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The Impact of Studying Agriculture at Secondary School Level to Agricultural Productivity Among Women Farmers in Navakholo Sub-County of Kakamega County, Kenya.

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Abstract: *Agricultural sector in Kenya has underperformed for several years and yet it's regarded as the backbone of the economy.It has been observed that women are a crucial contributing factor to the rural economy and main players in agriculture though do not have sufficient knowledge and skills and thus the reduced agricultural productivity. To generate interest in farming at early stage, teaching of agriculture was introduced to the Kenyan secondary school education system. This study sought to find out the impact of studying agriculture at secondary school level to agricultural productivity. Correlational research design was used and amulti-stage random sampling method was adapted.A sample size of 422 women farmers was used. Data was collected using questionnaires and Focus Group Discussion. Analysis of data was bya statistical package for social sciences (SPSS). The study revealed that 10.9% of women farmers in Navakholo sub-county had attained secondary school education while 44.9% had never attained any formal education. Only 80.5% of the secondary school holders were involved in the practice of production which is highly recommended. The study established that learning of agriculture had a positive impact on farmer productivity since there was a significant (P<0.01) relationship agricultural productivity.It was recommended that the government should allocate funds for teaching applied technology and innovations during implementation of secondary school Agriculture syllabus. The Ministries of Agriculture and Education should jointly develop a curriculum that fully implements a practical approach to the teaching and learning of agriculture to have positive impact on food productivity and rural economy.*

Key words*: Agricultural productivity, Women agricultural education.*

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I. Introduction

Many people around the globe rely on agriculture as the primary source of food and employment[1]. It contributes to ~6.4 % of the world's gross development product (GDP)[1]. Women provide 43 % of the agricultural labour force worldwide and more so in the developing countries [2].Agriculture employs more than half of the total labour force and provides a livelihood for small-scale producers[3]. Eighty percent (80%) of all farmers in sub-Sahara Africa(SSA) are smallholder and employ about 175 million people directly [4]. Women comprise a half of the labour force [5]. Women also are actively involved in agricultural production though in small scale proportions6.In Kenya, agriculture is the backbone to our economy contributing to ~27% of the total GDP. Women play a great role in the Kenya Agricultural production in that86% of the total small scale farmers are women[7].

To boost agricultural knowledge and skills, agriculture as a subject was introduced in school's curriculum as early as the colonial education [8]. Nearly all the schools started offering agriculture subject, a time the 8-4-4 system of education was introduced in Kenya [9]. In primary school curriculum, agriculture was part of science but in secondary schools, it is an applied subject [10].The youths are taught agriculture so that they can appreciate its role in the economy, since Kenya dependents on agriculture for her economic development. However, this subject has been removed from the primary school syllabus, and is an elective subject at secondary school level. Agriculture has been taught in secondary schools for long and therefore evidences have to be shown that some of the students who learnt agriculture subject are farmers[9].

Agricultural food production is a pillar in ensuring sustainable food security though this has been declining in most parts of the country. In western Kenya for instance, people don't have enough food [11]. Sugarcane production has depleted soils through continuous production as stated byNambiro in 2007[12]. According to Navakholo sub County crops report, maize and beans are the main subsistence crops grown in Navakholo sub-county, Kakamega County, Kenya [13].Agriculture, though done on small scale is the main source of livelihood for the majority of the population in Kakamega County [12]. This study sought to understand the

general contribution of agriculture subject education at secondary school level to women's participation and agricultural productivity. The specific objectives of establishing the proportion of former women agriculture subject students at secondary school level practising agriculture in Navakholo sub county, Kakamega County, Kenya and to evaluate their impact to agricultural productivity of former secondary school women agriculture subject students in Navakholo sub-county, Kakamega County, Kenya.

