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Full Length Research Paper

Influence of institutional factors on Sorghum production in Nakuru County, Kenya

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Agriculture in Kenya plays an important role in development as it contributes about 24% of GDP, 75% of industrial raw materials and 60% of export earnings and about 18% of the total formal employment. It also employs about 3.8 million people in farm, livestock production and fishing, while an estimated 4.5 million other people are employed in agriculture-related off-farm activities. Cereals including maize, sorghum, millet, and wheat among others largely constitute the major food items for many households, hence underlining their importance in ensuring food security. In particular, the utility of sorghum is in its climatic adaptability and household as well as industrial use. Hence it is not only a food security crop, but also a major income earner. Despite its utility, there is a remarkably low production of sorghum among Kenyan farmers against food security challenges. This paper provides insights into the institutional characteristics of farmers and how they influence their participation in its production. The institutional factors under study included access to sorghum seed, access to credit, access to contract farming, access to market information and group membership. Simple random and snowball sampling methods were applied in collecting data from 207 farmers using a questionnaire. Data collected was analyzed by the double hurdle model. Only access to seed, access to extension, access to market information and access to group membership were significantly influencing sorghum production in the study area. It was recommended that seed companies should avail improved sorghum varieties and farmers are encouraged to adopt them. There was also need for stakeholders to institutionalize access to extension, contract farming and group membership among farmers.

Key words: Sorghum production, institutional factors, Nakuru County.

INTRODUCTION

Agricultural productivity is needed for growth in the agricultural sector since the actual yields of major crops in Kenya are far below the potential yield (Karugia, 2003). There is need to expand areas under crop production and this could mean venturing into dry areas, hence the need for drought tolerant crops like sorghum to bridge this gap. Sorghum is a very important source of food and farm income for smallholder farmers, which can be enhanced especially if linked to new markets (Hamukwala et al., 2010). Sorghum is important to a substantial number of farm households in the East African region, especially in the semiarid areas. Most cultivars of these drought resistant grains represent food for the household, and cash income if there is a market for the sale of surplus production. Some cultivars are also grown for brewing, which offers another source of cash (Schmidt, 1988).

Sorghum performs well in areas between 500 and 1700 m above sea level, with seasonal rainfall of 300 mm and above. The disease that affects the crop is mostly the sorghum midge, which is one of the most damaging and

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widely distributed in all sorghum growing regions of Africa (EPZA, 2005).

In Kenya, sorghum is grown principally in the often drought-prone marginal agricultural areas of Eastern, Nyanza and Coast Provinces. Farm production went up from 118,227 tonnes in 2002 to 126,433 tonnes in 2003 (EPZA, 2005). Production of sorghum increased by a dramatic 75% from 602,910 bags in 2008 to 1,055,051 bags in 2009 with some slight improvement on the yield per ha to 6.09 bags, which is much lower compared with the 14.0 bags/ha recorded in 2005 and 10.5 bags/ha recorded in 2007. The area under the crop also registered an increased acreage to 173,172 ha in 2009 from 104,041 ha in 2008, a 67% increase. The acreage further increased to 254, 125 ha in 2011 from 225,762 ha in 2010, a 13% increase. This increase is attributed to increased area dedicated to the crop on account of being drought resistant and hence a primary poverty eradication vehicle especially in marginal areas (MOA, 2012).

Over the years, Kenya has experienced diminishing rainfall amounts probably due to the effects of the global climate change. This has led to decreased food production making her a food deficit country with most areas receiving relief food supplies in many of the years. This has necessitated the government to come up with programmes to encourage the growing of drought tolerant crops like sorghum as a means of ensuring food security and improved incomes. The demand for sorghum is gradually increasing owing to industrial needs such as in brewing by East African Breweries. However, sorghum production remains low despite the added agribusiness benefit.

