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Influence of Agricultural Extension on Household Food Security Status among the Smallholder Farmers

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Authors' contributions

This work was carried out in collaboration between all authors. Author JMC designed the study, wrote the protocol, performed the statistical analysis, managed the analyses of the study and wrote the first draft of the manuscript. Authors PPS and JKL supervised the work, managed the literature searches and edited the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Food security is critical to the economic, social, religious, political and cultural development Worldwide. It plays a great role in economic growth, poverty reduction and sustainable development in Kenya. A study was carried out in Kilifi South Sub-county in the coastal areas of Kenya, one of the areas where food insecurity incidences are prevalent. The study assessed the effect of the agricultural extension on household food security status among smallholder farming communities through interview schedules. Non-experimental design using descriptive survey was adopted for the study. Method of agricultural extension used, the motivation for participation in extension and technologies used concerning weather change data was analysed using descriptive statistics and multiple regression. The results indicated that 80% of all the farmers were food insecure. Those who used individual farm visits were 12% food secure while those whose motivation was increased farm productivity were 18% food secure. The farmers who planted early were 11% food secure. Farmers who used group method of an extension were 3% food secure while those who used farmer field days were 6% food secure. Farmers who were motivated to

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participate in agricultural extension to increase land fertility were 2% food secure while those who planted new varieties were 9% food secure. There was a significant (P= .05) positive relationship between food security and those who used individual farm visits, those who were motivated by increased farm productivity and those who practised early planting. This implies that individual farm visits, increased farm production and early planting are some of the most significant issues affecting food security in Kilifi South Sub-county. To further enhance the improvement of food security status in Kilifi South Sub-county, individual farm visits, increased farm production and early planting are necessary. This will help households make long-term investments in new agricultural innovations hence improved food production and food security levels.

Keywords: Food security; agricultural extension; agricultural technologies; multiple regression and survey design.

1. INTRODUCTION

The aim of extension services is to increase agricultural production in the world where about 85% of the population depend on rain fend agriculture for their livelihoods. Increasing agricultural production in Sub-saharan Africa has been a challenge due to unfavourable weather conditions and 62% depend on agriculture [1]. Improving agricultural production will only be possible if agricultural extension officers disseminate improved agricultural technologies [2]. Agriculture is the most important sector in Kenya's economy. Majority of the Kenyan farmers mainly depend on rainfall and are subsistence oriented. This rainfall is erratic and subsistence farming in the country have made farmers to experience food shortages. A study by [3] revealed that governments of developing countries provide extension services in order to increase food production for all citizens, raise income of the rural population and reduce poverty.

Extension services involve assisting people to acquire the necessary knowledge, skills and attitude to utilise this information or technology effectively. This definition agrees with that of [4] who reported that extension should be regarded as a process of integrating indigenous and derived knowledge, attitude and skills. [5] reported that farmers who are more exposed to extension information have a high propensity towards the adoption of farming technologies than those with less exposure. Farmers as individuals are known to gain from improved information provided through extension [6]. According to [3], extension services mainly involve the passing of agricultural information to the farmer. The farmer absorbs this information and tries to implement in their farming practices with the aim of improving food security.

Extension involves training of farmers which is crucial for making them increase food production and hence food security. Farmer education reduce ignorance of the new agricultural technologies and this leads to improved crop production and thus food security. Farmer education is done through community participation. According to [7], community participation is an active process by which smallholder farming community members influenced the direction and execution of an innovation with a view to enhancing their well-being in terms of food sufficiency, income, personal growth or other values that they cherish. He further stated that participation in extension is aimed at creating public awareness about the existence of agricultural innovations which if adopt enhances improved crop and livestock production and hence ensure food security. A study conducted by [8] revealed that agricultural extension is important because information about new agricultural practices in a particular environment can be used by farmers to improve their household food security.

According to [9], the major role of extension is seen as a process of helping farmers to make their own decisions by increasing the number of options from which they can choose, and by helping them to develop insight into the consequences of each option. They further reported that extension play a great role in popularizing farm technologies by working closely with the smallholder farming communities. [10] reported that the role of extension includes: Building the capacity of the smallholder farming communities and farmer organizations (CBOs) in order for them to pursue their development goals by articulating high quality demand for services. According to them, this is done by offering need-based practical training and close follow up which enable them to examine their farming environment comparing

with other farming situation. This in turn, develops farmers' aspiration for change through adopting different farm technologies that are suitable to their farming system.

