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ANALYSIS OF AGRICULTURAL EXTENSION SERVICE AGENTS INFORMATION SOURCES AND SORGHUM PRODUCTION IN BONDO SUB COUNTY, KENYA

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ABSTRACT

Developing countries are facing major challenges today with regard to food security because of changes in land use, coupled with population pressure and adverse weather conditions. Kenya government has responded to this by ensuring that farmers are given relevant information on farming through various sources such as availing information from research institutions, formal training, agricultural extension service agents, and media services through television and radio and from friends, relatives and neighbours. The farmers' agricultural knowledge determines the level of farm performance. The objective of the study was to determine the effect of extension service agents information source on sorghum production in Bondo Sub–County. The study used cross sectional survey design. The study used a target population of 37,296 farmers and a sample size of 380 farmers determined by Yaro Yamane formula (1967). Stratified random sampling was used. Qualitative data was analyzed through content analysis while quantitative data was analyzed by both descriptive statistics and inferential statistics. Pearson (r) Regression Analysis used to determine the effect of agricultural information sources on sorghum production aided by Statistical Package for Social Sciences (SPSS version 23) and Excel. Results were then presented in tabular form. The study findings show that the extension service information sources *(β=.728, F=9.214, R^2 = 0.746, Sig=0.003 at α=0.05)* have significant influence on sorghum production. The study therefore concludes that enhancing extension service agents information sources in increasing the sorghum production in terms of farmers output and subsequently farmers potential income in Bondo Sub County. The study recommends that policy makers in sorghum farming should lay more emphasis in enhancing integrated agricultural information sources in as much as enhancing the agricultural extension service agents' information sources to increase in sorghum production.

KEY WORDS: *Agricultural Extension, Information Source and Sorghum Production.*

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1. INTRODUCTION

The importance of agriculture in the Kenyan economy is profound. Despite the growth of industries and commerce, it continues to be the principal economic activity of the people of Kenya. In the developing countries, about 2.3 to 2.6 billion people are supported by agricultural systems (FAO, 2010). Agriculture contributes 30% of Gross Domestic Product (G.D.P), 75% of the employment and provides nearly all national food requirements in Kenya (Government of Kenya, 2010). According to GoK (2010), small-scale farmers have great potential in increasing agricultural production in less developed countries (LCDs), Kenya included. Additionally, Wanyama and Changach, (2013) noted that 85% of the Kenyan people live in rural areas and most of them in smallholder areas where farm units are only approximately 2 hectares. Despite enormous efforts to industrialize, Kenya remains an agricultural nation with the majority of its people, 85% living in the rural areas and depending on agriculture directly or indirectly for their livelihoods.

In recent years, agricultural production has not kept pace with population growth rate and today Kenya is facing one of the worst food crises in the last sixty years and has become a net importer of its major staple foods, maize and wheat. Food security refers to the condition in which all people, at all times, have physical, social, and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2010). Food availability, stability of supplies and food access are related determinants of food security. At the household level, food security implies an adequate access to food over time. This is possible when there is adequate food availability to the household, and an adequate income capacity for the purchase of the available food. Stability of food implies that the food availability is not affected by any shocks or risks affecting food production at all times. Food access has three components: physical access to food; economic access to food; and sustainable access to food. Availability of food, stability of food supplies and access are therefore three essential determinants of food security. Physical access implies food availability or food supply to the household, as there might

African Journal of Business and Industry
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be food available at the national level, which however may not trickle down to the household level.

A number of factors such as income, educational level, and household sizes are known to affect household food security, as they directly influence economic access and the sustenance of such access. Lack of food security, referred to as food insecurity, hunger, and poverty are closely linked. For farm households in rural areas, food availability means ensuring that sufficient food is available for them through their own production or purchase from markets. However, due to lack of adequate storage facilities and pressing needs, they mostly end up selling excess produce during the harvesting period. Sometimes they rely on market purchases during the hungry season, thereby creating a food insecurity situation for most rural farm producers and households. Efforts at achieving food security may also exact a heavy toll on households if they must spend most of their income on obtaining food. Production improvements are possible only if a differential exists between the actual production on the farms and what could potentially be produced with better expertise. Agricultural education is a key pillar of the economy of Kenya (Wanyama and Changach, 2013). Some benefits of agriculture education include greater value of outputs, greater physical production and quality improvements.