Though Nakuru County is among the high potential areas for sorghum, indications are that only a few farmers are engaged in commercial production and that the farmers are not able to produce sufficient quantities for consumption and get surplus for sale. The current status of sorghum cultivation in the County is not clear and underlying factors to lack of response to emerging trends in sorghum demand needs to be determined if the crop's production is to be effectively promoted. However, there has been paucity of research with regard to the institutional characteristics of sorghum producers and the acreage under sorghum production. There is therefore need to analyze the institutional factors influencing participation and extent of sorghum production as an initial step to finding the solution to increasing sorghum cultivation among smallholder farmers in Nakuru County.

METHODOLOGY

Study area and data collection

The study was conducted in Njoro and Rongai Districts in Nakuru County. Nakuru County lies within the Great Rift Valley and borders eight other districts namely, Kericho, and Bomet to the West, Koibatek and Laikipia to the North, Nyandarua to the East, Narok to the Southwest and Kajiado and Kiambu to the South. The County covers an area of 7,235.3 km^2 and is located between longitudes 35" 28" and 35" 36" and latitudes 0" 12" and 1" 10" South (NCAPD, 2005). It lies about 2100 m above sea level.

Rongai district comprises four divisions, eighteen locations and thirty seven sub-locations. It falls within an altitude range of between 1650-1850 m above sea level (a.s.l) with a temperature range of between 17 and 29°C. There are three agro-ecological zones namely Lower Highland 3 (LH_3), Upper Midland 2 ($UM_{2)}$ and Upper Midland 3 (UM_3). The annual rainfall is between 600-1000 mm as per the 2009 census, the district population is 142,127 with 33,868 farm families which form 24% of the population (Jaetzold and Schmidt, 2010). The major crops in the district include maize, wheat, sorghum, finger millet, cow peas, beans, Irish potatoes, sweet potatoes, fruits and vegetables and cassava, whereas the major livestock include dairy cows, dairy goats and poultry.

Njoro district comprises four divisions, twenty one locations and forty four sub-locations. There is a wide variation in altitude with Mauche lying within 2100-2500 m a.s.l, Mau Narok 1700-2850 m a.s.l and Lare 1650-2200 m a.s.l. with a temperature range of between 11 and 24.5°C. The district has diversified climatic conditions ranging from semi arid (Naishi in Lare) and highland in Mau Narok. The divisions lie within varied agro ecological zones with Mauche lying within UH1, UH2, and LH, Mau-Narok lying within UH1, UH2, and LH, Njoro lying within UH2, UH3 and LH3, while Lare lying within LH2, LH4 and UM3. The annual rainfall is between 600-1800 mm as per the 2009 census, the district population is 287,648 with 35,012 farm families which form 12.17% of the population (Jaetzold and Schmidt, 2010). The major crops in the district include Maize, Beans, Wheat, Irish potatoes, Cabbages, Kales, Carrots, Pyrethrum, sorghum whereas the major livestock include dairy cows, dairy goats, sheep and poultry.

The study was targeting both sorghum and non-sorghum farmers. Samples were obtained from Njoro division of Njoro District, and Kampi Ya Moto division in Rongai District which were purposively selected.

In Kampi Ya Moto Division, simple random sampling was applied in order to choose a sample of 105 farmers from a sample frame that was provided by the District Agricultural office. This method of sampling involved giving a number to every member of the population in the sampling frame, placing the numbers in a container and then picking any number at random. The subjects corresponding to the numbers picked were included in the sample.

In Njoro Division, both purposive and snowball sampling were applied. In the division, the number of sorghum farmers was so small as compared to non sorghum farmers and not well known and hence simple random sampling alone could not be used. Snowball

sampling is useful when the population that possesses the characteristics under study is not well known and there is need to find subjects. Purposive sampling was first used to identify sorghum farmers in the division who will form part of the sample. Snowball sampling was then applied using the purposively identified cases to identify more sorghum farmers to form part of the sample. In snowball sampling, initial sorghum farmers were identified using purposive sampling technique. The few identified farmers were then asked to name others that they knew to be producing sorghum until the list was exhaustive. Then simple random sampling was applied to select non sorghum farmers from the sampling frame until the desired sample size of 102 farmers was attained.

