



Assessment of the contribution of agricultural extension services on sorghum production for improved food security among smallholder farmers in Rachuonyo North Sub-County, Homa Bay County, Kenya

Awiti Abel*, Gor Obel, Walter Akuno

School of Agricultural and Food Sciences, Jaramogi Oginga Odinga

University of Science and Technology, Bondo, Kenya

Article published on July 08, 2024

Key words: Sorghum, Food security, Smallholder farmers, Kenya

Abstract

Agricultural extension services play a major role in improving production capacity more so in food crops. This study aimed at assessing the contribution of agricultural extension services on sorghum production for improved food security among smallholder farmers in Rachuonyo North Sub-County of Homa Bay County. Specifically, the study focused on: contribution of both private public extension services and influence of credit facilities on sorghum production for improved food security among the smallholder farmers in the study area. A descriptive research design was used. Semi-structured questionnaire was used to collect data. Both descriptive and inferential statistics were reported. Findings revealed that sorghum farming was dominated by the youth at 62% because majority of this age set are unemployed and therefore have resorted to farming as source of livelihood, 27% aged 36-55 years with only 11% being above 55 years. Binary logistic regression showed that both private and public extension services play a significant role on sorghum production for improved food security ($t=2.036$, $p=0.043$ and $t=6.441$, $p=0.000$ respectively). Their influence is distinguished by efficiency in service delivery. Availability of credit facility equally plays a significant role on sorghum production for improved food security ($t=2.868$, $p=0.004$). Food security in the study area was measured in terms of sorghum yield; those with low yield were considered to be food insecure. It is therefore recommended that the private and public extensions services such as distribution of farm inputs and training be scaled up so as to improve sorghum production. Farmers should also be able to access credit facilities such as loans without any limitation. The findings of this study will be useful to organizations and agencies already operating in the study area to identify their weaknesses and strength in service delivery.

*Corresponding Author: Awiti Abel ✉ awitiabel@gmail.com

Introduction

An agricultural extension service is application of farm practices that would improve farmer's living standard such as food security. 85 percent of world populations depend on rain fed agriculture for their livelihood (Chege *et al.*, 2018). Extension services create a link between farmers and research and information through education. Through this platform, various ways of boosting agricultural productivity are incorporated with research with the aim of improving farmers' standard of living.

Food demand is projected to rise between 59% to 98% by 2050 (Elferink and Schierhorn, 2016), with the largest increases anticipated in sub-Sahara Africa, South Asia and East Asia, however there is no surety of this anticipation due to various factors such as climate, social and political factors. The number of undernourished individuals worldwide is estimated to be 850 million, and it has barely changed between 1990–1992. Hunger hotspots, which are characterized by a high frequency and pervasiveness of food insecurity, particularly during extended periods of crisis, are of particular concern (Robertson *et al.*, 2019).

African small holder farmers are categorized on the on the basis of the agro ecological zones in which they operate the type and composition of their farm portfolios and landholding and on the basis of annual revenue they generate from farming activities (World Bank; CIAT, 2015). In areas of high population densities, smallholder farmers usually cultivate less than one hectare of land, which may increase up to 10 hectares or more sparsely populated areas.

On the basis of farm revenue, smallholder farmers range from those producing crops only for family consumption to those who earn income from their farming enterprise. Food insecurity has been noted to be the major cause of poverty in the world more particularly African states. The overall poverty situation in Kenya was approximately 56% of the population estimated at 30 million people (Mwadalu and Mwangi, 2013). In 2011, the government of Kenya reported that about half of her estimated

population of 38.5 million people was poor and some 7.5 million people lived in extreme poverty while over 10 million people suffered from chronic food insecurity. It was also noted that most communities that lived in arid and semi-arid region are greatly exposed to food insecurity due to recurring drought that interferes with crop and livestock productivity (Fitzgibbon, 2012).

According to comprehensive food security and vulnerability report by World Food Programme (WFP, 2016), Agriculture is the mainstay of the Kenyan economy, contributing 30 percent to GDP, but Kenya is a food deficit country, more particularly Homa Bay county where Farmers find it hard to access credit facilities needed to buy inputs such as fertilizers, pesticides and improved seed variety due to the conditions laid out to access them (WFP, 2016). This impact has forced majority of farmers to cultivate crops on small pieces of land measuring less than 0.05 acres, consequently resulting into low crop yield has thus affecting food security and the economy of the study area.