II. Materials And Methods

The study was conducted in four wards of Navakholo Sub County, of Kakamega County namely Bunyala West, Bunyala East, Ingotse-matiha and Bunyala Central in Kenya.A pre-test study was carried out in Bunyala central and its results used to calculate the instruments reliability and for this reason it was a suitable site for this research. It lies between latitudes 0º18'0'N and longitudes 34º33'0'Ewith a total population of 137,165people distributed in area of 257.9 km^2 [13].There are 20004 farm families, with approximately 0.75 acres (0.3 ha) of land under maize per household as indicated by the Navakholo ministry of Agriculture reports 2017.

The soils in the area are mainly clay loam and sandy loam on the upper side of the division although clay loams are the predominant. The rainfall ranges between 1800 and 2100mm per annum and is bi modal and temperature ranges from 18ºC to 22.5ºC [13].

Study population composed of 422 household heads who are women respondents obtained from an accessible population of households, ward agriculture extension officers, education officers in Navakholo sub-county, traders and creditors of Navakholo sub county, Kakamega County, Kenya. A correlational research design was used to determine the relationship between levels of participation in farming by women farmers having taken agriculture subject in secondary school with those without. In addition, the same design was used to examine the relationship between agricultural productivity for two main stable crops with the level of participation in farming by former secondary school women farmers in Navakholo sub-county.

The study population units, sampling methods and sample size of the research in Navakholo Sub-county were obtained as summarised in**Table1.**

Table 1: Summary of study population, sampling methods and sample size of the study in Navakholo Sub-county, Kakamega County, Kenya

Category of respondents	**Study population unit**	**Sampling method**	**Sample size**
Women farmers	Household	Multi-stage random	422
Key informants	Ward extension administrators	Purposive	3
	Sub county officials of education	Purposive	3
	Sub county officials of agriculture	Purposive	3
	Ward creditors	Purposive	3
	Ward traders	Purposive	3
FGD/ stakeholders;	• Teachers. • Agricultural ward administrators. • Sub-County education officials. • Sub-county agricultural officials • Creditors. • Traders. • Women farmers	Quota	8 – 12
Activity	Women socio-economic activities	Purposive	3

Source: Researcher (2019)

The sample size was derived using the following Fischer's formulae (Mugenda, 2008).

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

Where n= minimum desired sample size.
Z=normal standard deviation at 95% confidence interval.
p =the proportion of the target population which has the required characteristics of households (P = 0.5).
q=1-p **where,** 1 is the whole population.
Then
q=1-0.5=0.5
d= is the level of statistical significance (0.05).

Z=1.96, q=1-0.5 and d=0.05

Hence: $n=\frac{Z^2\ p\ q}{d^2}$

$$n=\frac{(1.96^2)\ (0.5)\ (1-0.5)}{(0.05)^2}$$

n= 384

The working sample was obtained by adding 10% of 384 to the sample size. This was essential to reduce the error experienced due to none response of some farmers during data collection.
Therefore, working stratified random sample was: 384+38=422 Households.
Primary data were collected as summarised in **Table2.**

Table 2: Summary of the data collection instruments for Navakholo sub-county

Study population unit	**Sampling method**	**Sample size**	**Data collection instrument**
Household.	Multi-stage random	422	Household questionnaire.
Key informants; agricultural extension ward administrators, agricultural crops officers, area education officers	Purposive	1 per ward	Key informants interview guide
Focus Group Discussions.	Quota	8-12 per ward.	Focus Group Discussions guide.
Observations; household women farming and marketing socio-economic activities.	Purposive	3	Observation check lists

Source: Researcher (2019)

Secondary Datawas derived from document content analysis (books, journals and review reports) at the education office, schools and Navakholo sub-county agricultural office.Data collection Instruments and tools were tested for validity and reliability prior to actual data collection.The following assumptions were made.
i. That the female farmers selected for the study consisted of both former secondary school agriculture subject women and non-agriculture subject women.
ii. That maize and beans are the main staple foodstuffs and was thereforecultivated by nearly all households.
iii. That during the study, all the respondents gave correct information and variables not captured in the current study and in the conceptual framework remained constant.
Data was analysed using statistical Package for the Social Sciences (SPSS Version 20). Data analysis focused on responses from 422 households.