Analytical technique

The double hurdle regression model was used in this study. It models non-participation and potential participation apart from the observed participation. It is a two tier decision or selection equation and the outcome depends on the selection to participate. The empirical model is as shown below:

Double hurdle empirical model:

$y_{i1}^{*} = Q_i'\alpha + v_i$ Participation decision

$y_{i2}^{*} = X_i'\beta + u_i$ Extent of participation

$y_i = X_i'\beta + u_i$ If $y_{i1}^{*} > 0$ and $y_{i2}^{*} > 0$

$y_i = 0$ Otherwise

Where:

y_{i1}^{*}: Latent variable describing the household's decision to participate in sorghum production

y_{i2}^{*}: Latent variable describing households' extent of sorghum production.

y_i : Observed dependent variable.

Q_i : Vector of variables explaining the participation decision.

X_i : Vector of variables explaining the extent of sorghum production.

v_i, u_i: Respective error terms assumed to be independent and distributed as $v_i \sim N[0, \alpha^2]$ and $u_i \sim N[0, \alpha^2]$

The first equation defines the participation decision and non-participation decision model where y_{i1}^{*} takes the value of one if a household made a decision to produce sorghum and zero if no production. This equation was used for analysis for the objective one. The second equation defines the intensity of participation where y_{i2}^{*} is the acreage under sorghum production. Q_i and X_i define socio-economic and institutional factors that affect the discrete probability of participation or non-participation and intensity of participation respectively. The institutional factors under study included access to sorghum seed, access to credit, access to contract farming, access to market information and group membership. v_i and u_i are the error terms of estimation in the participation and intensity of participation functions respectively.

The double hurdle regression results of participation and the extent of participation in sorghum production are presented in Tables 1 and 2. The tables show the estimated coefficients (α value), standard error and significance values of independent variables in the model. According to Gujarati (2004) and Pallant (2007), the coefficients measure the expected change in the model for a unit change in each independent variable, all other independent variables being equal. The sign of the coefficients shows the direction of influence of the socio-economic variable and it therefore follows that in this study, a positive value in Tier 1 indicates an increase in the likelihood that a household will participate in sorghum production and a positive value in Tier 2 indicates an increase in the likelihood that the household will put more land under sorghum production. On the other hand, a negative value in Tier 1 shows that the household is less likely to participate in sorghum production and in Tier 2 that the household is less likely to increase the acreage under sorghum.

The significance values (P-values) show whether a change in the independent variable significantly influences the dependent variable at a given level. In this study, the variables were tested at the 5% and 10% significance levels. Thus, if the significance value is greater than 0.1, then it shows that there is insufficient evidence to support that the independent variable influences the dependent variable. If the significance value is equal to or less than 0.1, then there is enough evidence to support a claim presented by the coefficient value. If the significance value is less than or equal to 0.05, then the variable is significant at 5% significance level. If the significance value is greater than 0.05 but less than or equal to 0.1, the variable is significant at 10% significance level. The standard error measures the standard deviation of the error in the value of a given variable (Hill et al., 2001; Gujarati, 2004).

RESULTS AND DISCUSSION

Institutional characteristics of sorghum farmers

The most important prerequisite for good crop production is the availability of good quality seeds of high yielding varieties, adapted to the growing area, and preferred by

Table 1. Double hurdle results for participation in sorghum production.

Variables	Tier 1 (Participation in sorghum production)					
	Coef.	Std. Err	z	Significance (p>|z|)	[95% Conf. Interval]	
ACCSEED	-0.3802	0.2213	-1.72	0.086**	-0.8139	0.0535
ACCREDIT	0.1080	0.2596	0.42	0.677	-0.4008	0.6169
ACCEXT	0.0724	0.2000	0.36	0.718	-0.3197	0.4644
CONTRCT	-0.0533	0.4353	-0.12	0.0902	-0.9066	0.7999
ACCMKTINFO	0.4259	0.2186	1.95	0.051**	-0.0026	0.8544
GRPMEMBER	-0.6766	0.3720	-1.82	0.069**	-1.4058	0.0525

N = 207; * and * * are statistically significant at 5 and 10% significance level respectively. Access to seed, access to market information and access to group membership were significant at 5%.