Sorghum is widely grown as a food crop in Sub-Saharan Africa, but commercialization has proved difficult for several reasons. Sorghum is grown in marginal, semi-arid environments characterized by low and erratic rainfall. In drought years, growers prioritize household food security and are reluctant to sell, making it difficult for buyers to ensure a consistent supply. Semi-arid environments are also characterized by low population density, poor infrastructure, and limited access to markets, which raises transaction costs and reduces incentives for both growers and buyers. Recently, competition for Africa's growing beer market has stimulated commercialization of sorghum to produce clear sorghum beer. The development of the value chain for sorghum beer has involved partnerships between national governments, multinational companies, plant breeders, intermediary suppliers, and sorghum growers (Van J., Wijk and Kwakkenbos, 2011).

Competition between multinational breweries has spurred the rapid spread of this value chain and sorghum beer is currently produced in Nigeria, Ghana, Sierra Leone, Kenya, Uganda, and Zambia. Multinational breweries view the value chain for sorghum beer as a model for 'inclusive business' that can be replicated across Africa (Diageo, 2013). Increased demand for local sorghum is expected to benefit smallholders and contribute to poverty reduction. However, there has been no systematic evaluation of the benefits to small-holder farmers from the value chain of sorghum beer

African Journal of Business and Industry
Volume 1, Issue 4, February 2018, PP 212-224
ISSN 2413-3213 (Print) & ISSN 2413-3213(Online)

in Kenya or whether it is justified to describe this value chain as 'pro poor'. World sorghum production in 2014 was 10,988 MT in United States, 7,300 MT in Mexico, 6,300 MT in Nigeria and 140 MT in Kenya being number 33 in the world. United States consumes most of the sorghum through intermediary livestock. The consumption in Nigeria stands at 6100MT, in India 4200MT, in Ethiopia 4000MT and in Kenya 200MT and this shows a deficit of 60MT.Sorghum is a cereal crop utilized as human food with a potential of providing food security in arid and semi-arid lands where many cereal crops produce little yield (Mamoudou, 2006). It is characterized by extensive root system and waxy bloom on leaves that reduces water loss (Paterson, 2008). Sorghum grows in areas of altitude 500 metres - 1700 metres above sea level (m a.s.l.), with an annual rainfall of 300mm. Among other areas, sorghum is produced in Makueni (1385m a.s.l), Siaya (1190m a.s.l) and (1967m a.s.l) Nakuru County. The production areas are characterized as semi-arid low lands, moist humid and cold highlands. Sorghum can replace maize (Zea mays L.) as staple food in case of crop failure as it is closely related to maize in utilization hence an alternative crop in marginal areas (Swigonova et al., 2004). Sorghum is used as human food as well as animal feed and industrial raw material (Mamoudou et al, 2006). As food, the grain is used in making porridge and thick porridge. It has a large germplasm collection that provides great opportunities for a sustainable crop production (Huang, 2004).

Sorghum production is mainly by small-scale farmers. Production constraints are lack of inputs and plant poor quality seeds as own saved seeds, obtained from neighbours or market, diseases and pests, these results in low yields. The demand for sorghum grains by the brewing industry is high yet the amount produced by farmers is low as it averages at 0.85 tons /ha (Gerda and Christopher, 2007). Low production is also attributed to infestation by the birds like Sudan Dioch (Queleaquelea), pests, poor drying of harvested grains and storage practices (Bannett and Hunter, 2003). Seed quality is important for a good seedling establishment and crop development, yield and quality grains (Muasya et al., 2008). Majority of farmers thresh their seed and damage them due to the breaking of seeds into small pieces hence reducing the seed quality. When seeds within a seed cot are broken into pieces, the embryos are damaged hence reducing the germination capacity of the seeds. The practice of drying sorghum panicles in direct sunlight by farmers has led to reduced seed quality. When seeds are dried at high temperatures, they lose vigour and viability. Loss in quality and quantity in cereal grains during storage is caused by fungi. The ecosystem within stored grain structures is limited in microbial species because of human efforts to maintain grain quality (Muasya et al., 2008).

