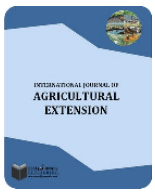

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IMPACT OF NATIONAL AGRICULTURAL EXTENSION POLICY ON AGRICULTURAL TECHNOLOGY TRANSFER AND AGRICULTURAL PRODUCTION FOR FOOD SECURITY AMONG SCALE FARMERS IN KENYA: A CASE STUDY OF SIAYA AND KILIFI COUNTIES

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A B S T R A C T

The intent of this study was to assess the impact of National Agricultural Extension Policy (NAEP) on agricultural technology transfer aimed at increasing agricultural productivity for food security among small-scale farmers and establish reasons for the continued low agricultural food production in Siaya and Kilifi counties despite implementation of various initiatives including implementation of the National Agricultural Extension Policy and National Agricultural Sector Extension Policy. Ex-post facto survey design was used and three hundred households from the sampling frame were selected for the study using purposive and simple random sampling techniques. One interview schedule, one semi structured questionnaire, an observation schedule and one focus group discussion guides were used to collect data. Findings indicated that extension workers and small-scale farmers ability to a transfer and access agricultural technologies improved after the implementation of NAEP reforms; However, the improved farmers' ability to access agricultural technologies failed to translate to increased agricultural production for most of the food crops and livestock and ultimately household food security. The paper recommends that more research to be carried out to establish the root cause of food insecurity at household level among small-scale farmers. Stakeholders in the field of agricultural should develop policy guidelines to ensure agricultural technologies transferred to farmers to promote agricultural produce as cash crops do not change the characteristics of the indigenous varieties to the extent that the status of household food security is compromised. Extension workers both in the government and private sector targeting the same farmer should have joint planning and ensure research that is carried out to increase agricultural production capture the interest of the farmers, and the characteristics of crop and livestock varieties that guide the breeding should be based on empirical data collected in the field to ensure the technologies that are advanced are acceptable to the farmers.

Keywords: Food Security, Agricultural Technology Transfer, Agricultural Productivity, Small-Scale Farmers, Policy

INTRODUCTION

The effectiveness and efficiency of agricultural technology transfer and its advisory service plays an important role in agricultural development and can improve the welfare of farmers who live in rural areas (International Initiative for Impact Evaluation (3ie), 2010). Over time, the national government together with private sector have established agencies to research and introduce exotic crop varieties and animals breeds especially those with export potential into the new areas of cultivation. The efforts have had a substantial impact on the location of staple production and for trading crops and animals products. The enormous agricultural productivity among countries combined with success of technology transfer aimed at ensuring that food security is achieved (Eponou, 1993). Despite large investments in technology transfer for increased agricultural productivity for food security over the last three decades by both the developed and developing countries, parts of Africa, Asia, and South America are still afflicted by hunger. Agricultural production has continued to be low and even declined (Madukwe, 2006). The low levels of agricultural productivity are the root cause of the

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problems of food security in sub-Saharan Africa (Sasson, 2012; Rosegrant & Cline, 2003). Improving food production for the African small-scale farmer remains one of the biggest and most important challenges. Individuals do not have access at to sufficient food for an active and healthy life most of the times contrary to what food security implies that 'it is the condition in which an individual has access at all times to enough food for an active and healthy life' (Stringer, 2000).