According to [11] participation includes people's involvement in decision-making processes, in implementing programs towards achievement of food security. They further stated that it occupied a central place in development thinking and practice. Governments, funding agencies, donors, and civil society actors such as NGOs, multi-lateral agencies like the World Bank and the International Monetary Fund have all arrived at a consensus that development cannot be sustainable and long-lasting unless people's participation is made central to the development process. [12] affirmed that active participation of the smallholder farming community is essential to improved democracy and better service. He further stated that participation enhanced social cohesion because communities recognize the value of working in partnership with each other and with statutory agencies. A study by [13] reported that participation through skill development, enhanced the opportunities for improving food security status, employment and an increase in community wealth and lastly, it gave farmers the opportunity to develop the skills and networks that were needed to address social exclusion.

According to [14], extension agents or researchers must take into account local constraints and cultural preferences when introducing agricultural innovations such as water harvesting for irrigation. However, [7] demonstrated that a transition to a more sustainable agriculture will not occur without the full participation and collective action of the farming community. This strategy is employed in popularizing and implementing the water harvesting structures.

2. RESEARCH METHODOLOGY

2.1 Introduction

This chapter describes research methodology used in this study. It discuses study location, research design, target population, sample size and sampling procedure, research instruments, piloting of the instruments, validity of the instruments. Reliability of the instruments, data collection procedures, data analysis techniques, research ethical considerations, and finally, data management and analysis.

2.2 Study Location

Kilifi South Sub-county comprises Bahari, Chonyi and Kikambala located in Kilifi South Sub-County in Coast Province. Kilifi South Sub-county is situated along the Kenyan coastal line. The area receives an average annual rainfall of between 400-1250 mm per year which is biannual and unpredictable. Limited research has been carried out on food security in the area. The inhabitants are the Mijikenda community. According to 2009 population census, fourty seven percent of the population were males while fifty three percent were females [15]. Kilifi South Sub-county is both arid and semi-arid, with erratic and unreliable rainfall. Most of the areas are generally hot and dry leading to high rates of evaporation. This combined with unreliable rainfall, limits intensive and meaningful land use and related development activities. The mean annual rainfall ranges from 400-1250 mm per year. The long rains last from March to May and short rains coming in November to December. The periods falling between June to September and January to February are usually dry. Kilifi South Sub-county was chosen from other sub-counties because of the magnitude of food insecurity.

2.3 The Research Design

This study used survey design and inferential statistics which are methods of collecting information by interviewing and administering questionnaire to a sample of individuals and then subjecting the data to multiple regressions [16]. This research design is appropriate due to its safeguard against bias and its ability to maximize reliability.

2.4 Target Population

The target population of this study was the rural households of Kilifi South Sub-county. According to [17], Kilifi South Sub-county has a total population of 28 074 inhabitants comprising of the target population of 6 184 households spread across Bahari, Chonyi and Kikambali divisions.

2.5 Sampling Procedure and Sample Size

Sampling procedure and sample size formula are identified in this section.

2.5.1 Sampling procedure

Sampling refers to a selection of a representative sample from a target population to be used in a

study to give desired characteristics about the population. This study used systematic random sampling which involved drawing every nth household in the population starting with a randomly chosen household in each of the villages in the three divisions. The nth household was the 5th household. The respondents were the head of the household or any available adult. Kilifi south Sub-county was chosen from other sub-counties because of the magnitude of food insecurity whose causes have not been researched on or documented.

2.5.2 Sample size

A sample size of 256 households' collected based on procedure by [18] was used in this study. This was obtained after data cleaning as some of the questionnaires were incomplete.

$$n = \frac{Z^2 pq}{d^2}$$

Where n = the desired sample
- Z = the standard normal deviate at the required confidence level.
- p = the proportion in the target population estimated to have characteristics being measured.
- q = 1-p
- d = the level of statistical significance set.