In response to issues affecting food security in Kenya, the government has managed to commit only 4.5 % annual budget allocation to the ministry of agriculture. The amount that is considered far much below what the ministry requires in its operations including financing agricultural extension services. To overcome this challenge, the government of Kenya has closely been sourcing support from international organizations such as World Bank and FAO to improve agricultural food production (FAO, 2014). In response, the organizations have responded in various ways including the introduction of different types of agricultural extension services such as Training and visits (T&V) approach that was sponsored by World Bank (WFP, 2015). The system has its own short comings especially in Kenya and Nigeria (Musa *et al.*, 2013), the system came under serious criticism both in Kenya and Nigeria because of top-down approach, inefficiency, ineffective and not financially sustainable. It was regarded as not serving the farmers interest instead it was a profit-oriented system.

The other model used in Kenya is the Farmer Field School (FFS) sponsored by Food and Agricultural Organization. This approach was adopted following its success in training Asian farmers on integrated pest management. The approach was first introduced in 1995 by the Food and Agricultural Organization (FAO) special programme for food security. Through observation and learning-by-doing, farmers are able to internalize the advantages of improved technology and adopt new practices in their own fields (Waddington *et al.*, 2014). Davis *et al.* (2012) evaluates the effectiveness of Agricultural extension services by looking at the impact of scaling up of farmers field school in Kenya, Tanzania and Uganda. Using estimates, Waddington concludes that Farmer Field school extension approach improve farmer's knowledge and adoption of beneficial practices and reduce overuse of farm inputs such as pesticides. This model has since been adopted by various county governments in Kenya and NGO's. In Rachuonyo North Sub-County area, Homa Bay County, Extension services are offered by the county government and Private organizations such as NGO's including One Acre fund, Homa Hills community development, religious organizations such as Catholic relief food organization, Parastatals such as Kenya Agricultural Livestock and Research Organization (KALRO) and International Livestock Research Institute (ILRI). Most of the institutions provide FFS extension model, where farmers come together to form a group, they're taught on various issues affecting agriculture. The extension officers are facilitators and guide farmers throughout the discussion (Fabregas *et al.*, 2017).

In 2015, the Kenyan government embraced a slogan called "NJAA MARUFUKU KENYA", whose main intention was to improve food security among its population, this plan was developed in the line with millennium development goal (MDG), whose one of the goals was to reduce hunger and poverty in Kenya by 2015.

Rachuonyo North Sub-County is estimated to be having a majority of its population living below poverty level According to Kenya Integrated and

Household Budget Survey (KIHBS) (KNBS, 2016). The poverty level in the region is estimated to be at 52.9 per cent, about 75% of its population is still facing food insecurity and for that matter, sorghum being a hardy crop characterized by drought resistance, pest and disease resistance traits is considered to be a best option of improving food security in this region. The study therefore examined the assessment of the contribution of agricultural extension services on sorghum production for improved food security among the small-scale holder farmers in Rachuonyo North Sub-County of Homa Bay County.

Materials and methods

Data collection

Descriptive research design was used in the study to give the characteristic of population under the study, whether they are food secure or insecure. Semi-structured questionnaires were administered to obtain data on the contribution of both public and private extension service provider and the influence of credit facilities on sorghum production for improved food security among smallholder farmers in Rachuonyo North Sub-County. Additionally, the study assessed the contribution of agricultural extension services on sorghum production for improved food security among the smallholder farmers in Rachuonyo North Sub-County. The questionnaire was administered by relevant enumerators who understood what data collection entails. The data obtained was used to answer the objectives that this study intended to achieve.

The study targeted smallholder sorghum farmers in Rachuonyo North Sub-County of Homa Bay County who are estimated to be around 3350. The farmers are the primary beneficiaries of the extension services and are the source of information regarding food security status. Therefore, they become an important element in the study. The agricultural extension officers create a link between the farmer and the research and the source of information to farmers on how to improve food productivity.