In Kenya, agricultural production has slackened drastically over the post-independence years from an average of 4.7% in the first decade to only below 2% in the 1990s. This decline culminated in a negative growth rate of -2.4% in 2000 and then rose to 6.4% in late 2000s and subsequently declined from 6.4% in 2010 to 1.5pc in 2011 (Alila & Atieno, 2006; Kenya National Bureau of Statistics [KNBS], 2012). The decline experienced in 1990s was blamed on the agricultural extension services provision system for being ineffective and inefficient (Rivera, 2001; Gustafson, 2002). It necessitated call for reform in extension to allow greater role by private sector in 1999 to 2000 (Rivera, 2001).The need for reforms were anchored on the premise that pluralistic service would provide appropriate mix of players from public and private funding and delivery mechanisms for extension, which would achieve differing agricultural goals and serve diverse target population (Anandajayasekeram, Puskur, Workneh, Hoekstra, 2008, as cited in Zhou, 2010). The mix of players included mainstream government agricultural extension services, non-profit making non-governmental organizations (NGOs), community based organizations (CBOs), and the profit making private sector (GoK, 2001, 2004). In order to improve the transfer of agricultural technologies to farmers in Kenya, National Agricultural Extension Policy (NAEP) was formulated and implemented using the National Agricultural and Livestock Extension Programme (NALEP), an umbrella framework under which all diversified mix of extension service providers who included mainstream government agricultural extension services, non-profit making non-governmental organizations (NGOs), Community Based Organizations (CBOs), and the profit making private sector that would ensure farming related technologies and services were available and accessible to the farmers (GoK, 2001, 2004). The policy was to guide and harmonize the management and delivery of agricultural extension services (Rivera, 2000, as cited in Rivera 2001; Government of Kenya (GoK), 2001). The main components of the policy were the development of pluralistic and demand driven approaches, and involvement of farmers in planning, implementation of agricultural projects and programmes and in resource management. These components were to encourage a more liberalized and collaborative agricultural extension service system.

The purpose of the study was to investigate the impact of transfer of agricultural technology and establish reasons why implementation was abortive in improving agricultural food production for household food security among small-scale farmers in Siaya and Kilifi Counties. Siaya and Kilifi Counties were selected from the forty three (43) counties located in five regions of Kenya among whom the NAEP reform was implemented by the Kenya Government and Swedish international development agencies (Sida). The two counties were selected based on the regions in which implementation of NAEP and NALEP were funded by Swedish international development agencies (Sida). Despite the effective implementation of the policy, Siaya and Kilifi Counties were among counties whose agricultural food production had continued to decline by 16% and 27% and had household food poverty population of 34% and 66.1% respectively. Specific objectives that guided the study were to:

- determine the extent to which NAEP reform improved the ability to transfer appropriate agricultural technologies and information to small-scale farmers in Siaya and Kilifi Counties.
- establish the status of agricultural productivity for household food security among small-scale farmers after the implementation of NAEP reforms in Siaya and Kilifi Counties.

METHODOLOGY

Study Location: The study was conducted in six sub-counties of Siaya and Kilfi Counties. The sub-counties were Yala, Ugunja and Wagai. Siaya and Vitengeni, Ganze in Kilifi County respectively. Siaya county is one of the forty-three Counties in Kenya found in Western region of the Country. The County covers an area of 132,000 hectares of land and is divided into six sub-counties with an estimated population size of 603,693 persons. It has five ecological zones with an estimated 37% of the high potential arable land. The area receives a bimodal rainfall pattern ranging from 1,800mm-2000mm per

annum on the higher altitude and 800mm to 1600mm on the lowlands and the temperature ranges between 15oC –21oC. Most of the agricultural activities are subsistence farming. The main crops grown are maize, sorghum, beans, sweet potatoes and finger millet and most farmers plant local seeds. The County experience a general food deficit in maize production as it is able to meet about 65% of its requirements (GoK, 2013). The county's household food poverty is 34%. Kilifi County covers an area of 50,448 km2 (GOK, 2013) and is divided into seven administrative divisions with an estimated population of 63,218 farm families. Food production which is within the low potential regions of the country has also continued to be low (GOK 2013). Most of the farmers are mainly small scale farmers occupying four coast lowland zones. The County food poverty rating is 66.1% (KNBS, 2007; GOK, 2013) and this makes it susceptible to dependency on relief food most of the times in the year.

The Research Design: The study used Ex-post-facto survey design. The design was appropriate for the study since the research aimed at observing and understanding the effect of transfer of agricultural technology and the status of household food security long after implementation of NAEP had taken place from a sample drawn from a target population. The design allowed field exploration and the use of semi-structured questionnaires to gather information at just one point in time.