$n= (1.96)^2(0.05)(0.05)/(0.005)^2$
$n= 384$

2.6 Research Instruments

Prior to the commencement of data collection, the researcher obtained all the necessary documents, including a certificate Pwani University Ethics Review Committee which was administered to the Sub county Commissioner to give the authority to conduct research in the area The main data collection instruments that were used in this study included a questionnaire. This was used for the purpose of collecting primary quantitative and qualitative data. Additionally, the questionnaire was used for the following reasons: its potentials in reaching out to a large number of respondents within a short time, able to give the respondents adequate time to respond to the items, offers a sense of security (confidentiality) to the respondent and it is objective method since no bias resulting from the personal characteristics [19]. The questionnaire was divided according to the objectives as the main areas of investigation. The study used primary data questionnaires, oral interviews from respondents on their opinion, preferences, feelings, judgments and attitudes to describe the factors that influence household food security among rural households in Kilifi south Sub-county.

2.6.1 Piloting of the instruments

A pilot study was conducted as a technique of testing the reliability of the data collection instruments especially the questionnaire and the interview schedules. In this study, a sample of 6 respondents was selected for piloting out of the target population. Piloting helped to identify any unforeseen limitations that could adversely affect the results of the findings of research. Such limitations and challenges were addressed before the actual study started in a bid to mitigate their effects on the study outcome. Piloting of research instruments assisted in increasing their reliability since any defects and possible contradictions, ambiguity or otherwise of the instruments such as the questionnaires was identified and corrected before the actual data collection for the study.

2.6.2 Reliability of the instruments

The reliability of research instrument covers the extent to which the tool yields the same results on repeated trials hence, the tendency towards consistency found in repeated measurements in what is referred to as the reliability of the research instrument. In this study reliability followed the following steps, the developed questionnaire was given to 6 identical respondents subjects not included in the main study the answered questionnaires were filled manually. After two weeks the same questionnaire was administered to the same group of subjects. Thus, test–retest method was used, the consistency in the answers provided assurance of reliability of the instrument. This showed that questionnaires were reliable and therefore they were used for the final study.

3. RESULTS AND DISCUSSION

3.1 Data Management and Analysis

Descriptive statistics was used to analyse the data. The resulting statistics formed inferential analysis basis. Regressions were used to validate the findings of the descriptive statistics because it controls other confounding variables

at the same time [20]. Significant relationships between categorical variables were also established. Multiple regression measures the relationship between the categorical dependent variable and independent variables which are usually continuous by estimating probabilities [21].

The regression equation is $y= a+ B_1X_1 + B_2X_2 + B_3X_3 + B_zX_z$ where z is the number of independent variables, y is the dependent variable, a is the constant and the Xs are independent variables. The Bs are listed in a column of coefficients. The study used Adjusted R Squared of 0.691. That is, 69 percent of a change in the dependent variable can be explained by changes in the independent variables. Before running statistical analysis, variables were examined for the presence of stochastic trends using normality test in order to confirm whether data conforms to ordinary least squares (OLS) assumptions. Using the P-P plots of regression, the data were found to be normally distributed.

According to [22], identifying an appropriate food security measure is a difficult issue as not all aspects of food security can be captured by any single outcome measure. This is because the household composition is variable, and the household is in itself subject to varying interpretations; there may be multiple income sources among adult members of one household who have strong incentives not to reveal to each other the full extent of their individual earning power or assets; the responsibility for the production of food may be shared among the adults; and finally, subsistence production is harvested piecemeal and is neither measured nor recorded. In order to avoid this difficulty; most analyses depend on measuring food consumption. Food security can be analysed in terms of food availability as compared with requirements [23]. They further reported that the net food available after selling the surplus to the market is a function of domestic production at household level. Food security at household level is best measured by food calorie intake [24]. FAO Recommended Daily Calorie Intake was used to determine food security index as shown below.

Food security index Z_n =

$$\frac{\text{Household's daily per capita calorie availability (A)}}{\text{Household's daily per capita calorie requirement (B)}}$$

$$\text{Food security index } (Z_n) = \frac{Y_n}{R}$$

Where Z_n is food security index of n^{th} household
Y_n is the actual daily calorie intake of the n^{th} household
R is the Recommended Daily Calorie Required by n^{th} household.

If food security index of each household is greater than or equal to 2060 it means that the household is food secure.