The proportionate sample size was calculated using the following formula as suggested by (Charan and Biswas, 2013).

$$\text{Sample size} = \{Z_{1-\alpha/2} p (1-p)\} / d^2$$

$Z_{1-\alpha/2}$ is standard normal variant (at 95% confidence level). As in majority of the studies p values are considered significant below 0.05 hence 1.96 is used in formula.

P = Expected proportion of population of farmers from previous study exposed to extension services.

d = Absolute error or precision.

$$\{1.96^2 \times 0.25 (1-0.25)\} / 0.05^2 = 288$$

Proportionate sample of 288 sorghum farmers from Rachuonyo North were used. Purposive sampling was employed to pick sorghum farmers in the study because it avoids bias and ensures that there is equal representation. A stratified random sampling technique categorized smallholder farmers into different subgroups or strata based on their acreage and administrative area. Then subjects were selected randomly and proportionately. Purposive sampling was used to select the other stakeholders, including administrators, farmers' representatives, and officers from the Sub-County agricultural offices, NGOs, and officers from the National Government.

Data analysis

The interviewed farmers were first described and put into two groups *viz.*, food secure or food insecure based on their sorghum yield. This was later used as the response variable for regression analysis. Descriptive statistic such as frequencies, percentages, means and standard deviations and graphics were used to report the analysis and visualization of the questionnaire data based on whether one practiced or not. Data was analyzed using SPSS version 25 statistical software. All the tests were done at 95% confidence level.

Furthermore, Chi-square statistics was used to test for association between those who grew sorghum and the socio-demographic variables such as age, location, gender, education level and occupation. The Chi-square is given by the formula.

$$\chi^2 = \frac{\sum_{i=1}^n (O_i - E_i)^2}{E_i}$$

Where;

χ^2 – is the Chi-square statistics tested at 95% confidence level

O_i – The observed values (frequencies) sampled from $i = 1, \dots, n$

E_i – The expected values (frequencies)

Moreover, a multivariate logistic regression was fitted to assess the effect of public and private extension services and access to credit on sorghum yield for household food security. The model was picked based on the nature of the response (food secure/insecure). The model specification was as follows:

$$Y = \exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon_{ij})$$

Where;

Y – is the response variable, sorghum yield

β_0 – is the intercept

β_i – The estimates of the regression parameters (slopes) for $i = 1, \dots, n$

$X_{i/s}$ – are the independent variables (access to credit, public extension services, private extension services) for $i = 1, \dots, n$.

Results

Descriptive statistics

Socio-demographic characteristics

Kibiri Ward represented 23% of the respondents, North and West ward had 43.6% and 33.4% representative respectively. Females who participated in this study were 55.4%, whereas the male gender was 44.6%. Majority of the participants were married at 49.8%, 37.3% being single, the widowed at 9.4%, and the divorced and separated at 1.4% and 2.1%, respectively. Most of the respondents were within the 18-35 age bracket, 27.2% were between 36 to 55 years and 11.1% were above 56 years old. The sampled participants were still young and energetic. Nearly half of the participants had no formal education, 17.8% had a primary certificate, 8.7% had a secondary credential, and 3.8% had a college certificate, 8% had a diploma, 10.8 a degree, and 2.8% had a postgraduate. Regarding occupation, 52.3% cited unemployed, 22.3% were self-employed, 12.2% were

employed, and students were 10.8%, whereas 2.4% had retired. Tables (1-6) show data of different socio demographic characteristics in the study area.

Table 1. Number of respondents in each ward

Ward	Frequency N (%)
Kibiri	66 (23.0)
North	125 (43.6)
West	96 (33.4)

Table 2. Gender distribution among the respondents

Gender	Frequency N (%)
Female	159 (55.4)
Male	128 (44.6)

Table 3. Marital status of the respondents

Status	Frequency N (%)
Single	107 (37.3)
Married	143 (49.8)
Widowed	27 (9.4)
Divorced	4 (1.4)
Separated	6 (2.1)