Sample Selection: The study sample was drawn from;

- The accessible population which included 51,490 and 21,025 households in Siaya and Kilifi County respectively.
- a saturation of all Agricultural extension officers from the Ministry of Agriculture, private non-profit making (NGOs) and private profit making organizations in the field.

A combination of purposive sampling, simple random sampling, and proportionate random sampling, were used. Purposive sampling was used to select the two counties where the policy reform was implemented. Simple random sampling was used to select three sub-counties from each county respectively. A saturated sample of all the 22 and 12 Extension Workers (EW) from the Ministry of Agriculture, Non-Governmental Organizations and private profit making organizations were selected in Siaya and Kilifi County respectively. Proportionate random sampling was used to select one hundred and fifty (150) small-scale farmers from Siaya and Kilifi County respectively.

Data collection:

Research instrument: One set of semi-structured questionnaire and semi- structured interview schedule were developed and administered to small-scale famers and to agricultural extension officers to collect data on status of transfer of agricultural technology and status of household agricultural food production. Observation schedule was used to make observation in the field on the condition/performance of the agricultural productivity in the field. One set of Focus Group Discussion (FGDs) was used to guide farmers' group discussion.

Validity: Validity of the instruments was confirmed before being used for data collection in the field. The validation was done for both the questionnaire and the interview schedule. This was important to ensure standardization of the instruments.

The instruments were presented to five (5) individual experts in the area of agricultural extension to assess the extent of external and internal validity of the instruments. Their comments were then incorporated into the instruments before being used in the field.

Reliability: To determine reliability, a pilot test was administered to a sample of 20 respondents in one of the focal areas in the County. The sample was selected from one of the focal areas, which was not among the study area. Cronbach's coefficient Alpha was computed to determine reliability coefficient. From the computation, a coefficient of 0.82 was obtained.

Data collection: Sampling frame for small-scale farmers from the selected focal areas was obtained from the County Director of Agriculture's office. Arrangements were then made on when to collect data from extension workers and with individual EWs on when to visit the field and administer the instruments to the selected sample of small-scale farmers.

Data analysis: The collected data were analysed using statements from interviews, while descriptive statistics such as frequency tables and percentages and inferential statistics, paired sample t-test were calculated using the Statistical Package for Social Sciences (SPSS version 20.0).

RESULTS AND DISCUSSION

Agricultural Extension Officers were asked question pertaining to their ability to transfer appropriate agricultural technology to small-scale farmers due to the results are as presented in Tables 1.

Table 1. EWs' ability to transfer agricultural technologies in Siaya and Kilifi Counties after implementation of NAEP.

Participation in various technology transfer activities	Agricultural extension officers (n= 34)			
	Siaya (n= 22)		Kilifi (n= 12)	
	f	%	f	%
Sensitization seminars of the policy	10	45.0	5	41.7
Training of farmers on policy reforms	10	45.0	4	33.3
Organised agricultural tours on policy	8	36.4	2	16.7
Workshops and seminars held on monitoring and evaluation	8	36.4	1	8.7
Collaborative activities	12	55	7	58.0
Field days and on farm demonstrations	22	100	12	100
Used farmers groups	22	100	12	100

The results in Table 1 show that over 50% of EWs participated in collaborative activities. There was observed 100% participation in field days and on farm demonstrations and formation of farmer groups while less than 50% participated in the rest of the activities. Descriptive data from the respondents indicated that participation in collaborative activities was only possible if the collaborating organizations were financially able to meet the cost of joint activities. Field days, on farm demonstrations and use of farmer group to transfer agricultural technologies were the main approaches that were encouraged and supported by the NAEP. The groups were formed on the basis of common interests. **Small Scale Farmers ability to Access Agricultural Technology:** To determine ability to access appropriate agricultural technologies, small-scale farmers were asked questions pertaining to awareness and membership to agricultural oriented groups, attended farmers training and frequency of interaction with agricultural extension officers before and after implementation of policy reforms. Results are presented in Table 2.