Table 2. Double hurdle results for extent of participation in sorghum production.

Variables	Tier 2 (Extent of Participation in sorghum production)					
	Coef.	Std. Err	z	Significance (p>|z|)	[95% Conf. Interval]	
ACCSEED	0.1024	0.1490	0.69	0.492	-0.1897	0.3944
ACCREDIT	0.0869	0.1811	0.48	0.631	-0.2681	0.4419
ACCEXT	-0.3097	0.1462	-2.12	0.034*	-0.5962	-0.0231
CONTRCT	-0.2268	0.2810	-0.81	0.420	-0.7777	0.3240
ACCMKTINFO	0.3148	0.1562	2.01	0.044*	0.0085	0.6210
GRPMEMBER	0.0524	0.2040	0.26	0.797	-0.3474	0.4522

N = 207; * is statistically significant at 5% significance level. Access to extension and access to market information are significant at 5% significance level.

the farmers. Availability of seed is important as it influences sorghum production. Availability will also influence the time of planting and the acreage under production and therefore yield. The results indicated that only 28.5% of the farmers had easy access to sorghum seed. This indicates that majority of the farmers in the study area have limited access to sorghum seed and this could be a major contributor to the low participation in sorghum production in the area. The findings further indicated that 59.3% of the farmers with easy access to seed were cultivating sorghum compared to 47.3% of them without easy access to sorghum seed. About 47.3% of the farmers with limited access to sorghum seed who are producing sorghum are a big proportion of farmers. This means that majority of the farmers in the study area are producing sorghum despite the fact that they have or have no easy access to sorghum seed. This could also be due to the fact that majority of them are producing sorghum on subsistence basis which means that they could produce sorghum with even the little sorghum seed that they can access.

Kenya's agricultural sector needs credit for production, marketing, long-term investment and for the setting up of employment creating rural enterprises. But the sector is starved of credit with demand outstripping supply by such a wide margin. However, its access by more farmers and appropriate quantity and quality of agricultural credit are crucial for realizing the full potential of agriculture as a profitable activity. In the study area, however, 80.7% of the farmers had no access to credit which means that majority of the farmers in the study area have no access to credit. This could be impacting negatively on agricultural production and sorghum production in particular. Reports indicate that 30% of all the households in Kenya were able to access credit in 2006, an indication that access to credit is low in the study area as compared to the national average (GOK, 2006). The results of the study however showed that 50% of the farmers with access to credit in the study area were participating in sorghum production. On the other hand, 50.9% of the farmers without access to credit were participating in sorghum production. The implication is that more farmers without access to credit are cultivating sorghum as compared to those with access to credit. However, majority of the farmers in the study area were producing sorghum for subsistence which gave an indication that the enterprise may not be requiring credit in its current status. This means that credit may not be a key factor influencing sorghum cultivation in the study area.

Agricultural extension plays a crucial role in decision making and enterprise selection by the farmer due to access to necessary information on production of various crops. In the study area, 58% of the farmers had access

to extension services. This is an indication that majority of the households in the study area have access to extension services. The results further indicated that 48.8% of the farmers with access to extension were producing sorghum. The results further show that 53.5% of the farmers without access to extension were growing the crop. The results give an indication that more farmers without access to extension are participating in sorghum production as compared to those with access to extension. Extension service providers may have promoted other crop enterprises at the expense of sorghum production. It also means that there are other factors influencing sorghum other than extension service.