Table 7. Summary regression coefficients

Variables	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B ₀	Std. Error	Beta		
(Constant)	1.721	.200		8.586	0.000*
private extension	.072	.036	.112	2.036	0.043*
public extension	.244	.038	.357	6.441	0.000*
Credit facility availability	.241	.084	.154	2.868	0.004*

a. Dependent Variable: impact on sorghum production for improved food security

Effect of private extension, public extension and credit facilities on sorghum Production for Improved Food security

A binary logistic Regression analysis was conducted to examine the impacts of both private and public extension services and credit facilities (predictor variables) on sorghum production for improved food security (Response variable) (Table 7). All variables held constant; it was found out that the predictor variables significantly predicted response variables; a unit increase in private extension services causes a 0.072unit positive impact on food security. A unit increase in public extension services causes a 0.244-unit improvement in sorghum production; all other factors are constant. All other variables remained constant; the availability of credit facilities has a 0.241units more sorghum production compared to zones without access to them. Private extension services, public extension services, and credit facilities significantly impact sorghum production, $p < 0.05$.

Table 4. Age distribution among the respondents

Age group	Frequency N (%)
18-35 years	177(61.7)
36-55 years	78 (27.2)
56 years and above	32 (11.1)

Table 5. Level of education of the respondents

Level	Frequency N (%)
No formal education	138 (48.1)
Primary	51 (17.8)
Secondary	25 (8.7)
Certificate	11 (3.8)
Diploma	23 (8.0)
Degree	31 (10.8)
Postgraduate	8 (2.8)

Table 6. Occupation among the respondents

Status	Frequency N (%)
Student	31(10.8)
Employed	35(12.2)
Self-employed	64(22.3)
Unemployed	150(52.3)
Retired	7(2.4)

Discussion

Socio-demographic characteristics

From the study, most of the participants were from north Karachuonyo ward, 125(43.6%), 96(33.4%) of the participants were from west Rachuonyo ward and the remaining 23 percent were from Kibiri. More than 50 percent of the participants were of the female gender. About half of the sorghum farmers were married, 37.3 percent single and the rest were widowed, divorced or separated. More than 60 percent of the sorghum farmers were aged between 18-35years, 27 percent aged 36-55 years, and 11.1 percent were above 56 years. Participants had various levels of study; around 51.9% of them had some formal education whereas 48.1% had no formal education. Farming is a form of employment, 52.3% stated that they were unemployed, 22.3% employed themselves, 12.2% were employed, and student farmers were 10.8% and the retired being 2.4%.

Impact of private extension on improved food security

Private extension services are among the services that are valued most compared to the public extension. The private sector provides farmers with farm inputs such as seeds, fertilizers and other farm products, advisory services regarding sorghum routine management practices as well as linking farmers to the market and researching on advanced technology farming to better farmers welfare. Sustainable food security is mostly influenced by introduction of modern technology by private extension, more than 86% of the participants agree with the statement. More than 80% of the participants believe that private training of farmers tends to lead to higher production hence improving food security. Private extensions provide farmers with farm inputs at subsidized costs as cited by 80.5% of the respondents.

Contribution of credit facilities on sorghum productivity

Credit organizations have a great impact on smallholder farmers since most of them are not able to fund their projects. However, credit organizations have got their own limitations and drawbacks (Mutua and Oyugi, 2016). Over 90% of the farmers depend on credit facilities for financing to access farm inputs such as fertilizers and seeds whereas 88% state that they have limited access to credit facilities due to various reasons.

The limitations to credit facilities cited by over 81% of the farmers are lack of security to act as bank collateral to the facility, high repayment rates and unavailability of credit institutions within the region. (Mutua and Oyugi, 2016) state that interest rates have increased hence lower income investors such as sorghum farmers are restricted hence cannot finance high return projects. The return from the project can also be equal to the interest charged by the banks hence unsuitable for improved sustainability. This study also supports (Okpara, 2014) that less than 20% of Africans have access to credit facilities due to poor transport and infrastructure as well as low population densities. Credit facilities however have a significant

association with the location as seen from the chi-square test, $p < 0.001$. West Karachuonyo ward was observed to have more credit facilities compared to other wards. This may be attributed to factors such as good infrastructure and high population densities.