African Journal of Business and Industry
Volume 1, Issue 4, February 2018, PP 212-224
ISSN 2413-3213 (Print) & ISSN 2413-3213(Online)

Agricultural extension is considered an important Service in increasing agricultural production and attaining Sustainable development. Its role is to help people identify and address their needs and problems. In some cases, Agriculture Ministries use extension to achieve government Goals that may or may not coincide with farmers' Objectives. If applied successfully, agricultural extension should result in outcomes, which include observable Changes in attitudes and adoption of new technologies, and improved quality of life based on indicators such as Health, education and housing. In both developed and developing countries, benefits from investment in Extension and research have been reported to range from 30-60%. It has been recognized that Agricultural extension accelerates development in the presence of other factors such as markets, agricultural Technology, availability of supplies, production incentives, and transport (Gerda and Christopher, 2007).

2. STATEMENT OF THE PROBLEM

Sustainable Development Goals place heavy emphasis on food security. However, Kenyan people have continued to experience declined production of staple foods (Ariga, 2010). (Muasya et al., 2008) indicated that small-scale farmers have great potential in increasing agricultural production when provided with necessary agricultural information on production, technology adoption and relevant farm inputs. FAO (2010) suggested that in order to enhance agricultural development, new commodities and new methods of production must be developed. In Kenya, various agencies, research institutes, agricultural universities/colleges and nongovernmental organization develop these new methods of production. Despite the availability of these interventions, Bondo Sub County has continued to suffer food insecurity. The question is, does this information reach the farmers and how does it influence the production? The study therefore investigates the influence of sources of agricultural information on sorghum production in order to determine the gap between agricultural information and sorghum production.

3. OBJECTIVE OF THE STUDY

The main objective of the study was to establish the effect of agricultural extension service agents' information sources on sorghum production in Bondo-District, Kenya.

African Journal of Business and Industry
Volume 1, Issue 4, February 2018, PP 212-224
ISSN 2413-3213 (Print) & ISSN 2413-3213(Online)

4. RESEARCH QUESTION

This study was guided by the following research question: What is effect of agricultural extension service agents' information sources on sorghum production in Bondo-District, Kenya?

5. LITERATURE REVIEW

Abu (2013) conducted a study on the impact of extension contact on crop income with a view to evaluate the agricultural extension in Bangladesh. Abu (2013) used 1000 farmers and collected data using field surveys and multistage random sampling technique. The results indicated that the impact of extension contact coefficient on crop income was positive and strongly significant. This, however, does not give the exact influence of extension service on sorghum production, which forms the basis of this study.

Owens (2001) study on the impact of agricultural extension on farm production in resettlement areas of Zimbabwe established that access to farm-level extension visits does increase sorghum production though he said results from single-year cross-sectional studies should be treated with caution. This study focused on a single year cross sectional study, so in consideration of Owens, (2001) study caution, the study tries to establish the effect of agricultural information sources on sorghum production taking caution on irregular trends. The study also tries to establish the extent to which extension service influences sorghum production as compared to Owens, (2001) finding of 15%.

Adam, E.A., Kuhlmann F., Mau M., Elobeid, H. A. & Elamin E.M., (2005) analysed the "Factors Affecting Sorghum Production in the Gezira Scheme – Sudan and Implications on the Household Food Security". The findings indicated that an extension agent service is one significant factor in explaining sorghum production. Whereas the study found that sorghum production increased by 67% attributed to different factors including extension agent service, the individual statistical contribution for extension agent service on sorghum production was not captured. The focus of this study is thus to establish the extent to which the extension service as a source of agricultural information statistically influences sorghum production.

