordable by wealthier farmers and hence the adoption of such technologies is limited to larger farmers who have the wealth.

In addition, changes that cost little are adopted more quickly than those requiring large expenditures; hence both extent and rate of adoption may be dependent on the cost of a technology. In the study area, most of the non-adopters did not take up the technology may be due to fear of the technology expenses. Because the technology is capital intensive, farmers are regarding it as the continuous costs of the system in its life span.

One of the major constraint to the adoption of the technology is this study was its complexity. This is the degree to which an innovation is perceived as difficult to understand and use. Most of the non-adopters believe that the floating tray system is too technical. This may be caused by the interaction between age and educational status variables. For those farmers who had few numbers of years in schooling, had low or no adoption of the technology. The reason may be that, they do not want to continue to acquire new skills and knowledge. In addition, old farmers do not want to take new innovations believing the complexity of the floating tray system.

Furthermore, Rogers (1995) suggested that new innovations may be categorized on a complexity-simplicity continuum with a qualification that the meaning (and therefore the relevance) of the innovation may not be clearly understood by potential adopters. When key players perceive innovations as being simple to use the innovations will be more easily adopted.

The small scale tobacco farmers are resource constraint. The indication of the constraint of lack of capital was found on non-adopters. Technologies that are capital-intensive are only affordable by wealthier farmers and hence, the adoption of such technologies is limited to larger farmers who have the wealth (Khanna, 2001). As a major constraint farmers who do not use the float tray system in the study area presented that the technology was capital intensive. This may be due to limited off-farm activities. There are some activities that generate more income than tobacco farming. These activities would allow farmers to have enough capital to invest in new innovation. Capital is therefore a major constraint that has a serious impact on floating tray system adoption.

Information reduces the uncertainty about a technology's performance hence may change individual's assessment from purely subjective to objective over time (Caswell et al., 2001). So, a farmer must have access to various sources of information about an innovation. This information should be complimented with training of the innovation. The combined effect of information and training is a prerequisite to technology adoption. Good training programs and contacts with producers are a key aspect in technology dissemination and adoption. In the case of Bindura District, Ward 3, the researcher found lack of information and training as some of the valid constraints in floating tray system adoption. This may be due to how often the training programs of floating tray system use were being conducted. Farmers presented these constraints; the reason was that when trainings were done they were not yet tobacco growers. They might have tried the technology but failed to use it due to lack of training.

Challenges faced by adopters

Floating tray system may not always be readily adopted by smallholder farmers because it conflicts with convectional seed bed practices which are inherent in farmers (that is, these practices are mutually exclusive). Some of the problems arise from deep socio-cultural beliefs and downgrading of floating tray technology. Below are some of the challenges faced by farmers:

i. There are labour constrains in the first years of floating tray seed farming. Bed construction includes labour intensive tasks and heavy work for those physically challenged,
ii. Lack of self-confidence: Farmers felt that they may not be able to handle the floating tray system. This is because most of them are resource constrained hence they aim lower production level,

iii. Lack of finance to purchase adequate inputs (pine bark, float trays, and black plastic),
iv. Inability to construct durable and suitable beds,
v. Attack of seedlings by crickets at vegetative stage,
vi. High weed and pest infestations in the first year,
vii. Accumulation of algae in the seed beds in the first year,
viii. Unavailability of pine bark,
ix. Long distance from the research station,
x. Very high initial costs to establish the system.

Opportunities lost by non-adopters

The float tray seedling production system has several advantages over the conventional system:

i. Use of fewer chemicals and smaller quantities,
ii. Employs economical integrated management of diseases and pests,
iii. Uses less water and fertilizers,
iv. Produces superior and more uniform drought tolerant seedlings,
v. Facilitates easier field management, arising from a more uniform crop,
vi. Yield and quality from float seedlings are similar or better than conventionally-produced seedlings.

Conclusions

Extent of adoption

The study indicates that there is low adoption of floating tray system in Bindura district, Ward 3. This came as a result from the one sample t-test employed to compare the means. There was no significant difference between the means, hence accepting of the hypothesis that there is low adoption. A number of factors including age, years in schooling and dependency ratio significantly affect the probability of adopting conservation farming technologies. This therefore, means farmers need to be educated or trained more for them to accept the technology of conservation farming.