Impact of public extension services

Public sector extension services, despite various challenges posed by private extension have managed to be of benefit to the farmers in west Karachuonyo. Over 80% of the respondents agree that public extension sector distribution of farm inputs, training farmers and introducing new farm technology has an impact on sorghum production for improved food production. Public extension training is offered through farmers field school or through visitation and training of farmers. However, the mode of training is associated with ward where the farmer comes from according to the chi square test performed, $p < 0.001$.

Contribution of private and public extension and credit facility availability on sorghum production

From the findings, private extension, public extension and credit facilities have a significant positive impact on sorghum production for improved food security. The impact of public extension services followed by credit facility and finally private extension. Public extension services are mostly embraced in north Karachuonyo than private extension services since it is the long serving knowledge disseminator and promotes adoption of modern technologies (Salami *et al.*, 2010).

Conclusion

Services offered by private extension agencies are more valued than services offered by public agencies in the study area because of their efficiency. In addition, provision of farm inputs on credit basis and training of farmers plays a significant role in improving food security among smallholder sorghum farmers in the study area.

Recommendation(s)

Both the county and national government should ensure that farmers in Rachuonyo North Sub-County

are provided with affordable agricultural extension services in order to improve food production. Especially those who have never been exposed to it, in addition, the county government of Homa Bay and financial institutions in the area should work closely and come up with measures that would ensure farmers are able to access credit facilities without facing any hindrances such as security requirement.

References

Ahmadpour A, Soltani S. 2014. The need for a strong public-private linkage in agricultural extension system (case study: Sari Township, Iran). *International Journal of Agricultural Management and Development (IJAMAD)*.

Alila PO, Atieno R. 2016. Agricultural policy in Kenya: Issues and processes.

Beinah A, Kunyanga C, Ngugi K. 2020. Utilization and processing of sorghum by small holder farmers in drought prone agro-ecological zones of Kenya. *Advances in Social Sciences Research Journal* **7(10)**.

Benor D, Baxter MW, Harrison JQ, Bank W. 2014. Agricultural extension: The training and visit system. World Bank.

Birch I. 2018. Agricultural productivity in Kenya: K4D: Knowledge, Evidence and Learning for Development.

Bitzer V. 2016. Incentives for enhanced performance of agricultural extension systems. *Sustainable Economic Development and Gender*.

Carozzi M, Loubet B, Acutis M, Rana G, Ferrara RM. 2013. Inverse dispersion modelling highlights the efficiency of slurry injection to reduce ammonia losses by agriculture in the Po Valley (Italy). *Agricultural and Forest Meteorology*, 306–318.

Charan J, Biswas T. 2013. How to calculate sample size for different study designs in medical research? *Indian Journal of Psychological Medicine* **35(2)**, 121–126.

Chege JM, Lemba J, Semenyé PP. 2018. Influence of land tenure on food security status among smallholder farmers in Kilifi South Sub-County, Kenya.

Christiansen L, Swelam A, Hill R, Gasteyer S, Swanson B. 2015. Evaluating agricultural extension and advisory services through a governance lens. *Journal of International Agricultural and Extension Education*.

Davis K, Nkonya E, Kato E, Mekonnen D, Odendo M, Miiró R, Nkuba J. 2012. Impact of farmer field schools on agricultural productivity and poverty in East Africa. *World Development* **40(2)**, 402–413.

<https://doi.org/10.1016/j.worlddev.2011.05.019>

Demissie T, Duku C, Groot A, Muhwanga J, Nzoka O, Recha J, Osumba J. 2020. Sorghum Kenya: Climate risk assessment. *Climate Resilient Agribusiness for Tomorrow (CRAFT)*. CGIAR Research Program on Climate Change, Agriculture and Food Security. Retrieved from <https://ccafs.cgiar.org/resources/publications/sorghum-kenya-climate-risk-assessment>

Elferink M, Schierhorn F. 2016. Global demand for food is rising. Can we meet it? *Harvard Business Review*.

Fabregas R, Kremer M, Robinson J, Schilbach F. 2017. The effectiveness of public agricultural extension: Evidence from two approaches in Kenya.