Table 3: Summary of data analysis and presentation as per the specific objectives for the study of former women agriculture subject students

Specific objectives	**Data analysis method**
i.) To establish the proportion of former women agriculture subject students at secondary school level practising agriculture in Navakholo, Kakamega County, Kenya.	Chi square, and descriptive statistics
ii.)To evaluate the impact to agricultural productivity of former women Agriculture students in Navakholo Sub County, Kakamega County, Kenya.	Chi square, correlation analysis and descriptive statistics

Source: Researcher (2019)

Chi-square test equation.

$$X^2 = \Sigma \frac{\text{observed} \times \text{frequency} - \text{expected} \times \text{frequency})}{(expected \times frequency)}$$

Spearman's Rank order correlation was calculated between variables to establish similarities or differences between various rankings using the formulae.

$$r = 1 - \frac{6\sum D^2}{N\sqrt{N^2-1}}$$

Where r- Coefficient of correlation.
N- The number of pairs or rankings used in deviations of r.
D- The difference in a pair of rankings.
Standard error of the correlation was obtained using the formulae.

$$S.E_r = \frac{1 - r^{2\,u}}{\sqrt{N}}$$

The correlation coefficient was computed between variable and its magnitude compared with its probable error.
The probable error ($P.E_r$).

$$P.E_r = 0.6745 \left(\frac{1-r^2}{\sqrt{N}}\right)$$

Where $P.E_r$ - Probable Error.
r- Coefficient of correlation.
N- The number of pairs or rankings used in deviations of r.

III. Results And Discussion

Proportion of former women agriculture subject students at secondary school level practising agriculture

Results of the study summarised in **(Table4)** showed that majority of women farmers 190(44.9%) had never attained any formal education as opposed to 46 (10.9%) who had attained secondary education. These results agree with those ofAbdulhamid[14] who reported a high percentage of rural women attended not more than primary school yet participated in agriculture. A Chi- Square test, ($\chi^2_{3,0.01} = 214.40$) conducted on the results indicated a highly significant (p<0.01) variation in the education level of women farmers. Women's education empowers them to use credit and adopt technologies hence increasing productivity and rural livelihood [15,16].

Table4: Distribution of respondent to variables of study

Variable	Frequency	%	Chi-square	
			χ^2	P
Education level			214.40	<0.01
Illiterate	190	44.9		
Primary	16	4.0		
Secondary	46	10.9		
Tertiary	170	40.2		
Factors affecting production			426.61	<0.01
Ploughing	86	20.6		
Fertility	335	79.2		
Farm and crop security	1	0.2		
Benefits from credit facilities			325.39	<0.01
Benefited	397	93.9		
Not benefited	25	6.1		
Availability of extension services			391.61	<0.01
Available	415	98.1		
Not available	7	1.9		
Effectiveness of extension services			6.149	<0.05
Effective	237	56.0		
Not effective	185	44.0		
Support provided			220.18	<0.01
Training	115	27.8		
Farm inputs	173	41.9		
Weeding and ploughing	89	21.5		
Financial	43	8.5		
Any other	1	0.2		
Practice of production			156.14	<0.01
Monoculture	122	29.1		
Mixed culture	300	70.9		
Marketing channels for maize and beans			419.01	<0.01
Local market	421	99.8		
Farm gate	1	0.2		
Learned agriculture and sat for KCE/KCSE			0.021	>0.05
Yes	209	49.6		
No	213	50.4		
Number of bags of maize harvested per acre			178.79	<0.01
Below 5	13	3.3		
5-10	65	15.4		
11-15	177	41.8		
Above 15	167	39.5		

Impact to agricultural productivity of former secondary school women agriculture subject students

The majority of the respondents 335 (79.2%) indicated thatsoil fertility was a factor influencing maize productivity.A Chi Square test, ($\chi^2_{2,0.01} = 426.61, p = 0.01$) conducted on the results indicated that there was a significant relationship between the factors influencing productivity of maize and agricultural productivity of former women Agriculture subject students in Navakholo sub-county(p<0.01).