Nambiro E., Jonas C. & Alice M., (2010) conducted a study on the impact of extension service on farm crop production in Kenya. The study used cluster sampling with a sample size of 154 farmers in Kakamega. The study used a 2–step estimation technique (Data Envelopment Analysis (DEA)

African Journal of Business and Industry
Volume 1, Issue 4, February 2018, PP 212-224
ISSN 2413-3213 (Print) & ISSN 2413-3213(Online)

and Tobit Model) to evaluate the extent to which the extension service as a source of agricultural information statistically influences farm crop production. The DEA model involves use of linear programming methods to conduct a non-parametric piecewise surface (or frontier) over the data to calculate efficiencies relative to this surface (Coelli et al., 2002). DEA can be either Constant Return to Scale (CRS) or Variable Return to Scale (VRS). CRS is appropriate when all DMUs are assumed operating at an optimal scale, or otherwise VRS is appropriate. Sorghum farmers in the study areas were found to experience variations in agricultural production occasioned by factors such as financial constraints, imperfect competition, fluctuating input prices and unreliable labour supply. The use of VRS was assumed appropriate in order to account for these variations. Technical efficiency was estimated based on output-orientation where a HH produces maximum output given a level of inputs and it determines the maximum proportional increase in output produced with inputs level held fixed.

In DEA, the performance of a farm is evaluated in terms of its ability to either shrink usage of an input or expand the output level subject to restrictions imposed by the best-observed practices (Gul et al., 2009). Data was disaggregated into farmers with and those without access to soil-related agricultural information services from extension agents. The results shows that farmers with access to soil-related agricultural information services from extension agents were more technically efficient (average technical efficiency of 90%) in crop production compared to those without access to agricultural information services from extension agents (technical efficiency at 70%). The study, however, used maize instead of sorghum, which could have had different parameters in question. This study thus uses a cross-sectional survey design with a sample size of 380 to establish the extent to which the extension service as a source of agricultural information statistically influences sorghum production in Kenya.

6. RESEARCH METHODOLOGY

The study used a descriptive cross-sectional survey design. It involved gathering data that described events and then organized, tabulated, depicted, and described the data collection. The choice of this design was appropriate for this study since it is restricted to fact-finding and is relatively easy to carry out within limited time. The study used structured questionnaires and focus group discussions as data collection instruments. The study used cross sectional survey design. The study used a target population of 37,296 and a sample size of 380 determined by Yaro Yamane formula (1967). Stratified random sampling was used. Primary data was collected through

African Journal of Business and Industry
Volume 1, Issue 4, February 2018, PP 212-224
ISSN 2413-3213 (Print) & ISSN 2413-3213(Online)

structured questionnaires. The structured questionnaire by definitions is a group of structured questions with each item in the questionnaire developed to address a specific objective or research question of the study (Mugenda and Mugenda, 2003). This tool of data collection was chosen due to the ease with which it could be administered. With the help of research assistants, the questionnaires were then dropped to the targeted respondents and collected one week later.

7. DATA ANALYSIS

The data collected using questionnaires were analyzed quantitatively using inferential and descriptive statistics and tested using Pearson chi-square test of independence at 0.05 the level of significance to assess associations. In order to ensure logical completeness and consistency of responses, the completed questionnaires were checked thoroughly by editing, coding, entering and then presented in comprehensive tables which would show the responses of each category of variables and analyzed through descriptive and inferential statistics. Quantitative data generated was keyed in and analyzed aided by the use of Statistical Package of Social Sciences (SPSS) version 23 to generate information which was presented using tables, frequencies and percentages

8. RESEARCH FINDINGS AND DISCUSSION

Regression analysis was used to establish the effect of agricultural extension service agents' information sources on sorghum production in Bondo District, Kenya. Precisely, the following linear model was used:

$$Y = \beta_0 + \beta_1 X_1 + \varepsilon$$

Where Y stands for sorghum production, while β_0 is the intercept(a constant), β_1 is the slope associated to the independent variable (X_1) and ϵ is the error term which is assumed to be independent, identical normally distributed random variable with a zero mean and a constant variance. In this study, X_1 denotes agricultural extension service agents' information sources. The finding was tabulated as shown in Table 8.1.