FAO. 2009b. Expansion of farmer field schools programme in Eastern and Southern Africa: Project findings and recommendations: Africa region: Kenya, Mozambique, Tanzania, Uganda. Rome: Food and Agriculture Organization.

FAO. 2014. Food loss assessments: Causes and solutions. Rome: Food & Agriculture Organization of the United Nations.

- FAO/KARL/ILRI.** 2003. Farmer field schools: The Kenyan experience. Report of the farmer field school stakeholders' forum held on 27 March 2003 at ILRI, Nairobi, Kenya.
- Fitzgibbon C.** 2012. Economics of resilience study – Kenya country report. 25 ANLAP since 199-2022.
- Fuglie KO, Rada NE.** 2013. Resources, policies, and agricultural productivity in Sub-Saharan Africa. Economic Research Report 145368, United States Department of Agriculture, Economic Research Service.
- Goddu K.** 2012. Meeting the challenge: Teaching strategies for adult learners. Kappa Delta Pi Record **48(4)**, 169–173.
- GoK.** 2010. Agricultural sector development strategy (ASDS) 2010–2020. Nairobi, Kenya: Government Printer. Government of Kenya.
- GoK.** 2012. County fact sheets. Summary by the Kenya Commission on Revenue Allocation. Government of Kenya (GoK).
- Grow intelligence.** 2015.
- Hosseyni S, Khaledi M, Ghorbani M, Brewin D.** 2012. An analysis of transaction costs of obtaining credits in rural Iran. *Journal of Agricultural Science and Technology*.
- IBP I.** 2017. Mexico business law handbook volume 1 strategic information and basic laws.
- Mbula J, Kinyanjui JK.** 2019. Knowledge for wealth creation.
- Kassam AH.** 2017. The common misconception among farmers regarding private extension services is that they are prohibitively expensive and unaffordable, but the reality is that they provide high-quality services since they are for-profit businesses.
- Kimuyu P, Omiti J.** 2015. Institutional impediments to access to credit by micro and small scale enterprises in Kenya. Institute of Policy Analysis and Research.
- KNBS.** 2016. Kenya integrated household budget survey 2015-2016. Nairobi, Kenya: Kenya National Bureau of Statistics.
- Korhonen V.** 2010. Cross-cultural lifelong learning. Tampere University Press.
- Kothari R, Gaurav.** 2014. Research methodology, methods and techniques.
- Labarthe P, Laurent C.** 2013. Privatization of agricultural extension services in the EU: Towards a lack of adequate knowledge for small-scale farms? *Food Policy* **38**, 240-252.
<https://doi.org/10.1016/j.foodpol.2012.10.005>
- Ministry K.** 2009. Rachuonyo.
- MoA.** 2013. National agricultural sector extension policy (NASEP). Ministry of Agriculture, Livestock & Fisheries.
- MoA.** 2014. National agricultural sector extension policy (NASEP). Ministry of Agriculture, Livestock & Fisheries.
- MoALF.** 2016. Climate risk profile for Homa Bay County. Kenya County Climate Risk Profile Series. Nairobi, Kenya: The Ministry of Agriculture, Livestock and Fisheries (MoALF). Retrieved from <https://ccafs.cgiar.org/resources/publications/climate-risk-profile-homa-bay-county-kenya-county-climate-risk-profile>
- Moghaddasi M, Morid S, Delavar M, Hossaini Safa H.** 2017. Lake Urmia Basin drought risk management: A trade-off between environment and agriculture. *Irrigation and Drainage* **66(3)**, 439-450.