Contract farming is a system for production and supply of agricultural/horticultural produce under forward contracts between producers and buyers (Haque, 2000). It is a case of bringing the market to the farmers, which is navigated by agribusiness firms (Christensen and Scott, 1992). Majority of the respondents had no access to contract farming involving cereal crops. Only 5.3% of the farmers had access to contract farming. This is an indication that majority of the farmers in the study area have no access to contract farming. The results further showed that 54.5% of the farmers with access to contract farming were participating in sorghum production. This suggests that contract farming could enhance sorghum production. Contract faming ensures ready market for the contracted crop at agreed prices. This implies that the initiative by EABL to introduce contract farming for sorghum in its effort to supplement barley in brewing will be a big boost to sorghum farmers in the study area. About 50.5% of the farmers without access to contracts were participating in sorghum production. The results show that if access to contract farming on sorghum was increased, most farmers in the study area could participate in sorghum production. This could also result to increased acreage under sorghum due to assured financial returns.

Market information plays a crucial role in agricultural production and more so in sorghum production. Farmers use market information to plan future production and also in decision making on when and where to sell their produce. In the study area, the results of the study indicate that out of the 207 farmers, 71.5% of the farmers had access to market information. This is an indication that majority of the households in the study area have access to market information for sorghum. This could be playing a crucial role in informing farmers on sorghum production decisions in the study area. It was also noted that majority of the farmers with access to market information do not participate in sorghum production whereas a majority of the farmers without access to market information are participating in sorghum production. Out of the 71.5% of the farmers who had access to market information, only 45.9% were participating in sorghum production. Out of the 28.5% of the farmers who had no access to market information, about 62.7% were participating in sorghum production. The fact that access to market information could be influencing farmers in the study area to produce other crops at the expense of sorghum may be due to better market prices as compared to sorghum especially when farmers are not assured of adequate financial returns from sorghum.

Farmers' Organizations (FOs) are essential institutions for the empowerment, poverty alleviation and advancement of farmers and the rural poor. Individual small farmers are weak players in the market but by organizing into larger groups they can increase their bargaining power. According to Kherallah and Kirsten (2001), collective action is important in agricultural production and marketing because it contributes towards reduced transaction costs and it strengthens farmers' production and bargaining power. In the study area, the results of the study show that 91% of the farmers were not members of sorghum production or sorghum marketing groups. This means that majority of the farmers in the study area are not members of producer and marketing groups. Most of the farmers produce individually and market their produce on their own, hence missing on the benefits of collective action which could be impacting negatively on production and marketing in the area. However, majority were not group members due to weak cooperative movement in the region, group management wrangles and lack of accountability and past experiences with group association. The results further revealed that majority of the farmers who were members of farmer groups were producing sorghum. The results show that 63.2% of the farmers with membership in farmer groups were producing sorghum. This implies that majority of famers in the study area who are members of farmer groups are producing sorghum. This is an indication that group membership among other factors could be having an influence in sorghum production decisions. On the other hand, 49.5% of the farmers who were not members of farmer groups were producing sorghum. Non group members were the majority in the study area. These results show that that if group membership was increased in the study area, more farmers would produce sorghum, alongside other crops.

Model empirical results

The main objective was to identify the institutional factors that influence participation and extent of participation in sorghum production among the smallholder farmers in the study area. The data collected was analyzed using the double hurdle model.

Significant variables in the participation model

As indicated in Tables 1 and 2, some predictor variables influence decisions in participation in sorghum production significantly in Tier 1 and some variables also influence

extent of sorghum production significantly as shown in Tier 2. Out of the 6 independent variables used in the model in Tier 1, access to seed, access to market information and access to group membership were statistically significant at the 10% significance level as shown in Table 1.

Access to sorghum seed has a negative sign and a significance value of 0.086. There is enough evidence therefore to support that access to sorghum seed is influencing participation in sorghum production negatively. The results showed that only 28% of the farmers had easy access to sorghum seed and this could be the reason for the negative relationship as majority of the households have no access to adequate sorghum seed. Access to sorghum seed had however been hypothesized to have a positive relationship in that farmers were more likely to participate in production if they had easy access to sorghum seed but findings in the study area reveal that sorghum seed was not readily available, especially hybrid seed. This corroborates with the findings of Curran and Cook (2009) who found that most of the sorghum seed used by small scale farmers was uncertified, was traded among farmers and that supply of modern sorghum varieties in local markets were limited. However it was unclear as to whether this lack of modern varieties in the seed market was due to lack of supply or lack of demand as very few vendors were selling modern sorghum varieties. It is possible farmers here prefer the local sorghum seed.