Table 2. Small-Scale Farmers Ability to Access appropriate agricultural Technologies after implementation of NAEP in Siaya and Kilifi Counties (n=300).

Accessibility to agricultural extension services	Siaya County's Small-scale farmers (n=150)				Kilifi County's Small-scale farmers (n=150)			
	Yes		No		Yes		No	
	n	%	n	%	n	%	n	%
Awareness of demand driven approach being used by EWs	100	66.7	50	33.3	104	69.3	46	30.7
Membership to agricultural oriented groups	100	66.7	50	33.3	104	69.3	46	30.7
The frequency of interaction with extension workers:								
-Twice/ > twice per month	25	16.9	127	83.1	0.01	0.0	150	100
-Per month/seasonally/none	129	85.0	23	15.0	50	100	0	0.0
Attended farmers training	72	48.0	78	52.0	69	46.0	81	54
Had agricultural demonstrations implemented on their farms	49	32.7	101	67.3	45	30.0	105	70.0
Participated in agricultural demonstrations and projects implemented in the field	90	60.1	60	39.9	92	61.3	58	38.7
Lived more than 4 Km from the agricultural extension offices	116	77.3	34	22.7	78	52.0	72	48
Accessed funds for project activities	17	11.3	133	88.7	50	33.3	100	66.7
In contact with agricultural extension officers	92	59.3	61	40.7	100	66.7	50	33.3
Consulted EWs whenever there was need	100	66.7	50	33.3	52	34.7	98	65.3

Results in Table 2 revealed that over 50% of the small-scale farmers were aware of the demand driven approach that was being used by EWs, were members to agricultural oriented groups, were in contact and consulted EWs whenever it was necessary and lived more than 4 Km from agricultural offices. Majority (over 80%) participated in demonstrations and projects implemented on their farms and interacted with EWs once per month, seasonally or not at all. However, the number of farmers who interacted with EWs twice or more and accessed funds for project activities was less than 20% with those who had demonstration plots on their farms and attended farmers training being less than 50%. Respondents stated that accessibility and proximity to extension offices enhanced consultation and sharing of ideas. Descriptive information gathered during the interviews sessions and FGDs indicated that the low percentage of households' access to funds was due to the stringent conditions that required groups to write a proposal that could competitively compete for the funds. Most of the group members lacked the technical knowledge in proposal writing and this negatively affected the number of projects implemented on their farms. Another drawback that affected farmers groups was the disintegration of some of the groups when they failed to achieve their objectives and when the projects implemented in their vicinity ended or were up-scaled.

Agricultural Productivity for Household Food Security: Data pertaining to households' agricultural productivity for food security was collected on the status of food production and food security before and after the implementation of the policy.

Households' Agricultural Food production: Data pertaining to agricultural productivity for food security was collected on the situation before and after the implementation of the policy. A three months period of observation was used to determine the adequacy of the food produced. This is the seasonal period most of the annual crops take to grow to maturity in the study areas. The results regarding households agricultural food production are as presented in Table 3.

Table 3. Siaya and Kilifi Counties' Small-Scale Farmers' Household Agricultural Food production before and after NAEP Reform.

Variable	HH % in Siaya County		HH % in Kilifi County	
	Before	After	Before	After
Maize	100	100	100	100
Sorghum	78.6	16.3	23.0	8.7
Millet	0.6	0.0	0.0	0.0
Cassava	47.0	57.0	53.7	52.7
Pulses	90.0	67.0	19.0	13.3
S/potatoes	64.8	84.3	10.7	17.3
Vegetables	83.3	70.0	79.3	40.0
Miscellaneous crops	38.7	60.3	13.0	39.7
Cattle	34.3	34.0	29.0	26.3
Poultry	85.8	83.7	65.0	43.0
Shoats (Goats and sheep)	35.4	39.0	36.3	40.7
Dairy produce	31.6	36.6	12.7	13.7
Others (pigs, guinea fowl)	41.7	43.0	0.3	28.0