The Daily Recommended Calorie Requirement for Kenya is 2060 kcal (Kenya National Bureau of Statistics, 2009). Per Capita Daily Calorie Intake was obtained by multiplying the calories intake of each household by its household size. The household Per Capita Daily Calorie Requirement was obtained by dividing the households' Daily Calorie Requirement by household size.

The total household calorie requirement was obtained by multiplying the total number of adults in each household by the Recommended Calorie Requirement of 2060 kcal. Then, the total energy requirements for different age groups were converted to adult equivalent each group multiplied by the corresponding conversion scale (Table 2). The daily food (Calorie required) was estimated by grouping household members into age groups, then the daily calorie required of each age group was converted into adult equivalent as shown in (Table 1). The daily calorie intake was obtained from the net food available. Food available is the actual food consumed. The content of energy of 1 kg of each type of food consumed was obtained from literature as shown in Table 2.

Table 1. Recommended daily energy intake and conversion factor

Age category (Years)	Average energy allowance per day	Conversion factor
<6	750	0.29
6-15	1200	0.51
16-30	1500	0.71
31-50	2350	0.98
51+	2200	0.9

Source: Kenya National Bureau of Statistics (2012)

Table 2. Cereal equivalent conversion ratios

Food crop	Calorie/kg	Milling ratio	Maize equivalent ratio
Maize	3590	0.85	1.00
Cowpeas	3640		0.92
Sorghum	1350	0.65	0.40
Cassava	1490	0.85	0.40

Source: Okigbo (1991)

The total quantity of each food (in kilogram) available was then multiplied by the energy content (e.g. total kilogram of maize consumed per week*3590 kcal = total kcal of maize available). This procedure was repeated for cowpeas, sorghum and cassava. However, due to milling losses, the quantity consumed per week was multiplied by 3950 kcal and the milling ratio of 0.85 for maize and 1350 kcal and the milling ratio of 0.65 for sorghum respectively. Then, the total kcals of food ie maize, cowpeas, sorghum and cassava were summed up and then divided by 7 in order to get the Daily Recommended Calorie Requirement. Based on the recommended daily calorie intake of 2060 kcal, it was found that 48 smallholder farmers which is equivalent to 19.2% of the households were food secure and 202 which is equivalent to 80.8% of the smallholder farmers were food insecure.

Table 3 illustrates the sample of responses from the respondents in terms of participation in agricultural extension and technologies promoted. The results of agricultural extension is presented and discussed below.

The results indicate that 78% of the households participated in agricultural extension while 22% did not (Table 3). The results also reveals that 17% of the households participating in agricultural extension were food secure while 3% of the households who did not participate in extension were food secure. A similar study conducted by Ojogho [25] reported that 28% food secure households participated in extension in Wareng district Kenya.

Analysis of the method of agricultural extension used indicated that 11% of food secure households used individual farm visits while 3% of the food secure households used group method. This is similar to another study by Qamar [26] who reported that majority of the smallholder farmers in Kenya receive individual farm visits.

The results indicate that 72% of the households were motivated to participate in agricultural extension by increased productivity while 28% were motivated by land fertility (Table 3). The results also show that 18% of the food secure households were motivated to participate in agricultural extension by increased production while 2% were motivated by land fertility.

Analysis of the influence of agricultural technologies revealed that 11% food secure households practiced early planting while 9% of the planted new varieties. A similar study by Fliegel [27] indicate that 8% of the food secure households in Ethiopia practiced early planting while 27% food secure households were planting new varieties.

Results of Multiple regressions on determinants of food security status were as presented in Table 2.

The relationship between the participation in extension and food security status was significant (*P*= 0.005) and was positively related to food security status. The relationship between the dependent variable and independent variables was strong (R^2=0.691). The results imply that as more household heads participate in extension, food security status increase. These findings are consistent to those of Cohen and Upcoff [12] who reported that extension services act as a means for advice on agricultural productivity and hence promote household food security. This is supported by Binswarnger [13] who reported that participation in extension includes people's involvement in decision-making processes, in implementing programs towards achievement of food security. The results indicate that most of the farmers who participated in extension were food secure. When majority of the farming community receive extension services it is expected that the level of food insecurity goes down by a reasonable margin.