Extension services and activities are vital in sustaining food production [17]. In the current study, most women farmers pointed out that extension services were available 415 (98.1%) being provided by several stakeholders who were by then operating in the region and engaged in maize production. Despite the availability of the extension officers, their impact on production was not much felt with 56.0% of the respondents agreeing that the extension officers were effective while 44.0% indicated that they were not effective.A key informant crops officer from Navakholo sub-county pointed out that extension staff workers were few and could not reach all the farmers to provide extension services as frequently as expected.

Farming support received by women farmers included training 115 (27.8%), farm inputs 173 (41.9%), Weeding and ploughing 89 (21.5%), financial 43 (8.5%) and other accounted for 1 (0.2%).Access of food development packages by woman farmers motivate them to participate more actively in farming and increase output through technology [15,16].A Chi- Square test, ($\chi^2_{4,0.01} = 220.18$) conducted on the results indicated that

there was a significant effect of the support($p<0.01$) provided by external sources and their impact on productivity of former women Agriculture subject students in Navakholo sub-county.

Most women farmers 191(45.2%) sourced inputs used in farmingfrom NGOs. Women farmers received inputs such as maize seeds, fertiliser and ploughing services on credit. These results agree with FAO reports[19]which posted that access to inputs as resources in farming increases productivity and is also supported by the current study as Chi Square test, ($\chi^2_{3,0.01} = 230.19$) conducted on the results indicated that there was significant effect($p<0.01$) of input sources to agricultural productivity by womenin Navakholo of Kakamega County, Kenya.

Results indicated that 421 (99.8%) of women farmers sold their products through local market while 1 (0.2%) employed the farm gate. The results concur with a previous researcher who posted that agriculture remains unattractive if women lack knowledge in farming and marketing[20].A Chi -Square test, ($\chi^2_{1,0.01} = 419.01, p = 0.01$) conducted on the results indicated that knowledge on market trends significantly impacted on agricultural productivity.

The results revealed that 209 (49.6%) had learnt agriculture and sat it at KCE/KCSE while 213 (50.4%) had not learned Agriculture subject. A Chi Square test, ($\boldsymbol{\chi^2_{1,0.05} = 0.021}$) conducted on the results indicated that there was no significant ($p>0.05$) relationship in learning of Agriculture and sitting for KCSE/KCE and its impact to agricultural productivity of former women Agriculture subject students in secondary schools in Navakholo of Kakamega County, Kenya. A key crops officer informant claimed that quick, wise decisions are made by women farmers with agricultural knowledge and skills. High productivity was seen among the women farmers who did agriculture at secondary level. The non-KCSE women farmers could only manage their crops with the help of extension officers. According to Robinson-Pant [21] "skill development" should take place through formal, informal and non-formal education system simultaneously during the learning period of a student. Hence, goals such as food security, job opportunity for the people, poverty eradication and rural income generation will be met [13,22].

Analysis showed that 13 (3.3%) of the women harvested less than 5 bags of maize per acre, 65 (15.4%) harvested 5-10 bags, 177 (41.8%) harvested 11-15 bags while 167 (39.5%) harvested over 15 bags. Under optimum condition the expected number of bags of maize from a well maintained piece of land in Navakholo were 20 bags per acre. Therefore, results from the current study indicate underperformance for nearly all the women respondents. The Focus Group Discussions indicated that low productivity was attributed to factors such as: lack of finance as well as lack of knowledge and skills. If farmers had information on how much fertilisers to incorporate in the soils to give the highest yield, then they would have obtained maximum yields. The results are in agreement with the study done by Wabobwa and Wakhungu[17]which posted that knowledge and skills are important in sustaining food security while Tino et al[23] asserts that knowledge plays a greater role in agricultural productivity.