The results show that maize was grown by all households before and after the NAEP implementation. Except for the increase in percentage of households who produced cassava and sweet potatoes, the percentage of households' who engaged in production of the rest of the agricultural produce declined after the NAEP implementation. Millet was grown by a negligible percentage of households in Siaya County. The percentage of households that engaged in production of various livestock was generally below 50% in both Counties except for poultry production which was over 80% in Siaya County. The observation and information made in the field and during FGDs showed that acreage under production for most of the households was less than two acres. Farmers attributed the decline in production to quality change of the new varieties of sorghum and root crops. The new varieties of sorghum were not palatable while the root crops attained physiological maturity at the same time and could not be left in the field to allow for piece meal harvesting.

In order to ascertain any significant differences between the percentage of households' food production in Siaya and Kilifi Counties before and after the implementation of NAEP, a paired sample t-test was performed at significance level of 0.05 on the hypothesis that "The implementation of NAEP did not significantly improve the small-scale farmers' household agricultural production in Siaya and Kilifi Counties". The results are summarised in Table 4.

Households' Agricultural Food Security: data depicted in Table 5 reflectins the household's food security. Data shows the percentage of households with either sufficient or insufficient in various types of commonly grown and used agricultural produce in Siaya and Kilifi Counties prior and after implementation of NAEP reforms.

Table 4. Households' Food Security in Siaya and Kilifi Counties (n=300).

Food Produce Sufficiency at household level	Siaya County (n=150)						Kilifi County (n=150					
	NAEP implementation		Mean	t-test	df	Sig 2-tailed)	NAEP implementation		Mean	t-test	df	Sig 2-tailed)
	Period	Mean					Period	Mean				
Maize	Before	1.59	0.43	10.541	149	0.007	Before	1.43	0.11	2.783	149	.006
	After	1.99					After	1.00				
Pulses	Before	1.47	0.47	9.375	149	0.051	Before	1.87	-0.10	-4.069	149	.000
	After	1.00					After	1.97				
Sorghum	Before	1.59	-0.40	-9.913	149	0.000	Before	1.55	-0.31	-5.843	149	.000
	After	1.99					After	2.00				
Cassava	Before	1.49	0.34	8.762	149	0.000	Before	2.03	0.00	0.000	149	0.000
	After	1.95					After	2.00				
Sweet potatoes	Before	1.41	0.40	8.630	149	0.000	Before	1.97	0.09	0.607	149	0.000
	After	1.89					After	2.01				
Miscellaneous crops	Before	1.89	0.22	1.172	149	0.260	Before	167	-0.13	-0.807	149	0.433
	After	1.50					After	180				
Dairy produce	Before	1.50	-0.56	-2.563	149	0.020	Before	167	-	-	-	-
(Milk and eggs)	After	1.34					after	2.00				
Monetary income from agricultural produce	Before	1.81	0.47	11.418	149	0.060	Before	2.07	0.07	2.701	149	.080
	After	1.34					After	2.00				

Note: P ≤ 0.025

The means for most of the items used to measure percentage of households who were sufficient in different types of agricultural food produce in both Siaya and Kilifi Counties when both end of 0.025 of the distributions were added together showed that there was statistically significant differences at $\alpha = 0.05$. The null hypothesis was therefore rejected. However, the means and t test values were negative implying that the statistical difference was negative statistically significant.

Households' Agricultural Food Security : Table 5 shows the percentage of households with either sufficient or insufficient in various types of commonly grown and used agricultural produce in Siaya and Kilifi Counties prior and after implementation of NAEP reforms.