AJOBI
African Journal of Business & Industry

African Journal of Business and Industry
Volume 1, Issue 4, February 2018, PP 212-224
ISSN 2413-3213 (Print) & ISSN 2413-3213(Online)

Table 8.1: Correlation Coefficient Analysis of Extension Service Agents Information Sources and Sorghum Production (Quantity Output)

Model	Unstandardized Coefficients		Stand. Coef.	t	Sig.
	B	Std. Er.	Beta		
	2.345	1.05		2.475	.000
	.728	**.017**	**.711**	**2.221**	**.003**
R	.892				
R-squared	0.796	Mean dependent variable		1.877	
Adjusted R-squared	0.746	S.D. dependent var		0.685	
F-statistics	9.214	Durbin-Watson statistic		1.766	
Prob(F-statistics)	0.003	Standard Error of Estimate		0.0256	

Source: Survey Data (2018)

Table 8.1 displays the summary of the model used which assess its best fit to the data and its coefficient estimates in an attempt to investigate the effect of extension service by agents on the sorghum production in Bondo Sub County. From table 8.1, column 2, it is observed that R^2 which is the models goodness of fit for the regression line obtained is 0.796. This means that 79.6% of variation in the dependent variable-sorghum production is being explained by the variation in independent variable-extension service agents with only 20.4% of the variation in dependent variable (sorghum production), being attributed to the error-term introduced in the theoretical model or other variables other than extension service agents. The correlation coefficient, denoted in table 8.1, column 2 by R, between the variables under study, precisely between extension service agents and sorghum production is 0.892. From statistical point of view, since R=0.892 is quite close to 1, this finding suggests there is a positive and indeed strong association between the variables studied. Concretely, this suggests that any input in terms of extension service agents engineered by sorghum farmers will lead into more sorghum production in Bondo Sub-County. From table 8.1, column 2, it is observed that the computed F statistic (10, 276) is 9.214 and in column 2, the p-value for the overall regression relationship is (p = 0.003), which is less than 0.05 the level of significance. This indicates that the model used is a best fit for the data used, given all assumption of normality underlying the model. The Durbin-Watson statistic of 1.766 < 2.0 indicates that there is a positive serial correlation among the observation. This could be the reason why the model did not capture much of the variations in the dependent variable.

AJOBI
African Journal of Business & Industry

African Journal of Business and Industry
Volume 1, Issue 4, February 2018, PP 212-224
ISSN 2413-3213 (Print) & ISSN 2413-3213(Online)

Table 8.1 displays also the standard error of the estimate, which read, in column 5, 0.256 that is a measure of standard deviation around the fitted line. This measure suggests that about 95% of the prediction error in sorghum production is less than ±1.96 (0.026) = 0.0510. It can be further be observed that, from the current findings, this significance can be extended to 0.01, or 99.99% confidence interval, since p-value of 0.003 remains much less than 0.01 or a 1% level of significance. From table 8.1, the regression equation deduced to understand this relationship was:

$$P_{QUANTITY} = 2.345+0.728X_1$$

where P is sorghum production and X_1 is extension service agents. From the above equation, it can be observed (drawn from column 2) that there is a positive unstandardized beta coefficient of 0.728. This indicates that a unit change in extension service agents will increase sorghum production in terms of quantity in Bondo Sub-County by 0.728 units, while keeping the effect of formal education and mass media constant. With a p-value of $0.03 < 0.05$, in column 6, it can be concluded that extension service agents has a statistically significant effect on sorghum production in Bondo Sub-County ($F=9.214$, $R^2 = 0.746$, $Sig=0.003$ at $\alpha=0.05$). This finding tends to compare with that of Abu, (2013) in Bangladesh who used 1000 farmers and collected data using field surveys and multistage random sampling technique to assess the impact of agricultural extension on crop production in terms of income, which is a subject of quantity produced. The results indicated that the impact of extension agents on crop income was positive and strongly significant. This, however, did not give the exact influence of extension service on sorghum production, which this study puts at 0.728 units for quantity. Similarly, Owens, (2001) study on the impact of agricultural extension on farm production in resettlement areas of Zimbabwe established that access to farm-level extension visits does increase sorghum production though he said results from single-year cross-sectional studies should be treated with caution.

9. CONCLUSION AND RECOMMENDATION

9.1 Conclusion of the study

In any economy, crop farming especially sorghum production, which serves as one of the food security crops in Africa championed by sufficient agriculture information sources, would be a major pillar for economic development. It would provide several employment opportunities to the various segments of country's labour force besides offering nutrition hence uplifting the living

African Journal of Business and Industry
Volume 1, Issue 4, February 2018, PP 212-224
ISSN 2413-3213 (Print) & ISSN 2413-3213(Online)

standards to many people for further economic development. Due to this, the study sought to establish the agriculture information sources on the sorghum production in Bondo Sub County. The objective sought to determine the effect of agriculture extension service agents on the sorghum production in Bondo Sub County. The study therefore concludes that agriculture extension service information source have a statistically significant effect on sorghum production in Bondo Sub County with a correlation coefficient of β=*.728* for sorghum production in terms of quantity.

9.3 Recommendation of the study

The study recommends that policy makers in sorghum farming should lay more emphasis in enhancing integrated agricultural information sources in as much as enhancing the agricultural extension service agents' information sources to increase in sorghum production.

REFERENCES

Abu Z. M (2013), The Impact of Agricultural Extension Contact on Crop Income in Bangladesh. Bangladesh, *Journal of Agricultural Research*, Vol 38, Issue 2: 321-334. ISSN 0258-7122

Adam, E.A., Kuhlmann F., Mau M., Elobeid, H. A. & Elamin E.M., (2005), *Analysis of Factors Affecting Sorghum Production* in the Gezira Scheme – Sudan and Implications on the Household Food Security, *Conference on International Agricultural Research for Development.* Stuttgart-Hohenheim, October 11-13, 2005.

Amin, M.E. (2005), *Social Science Research Conception, Methodology and Analysis*, Kampala, Makerere University Printery.

Ariga J, Jayne TS & Njukia S, 2010. Staple food prices in Kenya. Report prepared for the COMESA Policy Seminar on "Variation in staple food prices: Causes, consequences, and policy options", under the Comesa-MSU-IFPRI African Agricultural Marketing Project (AAMP), 25–26 January, Maputo, Mozambique. Available at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.193.6211&rep=rep1&type=pdf

Barnett,H.L. and Hunter, B.B. (2003). *Illustrated Genera of Imperfect Fungi*. (3rd edition), Burgess Publishing Co., pp. 273

Coelli, T., Sandura, R. and Colin, T. (2002). Technical, Allocative, Cost and Scale in Bangladesh Rice Production: A Non-parametric Approach. *Agricultural Economics*, 53, 607-626.

African Journal of Business and Industry
Volume 1, Issue 4, February 2018, PP 212-224
ISSN 2413-3213 (Print) & ISSN 2413-3213(Online)

Cronbach, L.J. (2004), My Current Thoughts on Coefficient Alpha and Successor Procedures. *Education and Psychological Measurement,* 64; 391-418.

Diageo (2013), Annual Report, Diageo.