Access to market information has a positive sign and a significance value of 0.051. This significance value indicates that there is enough evidence to support that as access to market information increases, the likelihood of participation in sorghum production increases. The positive sign indicates a positive relationship between access to market information and participation in sorghum production in the study area. This means that access to market information influences participation in sorghum production positively since they are aware of the existing markets and prices. This becomes helpful while planning production. Thus if farmers have more access to market information then the likelihood of participation in sorghum production increases. From the results on access to market information, majority of the farmers had access to market information in the study area and this could also be the reason for the positive influence. This is in consonance to Okwoche et al (2012) who noted access to market information had a positive effect on sorghum production and utilization and that majority of sorghum farmers have access to sorghum market information.

Access to group membership has a negative sign and a significance value of 0.069. The significance value indicates that there is enough evidence to support that access to group membership is influencing participation in sorghum production negatively. There is a negative relationship between access to group membership and participation in sorghum production in the study area which suggest group membership influence sorghum cultivation negatively. From the results on access to group membership, only 9% of the sampled farmers had access to group membership and this could be the reason for the negative relationship between group membership and sorghum cultivation in the study area. Most of the farmers were producing sorghum for domestic use and this could also probably be the main reason behind low levels of group membership in the study area. It had been hypothesized however that access to group membership has a positive influence but in the study area majority of the farmers have no access to group membership and this could be influencing participation in sorghum production negatively in the study area. However the results of this study are in disagreement with the findings of Okwoche et al. (2012). In their study, they found that majority of the farmers held membership of cooperative societies and Sorghum Farmers' Association. Their study revealed that only 6.15% of them did not subscribe to any social group. Those that subscribed to cooperative societies did so mainly to have access to credit whereas those involved in Sorghum Farmers' Association did so because of easy access to extension services, market and credit facilities. Most of the farmers in their study however were commercial sorghum producers which could be the reason high group membership whereas in Nakuru County, majority of the farmers produced for domestic use with little commercial use. However, community interest groups such as farmer organizations and cooperatives are useful in pooling of resources and enhancing bargaining power in the market.

Significant variables in the extent of participation model

Out of the 6 independent variables used in the model in Tier 2, only access to extension and access to market information were statistically significant at the 5% significance levels as shown in Table 2.

Access to extension has a negative sign and a significance value of 0.034. The significance level shows that there is enough evidence to support that access to extension is influencing acreage under sorghum cultivation negatively. From the results on access to extension, about 41% of the households had access to extension. This is a big proportion of farmers and this could be the reason for the negative relationship. Similar findings are reported elsewhere. For example, results of a study by Martin and Taylor (1995) indicate that farmer-extension contact is important for both commercial and subsistence farming systems. However they found that many farmers attributed their non adoption of modern sorghum varieties and other technologies to lack of enough farming technical know-how. This was directly linked to a weak research-farmer linkage and low

technology dissemination effort. However, Nashon et al. (2008) found conflicting results. They found that access to extension advice positively and significantly influenced the use of improved sorghum at 5% significance level. They attributed this to the fact that extension service is the main source of farming information to farmers. This means that if extension service was increased, then adoption of sorghum could increase.

Access to market information has a positive sign and significance value of 0.044. This means that there is enough evidence to support that as access to market information increases, the likelihood of more acreage under sorghum production increases. This shows that farmers with access to market information are more likely to put more acreage under sorghum in the study area than those who do not as had been hypothesized. Access to market information empowers farmers with means of disposing their produce based on favourable commodity prices. This will then encourage increasing of area of farm under sorghum, revealing why majority of the respondents in the study area able to access market information grow the crop. This is in line with the findings of Okwoche et al. (2012) who also reported a positive correlation between these factors of production for sorghum.