Results in Table 5 show that, the percentage of households whose most of the farm produce was sufficient and could last three or more than three months was less than 50%. Observation made in the field and data collected from individual farmers' indicated that sufficiency of farm produce at household level was guided by individual farmers' ability in terms of knowledge of how to utilize a particular farm produce and its

preservation. The susceptibility of some of the produce to pest and post harvest losses also affected the amount of produce that was stored for household utilization.

In order to ascertain any significant differences between the percentage of households' food security in Siaya and Kilifi Counties before and after the implementation of NAEP, a paired sample t-test was performed on percentage of households with sufficient agricultural produce of commonly used crops and dairy produce at significance level of 0.05 on the hypothesis that "The implementation of NAEP did not significantly improve the small-scale farmers household food security in Siaya and Kilifi Counties".

DISCUSSIONS

Extension workers participation in most of the activities implemented as avenues for gaining essential technical agricultural knowledge and skills is crucial as it provides them the opportunity to develop competency in technology transfer. The participation in collaborative activities where EWs from different organizations hold joint activities such as ex-situ demonstrations, field days and tours facilitates exchange of ideas resulting in technical capacity building which makes agricultural extension officers more competent in their work. Holding of collaborative activities such as field days, on farm demonstrations, transport for farm visits and meetings by agricultural extension services providers improves accessibility of agricultural technologies to farmers. It also avoids duplication of technologies in the field and saves on resource use as it allows the extension interventionists to meet farmers at one point. However, availability of these agricultural technologies and information to small-scale farmers can be affected by lack of facilitation of agricultural extension officers in terms of transport which limit coverage of extension officer, the quality and relevance of technology to farmer's current needs and suitability to the ecological requirements in a specific region. On the other hand, lack of coordination in collaboration among extension interventionists and prohibitive cost of farm inputs can result in conflicting information to farmers and failure of interventions. Swanson & Samy (2003) recommends that agricultural extension officers should participate in various activities that are implemented by agricultural oriented programmes to ensure technical capacity building. Similar findings were reported by Swanson (2006) who established that collaboration provided opportunity for interaction which is essential for exchange of ideas and technology capacity building among the participants. These findings are also consistent with those of Hanyani-Mlambo (2002) who observed that collaboration is important for some programmes as it provides unification and coordination of agricultural extension services, various stakeholders' resources, skills, expertise and experience. The observed high percentage of farmers in various agricultural activities implemented in the field by EWs in mainstream Government Ministry of Agriculture, NGOs and private agricultural organizations may be attributed to farmers' membership to agricultural oriented groups. Membership to groups improves farmers' ability to access and participate in various agricultural activities despite living more than 4 kilometres away from agricultural extension offices. Groups also make farmers accessibility to extension services more affordable and allows for better understanding and implementation of some of the technical agricultural concepts that may be difficult to interpret on their own. However, the effectiveness of the groups as avenues for accessing agricultural technologies and information may be hampered by financial constraints, cohesiveness, the common interest that holds the group together and viability of the groups especially when the implemented projects' life cycle end and the project has to be up-scaled to other regions. On many occasions groups may end up disintegrating if the follow ups or interaction with EWs becomes less frequent. For instance, the observed low frequency of interaction with extension workers could be attributed to individuals not being affiliated to farmer groups consequently inaccessibility to agricultural extension services. These findings agree with those of studies done by FAO (2001) who argues that increased participation in group activities is of central importance and therefore calls for efforts to promote farmers' organizations. The objective is to empower farmers and improve the adoption of technologies, especially if they are exposed to technologies coming from outside their communities. These findings are supported by Muyanga & Jayne (2006) and Ong'ayo & Akoten (2007) who found that farmers in groups could organise demand for and access to agricultural extension services and encourage individual participation for development. Ong'ayo & Akoten (2007) and Scarborough et al. (1997, cited in WB, 2003), also found that membership to farmer group encouraged interactions between farmers and