As the level of education of the household head increases the likelihood of adopting floating tray technology increases. This confirms the fact that floating tray system need special technical and managerial skills for proper utilization. Costs, capital and training issues are the most constraints that affect adoption of float trays. This highlighted the need for institutional support to the resource constraint farmers.

Recommendations

The researcher recommends that smallholder farmers should be educated on sustainable economic technologies in agricultural production such as floating tray technology. This has long term benefits in sustaining production of those who are resource constrained. It is also worth investing in establishing an innovation platform for tobacco seedling technologies. Research institution in this case TRB can review the efficiency of unsubsidized floating tray system to these smallholder tobacco farmers.

The researcher recommends TRB and AGRITEX to mainly focus on senior farmers in training of new innovations since they have a long time in farming tobacco. This is because, in the study, farmers who have more years in tobacco production are non-adopters of the floating tray technology. To reduce transport costs and uncertainty, the researcher recommends TRB to introduce outlets for provision of floating tray equipment in Bindura district. Challenges and opportunities are some of the variables that influence float tray technology adoption decisions of farmers. If Challenges and opportunities alone is the main determinant of adoption, float tray would have dominated the conventional way of seedling. The successful adoption of floating tray system requires, in addition to challenges and opportunities, two additional preconditions were included:

1. The target beneficiaries need to be aware or knowledgeable about the challenges and opportunity superiority of the technology. This may be achieved through extension services in the form of demonstrations, workshops, etc. Farmers' own attributes such as level of education may also augment or complement the public extension services, as educated farmers are active information seekers and experimenters,
2. The technology need to be accessible to the potential users. Awareness or knowledge does not guarantee actual adoption unless the technologies are made accessible to the farmers through institutional support systems.

REFERENCES

Agriculture Research and Extension (AREX) (2008). Annual report for Bindura District.
Baudron F (2001). Challenges for the Adoption of Conservation Farming by Small holders in Semi Arid Zambia. CIRAD, Harare. Zimbabwe.
De Vaus DA (1996). Surveys in Social Research4th Edition, London UCL Press and Allen and Umwin.
Food and Agriculture Organization *(*FAO) (2010). Corporate Document Repository, Issues in the Global Tobacco Economy.
Government of Zimbabwe (GOZ) (2009). Zimbabwe Policy Framework. Harare. Zimbabwe.
Khanna M (2001). Sequential Adoption of Site-Specific Technologies and its Implications for Nitrogen Productivity: A Double Selectivity Model." Am. J. Agric. Econ. 83:35-51.
Mansfield E (1968). Industrial Research and Technological Innovation. New York: Norton.
Mazarura U (2004). A Guide to the Use of the Floating Tray System for Tobacco Seedling Production in Zimbabwe, Harare.
Namara RE, Nagar RK, Upadhyay B (2007). Economics, Adoption Determinants, and Impacts of Micro-Irrigation Technologies: Empirical Results from India. Irrig. Sci. 25:283-297.

Rogers EM (1995). Diffusion of Innovations.3rd Edition. New York: The Free Press, 1983. 4th Edition: The Free Press, New York.
Rukuni M, Tawonezvi P, Eicher C, Munyuki-Hungwe M, Matondi P (2006). Zimbabwe's Agricultural Revolution Revisited, University of Zimbabwe Publications, Harare.
Thomlow S (2007). Assessment of Sustainable Adoption of Conservation Farming in Zimbabwe.
Zimbabwe Tobacco Production (Z.T.P) Records (2008). Tobacco Production in Zimbabwe.

UPCOMING CONFERENCES

International Conference on Sustainable Environment and Agriculture, Abu Dhabi, UAE, 17 Nov 2013

1st International Conference on Global Food Security, Noordwijkerhout, The Netherlands, 29 Sep 2013