CONCLUSION AND RECOMMENDATIONS

It was concluded that only access to seed, access to extension, access to market information and access to group membership were significantly influencing sorghum production in the study area. To fully tap the potential of increased participation and acreage under sorghum production in Nakuru County, seed companies should avail improved sorghum varieties and farmers encouraged to adopt them. There is need for stakeholders to institutionalize access to extension, contract farming and group membership among farmers. Farmers should be encouraged to embrace the demand driven extension approach by the Ministry of Agriculture. They should also be encouraged to get into contract farming with consumer stakeholders especially with EABL which has shown the initiative to promote sorghum production in the area. This can best be realized if the farmers work as groups as opposed to individuals. This study only focused on socioeconomic
factors of sorghum production. There is need for further research on the influence of other factors, such as economic and agronomic factors, and their influence on sorghum production.

REFERENCES

Christensen E, Scott R (1992). Between the farmer and the state; Towards a policy analysis of the role of agri-business in Thai agriculture. Thailand Development Research Institute (TDRI). Background Report to the 1992 Conference on Thailand's Economic Structure: Towards the Balanced Development. Chon Bury, Thailand.

Curran S, Cook J (2009). Gender and Cropping: Sorghum in Sub-Saharan Africa. Washington: University of Washington.

EPZA (2005). Grain Production in Kenya . Export Processing Zones Authority.

Gujarati, D. (2004). Basic Econometrics, Fourth Edition. The McGraw−Hill Companies, New York.

Hamukwala PT (2010). Sorghum and pearl millet improved seed value chains in Zambia: Challenges and opportunities for smallholder farmers. The University of Zambia, Lusaka, Zambia.

Haque T (2000) Contractual arrangements in land and labour markets in rural India, Indian J. Agric. Econ., 55(3): 233-252.

Heckman JJ (1979). Sample selection bias as a specification error. Econometrica, 47: 153-161.

Hill RC, Griffiths WE, Judge GG (2001). Econometrics, Second Edition. John Wiley & Sons, New York.

Jaetzold R, Schmidt H (2010). Farm Management Handbook of Kenya, Volume II, Part B: Natural Conditions and Farm Management Information, Central Kenya (Rift Valley and Central Provinces) - pp 121-151:379-404.

Karugia JT (2003). A micro level analysis of agricultural intensification in Kenya: The case of food staples. Department of Agricultural Economics, University of Nairobi.

Kherallah M, Kirsten J (2001). The New Institutional Economics: Applications for agricultural policy research in developing countries. Markets and Structural Studies Division, Discussion paper No. 41, International Food Policy Research Institute, Washington DC.

Miyata S (2007). Impact of Contract Farming on Income: Linking Small Farmers, Packers, and Supermarkets in China. Washington: International Food Policy Research Institute.

MOA. (2012). Economic Review of Agriculture. Nairobi: Ministry of Agriculture.

Martin PL, Taylor JE. (1995). "Introduction." In Martin, P.L., W.E. Huffman, R. Emerson, J.E.Taylor, and R.I. Rochin, Eds., Immigration Reform and U.S. Agriculture. Publication No. 3353.University of California, Division of Agricultural and Natural Resources, Oakland, CA, 1995 pp.1-18.

Nashon A, Onyango E, Oucho P (2008). Assessment of adoption of sorghum production technologies in Siaya District, Kenya. Paper presented for Socio-economics, Policy and Biometrics Session of the 11th KARI Biennial Scientific Conference, KARI headquarters, Nairobi, 10– 14 November 2008 (pp. 1-10). Nairobi: KARI.

NCAPD. (2005). District Strategic Plan 2005-2010. National Coordinating Agency for Population and Development.

Okwoche VA, Asogwa BC, Obinne PC (2012). Agricultural Information Utilization among Rural Sorghum Farmers in Benue State of Nigeria. Euro. J. Sci. Res., 76 : 198-207.

Pallant J (2007). SPSS: A Step by Step Guide to Data Analysis using SPSS for Windows, Third Edition. New York: Open University Press.

Schmidt OG (1988). Priorities in post harvest research support for sorghum and millet in Eastern Africa. International Development Research Centre (IDRC).