agricultural extension officers and among farmers themselves and recognition of technical and economic interactions, which exists within the farm, is important in shaping farmers' responses to alternative technologies. In the process of interaction, farmers share experiences and build synergies which can be harnessed to collectively address a particular problem The statistically significant difference in percentage of small-scale farmers' who cultivated different types of agricultural food produce could be attributed to accessibility to appropriate agricultural technologies. Membership to groups provided the individual members the opportunity to interact with the outsiders and among themselves and in the process gained knowledge and skills which translated to increased agricultural production especially in staple and commonly used food crops. The observed negative statistically significant difference in percentage of households that produced sorghum, dairy produce and miscellaneous food crops and in most households could be attributed to individual farmers not being a member to agricultural groups or there was no implementation of project activities that emphasised the production of these specific farm produce. Or the technologies that were transferred pertaining the particular agricultural produce did not have positive impact to the households particularly in terms of palatability, and utilization. Some of the agricultural produce may not be grown by farmers when they lose their status by changing from being solely source of food to cash crop. For instance:

- The sustained 100% of households engaged in maize production was due to the crop being a staple food in over 90% of Kenyan households and its diversified advantages such as having ready market both external and internal. While the inadequate production of small seeded cereals such as sorghum and millet could be due to its low consumption caused by change in eating habits, change in quality caused by breeding for improved yields and resistance to pests and disease at the expense of palatability and the purpose the crop serves in the households. The results are consistent with those of Orr *et al.* (2016). Sorghum and millets in ESA are minor cereal crops compared to maize. In 2012, maize production in eastern Africa was 28 million t, compared to 6 million and 1.5 million t for sorghum and millets respectively. The decline in sorghum and millet production began with the introduction of maize during the colonial period and continued in some regions until at least the 1970s.
- Inadequate production of root crop due to change of original quality may be caused by breeding for improved yields and resistance to pests and disease at the expense of palatability and the purpose the crop serves in the households. For instance, root crops such as cassava and sweet potatoes and small seed cereals were grown as security crops used in times of scarcity.
- The decline in production may also have been caused by lack of extra labour to immediately process perishable crops on attaining physiological maturity and unfavourable climatic conditions. For instance, coastal region climatic conditions cannot support production of beans and this affected its sufficiency, low acreage put under production by individual households as observed in the individual farmers' fields. Most of the food crop introduced required use of external farm input for better yields. Yet, the price of farm inputs were prohibitive to most small-scale farmers and labour that was unavailable. These findings are more or less similar to those of Nweke *et al.* (2002) where they found that the proportion of cassava fields depended on the ease of farmers' access to markets. Nweke *et al*. (2002) observed that the fresh root cassava was bulky and perishable and therefore expensive to transport and market

Negative statistically significant difference in percentage of households with sufficient food that could last three or more months could be due to:

- Individual household's selection of what to grow influenced by several factors which included palatability, uses, storage qualities and marketability. The choice of what to grow can affect availability of food at household level especially if particular crop fails to perform well, lack of knowledge on preparation and cooking methods or lack of farm input. These findings agree with those of Onyango *et al.* (2010) who found that for food security to be attained, researchers and agricultural development practitioners need to identify how farmers form opinions on technologies introduced for crop improvement. The findings also agreed with those of FAO (1995, as cited in Rivera, 2001) that indicated that sorghum and millet products are more nutritious and palatable when grains or its flour is fermented or acidified and, therefore, require more time for preparing them.