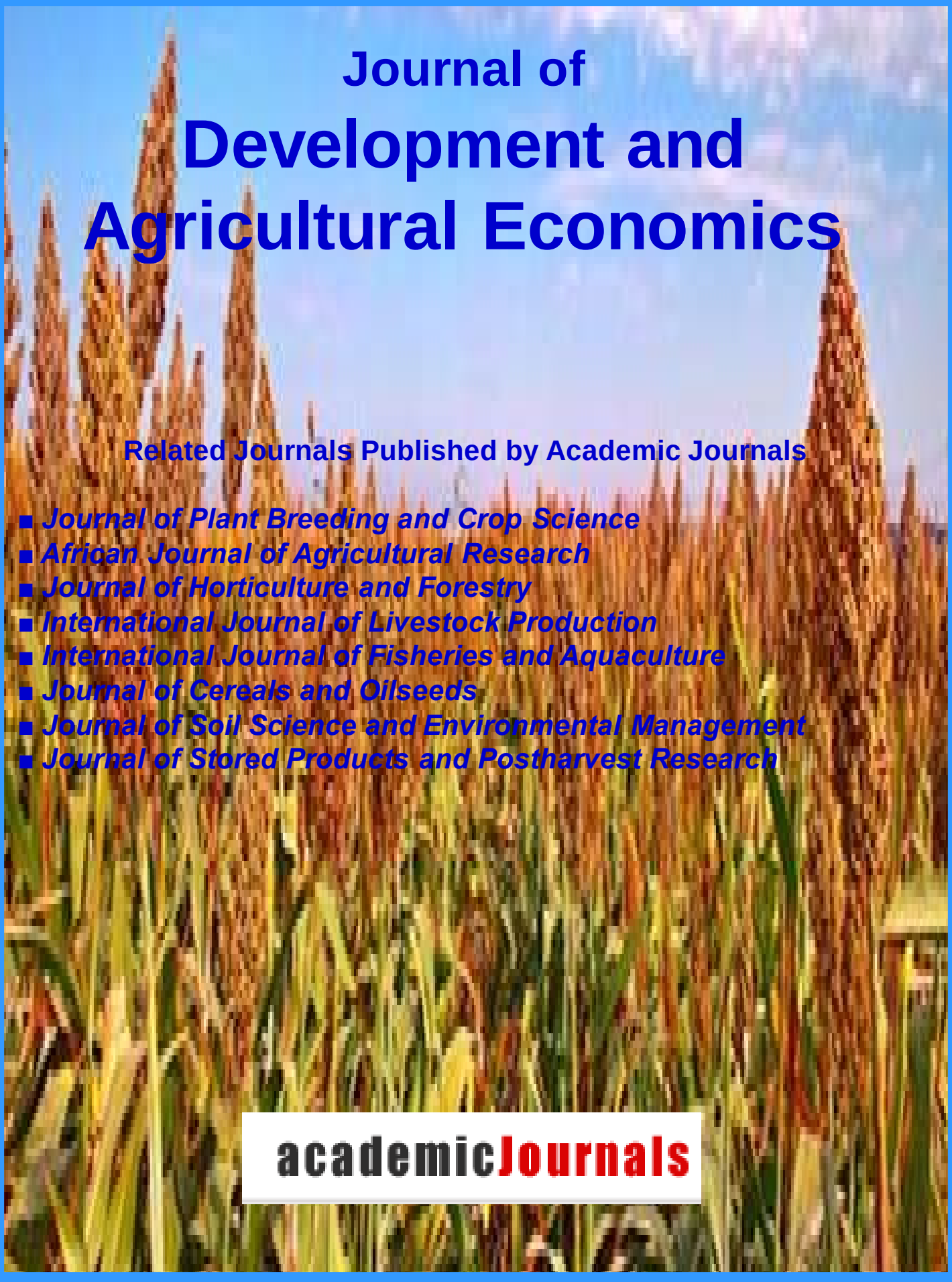
Global Food Security

Sustainable, healthy food for all

Conferences and Advert

November 2013
International Conference on Sustainable Environment and Agriculture, Abu Dhabi, UAE, 17 Nov 2013

September 2013
1st International Conference on Global Food Security, Noordwijkerhout, The Netherlands, 29 Sep 2013



Journal of Development and Agricultural Economics

Related Journals Published by Academic Journals

- *Journal of Plant Breeding and Crop Science*
- *African Journal of Agricultural Research*
- *Journal of Horticulture and Forestry*
- *International Journal of Livestock Production*
- *International Journal of Fisheries and Aquaculture*
- *Journal of Cereals and Oilseeds*
- *Journal of Soil Science and Environmental Management*
- *Journal of Stored Products and Postharvest Research*

academicJournals