- Mugenda MO, Mugenda AG.** 2003. Research methods: Quantitative and qualitative approaches. Nairobi: African Centre for Technology Studies (ACTS) Press.
- Musa Y, Aboki E, Audu I.** 2013. The limitations and implications of training and visit (T&V) extension system in Nigeria. *Journal of Agriculture and Sustainability*.
- Mutua JM, Oyugi LN.** 2016. Access to financial services and poverty reduction in rural Kenya.
- Mwadalu R, Mwangi M.** 2013. The potential role of sorghum in enhancing food security in semi-arid eastern Kenya: A review. *Journal of Applied Biosciences*.
- Ngode AQ, Ng'eno KE, Anjichi V.** 2021. Farm production factors affecting malt sorghum production among contracted sorghum farmers in Homa Bay County, Kenya. *African Journal of Education, Science and Technology* **6(4)**, 144-153. Retrieved from <https://ajest.info/index.php/ajest/article/view/724>
- Njagi TO.** 2019. Sorghum production in Kenya: Farm-level characteristics, constraints and opportunities. Tegemeo Institute. *Journal of Applied Biosciences* **71**, 5786-5799.
- Okati M, Ahmadpour MB, Sarani V.** 2021. Recognizing the factors affecting on food security in rural areas (Case study of villages in Zahak region in Sistan and Baluchestan province). *Journal of Rural Development Strategies*.
- Okpara JO.** 2014. Factors constraining the growth and survival of SMEs in Nigeria. Implications for poverty alleviation.
- Okuthe IK.** 2013. The influence of institutional factors on the adoption of improved sorghum varieties and technologies by smallholder farmers in Western Kenya. *International Journal of Humanities and Social Science* **3**, 196-207.
- Onono P.** 2018. Response of sorghum production in Kenya to prices and public investments. *Sustainable Agriculture Research* **7**. DOI: 10.5539/sar.v7n2p19
- Orr AM.** 2016. Sorghum and millets in Eastern and Southern Africa: Facts, trends and outlook.
- Osano HM, Languitone H.** 2016. Factors influencing access to finance by SMEs in Mozambique: Case of SMEs in Maputo central business district. *Journal of Innovation and Entrepreneurship*.
- Pirmoradi A.** 2013. Private extension: Functions and duties. *Journal of American Science*.
- Pius W, Chang'ach JK.** 2013. Education reforms in Kenya for innovation.
- Republic of Kenya.** 2012.
- Rivera WM, Zijp W, Alex G.** 2012. Good practices in contracting for extension. CABI.
- Salami A, Kamara AB, Brixiova Z.** 2010. Smallholder agriculture in East Africa: Trends, constraints and opportunities. Tunis, Tunisia: Working Papers Series N° 105 African Development Bank.
- Sikei GO.** 2009. The role and performance of the Ministry of Agriculture in Rachuonyo District. *Future Agricultures Research Paper* 016.
- Stathers TL.** 2013. Postharvest agriculture in changing climates: Its importance to African smallholder farmers. *Food Security*.
- Taylor B.** 2009. Andragogy's transition into the future: Meta-analysis of andragogy and its search for a measurable instrument. *Journal of Adult Education* **38(1)**, 1-11.
- Teklu HW.** 2011. Smallholder farmers' access to agricultural credit and its impact. LAP Lambert Academic Publishing.

- Van Niekerk J, Stroebel A, Whitfield K, Swanepoel F, Van Rooyen C.** 2014. Towards redesigning the agricultural extension service in South Africa: Views and proposals of smallholder farmers in the Eastern Cape. *South African Journal of Agricultural Extension*.
- Van Wijk J, Kwakkenbos H.** 2013. Beer multinationals supporting Africa's development?
- Waddington H, Snilstveit B, Hombrados J, Vojtkova M, Phillips D, Davies P, White H.** 2014. Farmer field schools for improving farming practices and farmer outcomes: A systematic review. *Campbell Systematic Review*. DOI: 10.4073/CSR.2014.6
- Wanigasundera W, Atapattu N.** 2019. Extension reforms in Sri Lanka: Lessons and policy options. In Suresh Chandra Babu, *Agricultural Extension Reforms in South Asia*. Academic Press.
- WFP.** 2015. Kenya food security and outcome and monitoring (FSOM), consolidated report. World Food Programme.
- WFP.** 2016. Kenya - Food security and outcome monitoring, 2016. Nairobi: World Food Programme.
- WFP.** 2016. Zero hunger: The heart of the 2030 agenda. World Food Programme.
- World Bank.** 2012.
- World Bank, CIAT.** 2015. Climate-smart agriculture in Kenya. CSA country profiles for Africa, Asia, and Latin America and the Caribbean series. Washington D.C.: The World Bank Group. Retrieved from <https://cgspace.cgiar.org/handle/10568/69545>