- Disposal of the crop soon after harvest by selling, giving out as gifts to relatives due to fear of incurring post harvest losses. Post harvest losses were incurred in maize, cassava and sweet potatoes. Some maize varieties were susceptible to weevil attack and, therefore, could not be stored for more than three months. Cassava and sweet potato varieties bred for early maturing and ready market had qualities that could not allow piece meal harvesting that was common traditional practice among most small-scale farmers. These crops could not be stored for future use when fresh or left in the soil long after reaching their physiological maturity. Poor storage quality such as susceptibility to weevils may have caused some households not to store the crop, hence causing insufficient food in most households.
- Negative characteristics of the crop may make it less palatable and also affects the nutritional content making it less popular in most households. The new sorghum variety introduced in demonstrations plot was not a favourite to most households because it was unpalatable and lacked medicinal values of which it was traditionally valued for. Unfortunately most households did not have the old variety in stock. FAO (1995, as cited in Rivera, 2001) studies noted that the shifts in consumer habits brought about by a number of factors such as the rapid rate of urbanization, inadequate domestic structure for processing and poor processing techniques in households contributed to low utilization of sorghum and millet.
- Introduction of two varieties of cassava in the field, one for utilisation in fresh form and the other in processed form, caused fear among households making it less common. The fear among households of the two varieties of cassava implied that differentiating between the two varieties was not easy and consumption of the processed form in its fresh form had negative consequences. The consequences may have been more severe in times of scarcity when households have few options to make on food sources in most households. These findings are consistent with those of Nweke *et al.* (2002) who observed that factors that limited cassava availability in households were; planting it for processing to sell than for utilization in fresh form, farmers' access to market and improved post harvest technologies and availability of labour for harvesting and for post harvest processing. Yet, others were its storability because of it being highly perishable and that cassava varieties contain cyanogenic glucosides, which could lead to chronic toxicity when processed wrongly.
- Promotion of cassava and sweet potatoes varieties as alternative cash crop affected food sufficiency in households as it made male members in the households to produce crops meant for household food security, a responsibility culturally bestowed on the women as custodians of household's food stores. These findings agreed with those of Borell-Benjamin (2007, as cited in Taylor, 2007) who found that sweet potato was not a common food in most households, but became a staple food during the dry season when most of other foodstuffs were in short supply. Borell-Benjamin noted that over the last 40 years, utilization of the produce has shifted from being a subsistence food crop or famine relief crop to a crop with new uses in some developing countries. These study findings also agreed with those of Immink and Alarcón (1992, as cited in Carr, 2005) who found that availability of household's food by smallholder farmers can be affected when food crops are displacement by cash crops.
- Lack of livestock and dairy produce in households could be due to lack of strategy on how to address improvement in the sector. It could also be due to keeping livestock of poor quality. These finding agreed with those of WB (2003) who found that insufficient livestock as direct and indirect source of food was due to inadequate funding of the livestock sector in developing countries.

CONCLUSION AND RECOMMENDATION

The ability of agricultural extension workers and small scale farmers to transfer and access of agricultural technologies improved. The transfer agricultural technologies were made possible through engagement of various agricultural extension services providers in various collaborative activities and use of farmer groups. Holding of collaborative activities by agricultural extension services providers improves their ability to transfer agricultural technology and farmers, ability to access agricultural technologies respectively. However, the improvement of farmers' ability to access agricultural technologies failed to translate to increased agricultural production and consequently household food security which is of concern to development partners and to the Kenya government. Some of the reasons given such as inappropriate technologies, change of traditional foods

such as sweet potatoes to produce for the market, up-scaling of the project activities and small-scale farmers' lack of knowledge on how to utilize some of the farm produce and the observed low acreage put under production may have affected the sufficiency of the agricultural produce in most households. The development and implementation of inappropriate agricultural technologies could be due to lack of proper mechanism or structures to guide the research scientists in their efforts to provide solutions to food poverty among households. The paper recommends that stakeholders in the field of agriculture should develop policy guidelines to spearhead the development and transfer of agricultural technologies that promote agricultural produce to serve as source of food and cash crop without compromising the status of indigenous farm produce that are used as food security in the household. Extension workers both in the government and private sector targeting the same farmer should have joint planning and ensure research that is carried out to increase agricultural production capture the interest of the farmers, and the characteristics of crop and livestock varieties that guide the breeding should be based on empirical data collected from farmers to ensure the technologies that are advanced are acceptable to the farmers. Finally, there is need for more research to be carried out to establish the main cause of food insecurity at household level among small-scale farmers.

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