FAO, (2010), Agricultural Sector Strategy: A Shared Vision 2011-2013, Palestinian National Authority. http://www.lac.ps/documents/(accessed on June 20 2016)

GoK, (2010), Agricultural Sector Development Strategy (2010-2020), Nairobi Printers.

GoK, (2010), GOK Reviewed and Project Document for Coordinating and Accelerating Millennium, Nairobi Printers.

GOK, (2010), Kenya Agriculture Sector Development Strategy 2010-2020, 2010, Implementation. First Draft (Volume 1and 2)

Government of Kenya. (2010). Economic Review of Agriculture. Nairobi: Ministry of Agriculture, Nairobi, Kenya.

Gul, M., Koc, B., Dagistan, E., Akpinar, M. G. and Parlakay, O. (2009). Determination of Technical Efficiency in Cotton Growing Farms in Turkey: A case study of Cukurova region. *African Journal of Agricultural Research*, Vol. 4 (10), pp 944 - 949.

Gerda, M. B. & Christopher, D. V. (2007). Can GM sorghum impact Africa? *Trends in Biotechnology*, 26(2), 64-69.

Huang, Y., (2004). Evaluation of genetic diversity in sorghum germplasm using molecular markers. *In* Proceedings of the XII International Plant and Animal Genomics Conference, San Diego, Calif., held 10–14 January 2004. *Edited by* S.R. Heller. p. 138.

Maunder, B (2006), "SORGHUM; the Global Grain of the Future", from National Sorghum Producers, www.sorghumgrowers.com/sorghum+101, (Accessed on March 16 2015)

Mamoudou HD, Hurry G, Alfred S, Alphons GJ, Van B. 2006. Sorghum grain as human food in Africa: relevance of content of starch and amylase activities. African Journal Biotechnology 5, 384 - 395.

African Journal of Business and Industry
Volume 1, Issue 4, February 2018, PP 212-224
ISSN 2413-3213 (Print) & ISSN 2413-3213(Online)

Muasya RM, Lommen WJM, Muui CW, Struik PC. 2008. How weather during development of common bean (Phaseolus vulgaris L.) affects the crop's Maximum attainable seed quality. *NJAS-Wageningen Journal of Life Sciences,* vol. 56, 85-100.

Mugenda, O.M., Mugenda, A.G, (2003). Research Methods. Quantitative and Qualitative Approaches. Nairobi: Acts Press.

Nambiro, Elizabeth; Chianu, Jonas; and Murage, Alice, (2010), Agricultural information services and technical efficiency among maize producers in Kakamega, Western Kenya, Contributed Paper presented at the *Joint 3rd African Association of Agricultural Economists (AAAE) and 48th Agricultural Economists Association of South Africa (AEASA) Conference*, Cape Town, South Africa, September 19-23, 2010.

Ownes, T., Hoddinott and B. Kinsey, (2003), The Impact of Agricultural Extension On Farm Production Resettlement Areas of Zimbabwe. *Economic Development & Cultural Channels*, Vol. 51, Issue 2: 337-357.

Paterson, H. Andrew, (2008), Genomics of Sorghum, *International Journal of Plant Genomics*, Volume 2008.

Sekaran, U. (2006), Research Methods for Business: A skill building approach, 4th edition. New Jersey: John Wiley and Sons, Inc.

Swigonova Z, Lai J, MA J, Ramakrishna W, Llaca V (2004), Close split of sorghum and maize genome progenitors. *Genome Res*. 14:1916–1923.

Wanyama Pius and Changach John (2013) Education Reforms in Kenya for Innovation, *International Journal of Humanities and Social Sciences,* Vol. 3, No. 9.

Van, J., Wijk & Kwakkenbos, H. (2011). Beer multinationals supporting Africa's development, How partnerships include smallholders into sorghum-beer supply chains. In: Van Dijk, M.P. & Trienekens, J., (2013), Promoting Sustainable Global Value Chains: The Role of Governance. Amsterdam: Amsterdam University Press