Group method positively related to food security status (*P*= 0.003). The relationship between dependent variable and independent variables was strong (R= 0.691). These findings agree with

an outcome of a study conducted by Amsalu [7] who reported that since rain-fed farmers are already vulnerable to current weather variability and associated shocks, it is essential to help them build their livelihood resilience through coping better with current weather-induced risks as a pre-requisite to adapting to future climatic changes.

The relationship between individual farm visits and food security status was significant (P= 0.000). The relationship between dependent variable and independent variable was strong (R= 0.691). This is in consistent with the findings of Ban and Hawkins [8] who found that individual farm visits is seen as a process of helping farmers to make their own decisions by increasing the number of options from which they can choose, and by helping them to develop insight into the consequences of each option.

Increased agricultural productivity was found significant and positively influencing food security status (P= 0.000). The relationship between dependent variable and independent variables was strong (R= 0.691).These findings agree with a study conducted by and Jones and Garforth [9] who reported that the role of extension includes:

Table 3. Agricultural extension and its effect on food security status

Variables	Sample	Percentage	Food insecure %	Food secure %
Participated in extension				
Yes	196	78	61	17
No	54	22	19	3
Total	**250**	**100**	**80**	**20**
Method of agric extension used				
Group method	25	10	7	3
Farmer field days	50	20	14	6
Individual farm visits	175	70	59	11
Total	**250**	**100**	**80**	**20**
Motivation for participation				
Increased agric productivity	180	72	54	18
Increased land fertility	70	28	26	2
Total	**250**	**100**	**80**	**20**
Technologies promoted by extension				
Early planting	149	60	49	11
New varieties	101	40	31	9
Total	**250**	**100**	**80**	**20**

Source: Field survey April-August 2014

Table 4. Multiple regressions of determinants of food security status

Variables	Coefficients (B)	Std error	t	*P* values
Extension services as determinants of food security status				
Participation in extension	65.255	7.342	1.710	0.005
Method of agric extension used				
Group method	57.618	9.352	1.471	0.003
Farmer field days	53.942	7.744	1.253	0.006
Individual farm visits	72.828	4.173	1.373	0.000
Motivation for participation				
Increased agric productivity	74.935	4.031	1.205	0.000
Increased land fertility	25.065	25.371	0.831	1.261
Technologies in relation to Weather change				
Early planting	72.833	1.947	1.403	0.005
Adopted technologies (New varieties)	42.960	11.291	0.425	0.110

Dependent variable: Food security status, R^2=0.691, F=1.731, df =7

Building the capacity of the smallholder farming communities in order for them to pursue their development goals by articulating high quality demand for services. According to them, this is done by offering need-based practical training and close follow up which enables them to compare their farming environment with other farming situations. This in turn, develops farmers' aspiration for change through adopting different farm technologies that are suitable to their farming system.

Early planting was found significant and positively influencing food security status (*P*= 0.005). The relationship between the dependent variable and independent variables was strong (R^2=0.691). These findings agree with a study conducted by Gundu [10] who reported that smallholder farmers do early planting after using traditional ways of determining when rains would come. These include traditional trees shedding their leaves and also bloom in a particular characteristic. These findings also agree with an outcome of a study conducted by [Nyoro and Jayne 11] who reported that since rain-fed farmers are already vulnerable to current weather variability and associated shocks, it is essential to help them build their livelihood resilience through coping better with current weather-induced risks as a pre-requisite to adapting to future climatic changes. Early planting takes advantage of the first rains by crops utilizing the moisture in the soil and mature faster than when planted late. The results indicate that farmers who planted early were food secure. It is therefore advisable for farmers in dry areas to always take advantage of early planting since it promotes the household food security.

4. CONCLUSION AND RECOMMENDATIONS

The study shows that majority (80%) of the households in Kilifi South Sub-county were food insecure during the period of the survey. Consistent with the expectation and findings from previous studies, participation in extension, group method, individual farm visits, increased agricultural production and early planting were found to significantly and positively influence household food security in the study area. In the light of the findings from the study, it is recommended that efforts should be made to ensure farmers participate in extension, encourage individual farm visits and early planting to promote increased agricultural production.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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