Majority of respondents 300 (70.9%) practiced mixed culture while 122 (29.1%) practiced monoculture. A Chi Square test, ($\boldsymbol{\chi^2_{1,0.01} = 156.14}$) conducted on the results indicated that there was a significant ($p<0.01$) relationship in the practice of production for women farmers and agricultural productivity in Navakholo sub-county, Kakamega County, Kenya A key ward extension informant indicated that stakeholders in maize production restricted farmers from planting maize and bean seeds in the same hole so that beans crops do not compete with the maize crop for the fertilisers offered to farmers for the purpose of maize production.Focus Group Discussions also revealed that mixed culture was preferred by farmers since they would harvest maize and beans in one season reducing the cost of production.

Cross tabulation was carried out between learning Agriculture and the practice of production to determine its impact to agricultural productivity(Table5).

Table5: Learned agriculture and Practice of production Cross-tabulation for women farmers in Navakholo sub-county, Kakamega County.

Learned agriculture and sat for KCE/KCSE		**Practice of production**	
		Mono culture	**Mixed culture**
Yes	Frequency	41	169
	%	19.5%	80.5%
No	Frequency	82	131
	%	38.5%	61.5%

Source: Researcher (2019)

Majority of those who learnt agriculture (80.5%) practiced mixed culture but only 61.5% of non-KCSE Agriculture subject women farmers practiced mixed culture. This shows that learning of agriculture had impacted them positively and its evidenced on productivity. Mixed culture has a lot of advantages and increases productivity as compared to mono culture.

To further understand how the studying of agriculture impacted on productivity, cross-tabulation was carried out to establish the relationship as described in **Table 6**. From the analysis, 66.7% of those who had learnt agriculture and sat for KCSE produced over 15 bags while only 12.7% of those that had not learned agriculture harvested over 15 bags. Focus Group Discussions attributed this performance to knowledge gained and management skills developed during learning agriculture subject at secondary school level. For the respondents who didn't learn agriculture and sit for KCSE, there productivity was lower and attributed to lack of management skills. A key crops officer informant asserted that to the non-KCSE subject women, extension services were offered informally in the process of crop management. The results concur with that ofTino[23] who posted that knowledge plays a greater role in agricultural productivity and those posted by [17] that, knowledge and skills are important in sustaining food security.

Table6: Learned agriculture and Number of bags harvested Cross-tabulation for women farmers in Navakholo sub-county, Kakamega County, Kenya

			Number of bags of maize harvested per acre			
			Below 5	**5-10**	**11-15**	**Above 15**
Learned agriculture and sat for KCE/KCSE	Yes	F	0	9	61	140
		%	0.0%	4.3%	29.0%	66.7%
	No	F	14	56	116	27
		%	6.6%	26.3%	54.5%	12.7%

Source: Researcher (2019)

Spearman rank order correlation carried out to establish the relationship between studying agriculture and productivity revealed a highly significant (P<0.01) relationship between studying agriculture and agricultural productivity. Looking at the tabulation, the correlation is positive and significant at the 0.01 level; that is, it's two-tailed i.e. $r = 0.55 \pm 0.034$, ($p < 0.01$).A key agricultural officer from Navakholo sub-county reported that if all farmers had learnt agriculture subject, then supervision of subsistence crops production would be easysince, the Agriculture subject KCSE women farmers followed management practices keenly and produced highest amount of products yearly. Hence, the study of agriculture subject had a positive impact on respondent's agricultural productivity.

210 (49.6%)former KCSE agriculture subject women farmersindicated that agriculture knowledge was useful in management practices of maize while 212 (50.4%) indicated that it was useful in marketing.A Chi Square test, ($\chi^2_{1,0.05} = 0.021$) conducted on the results indicated that there was no significant ($p>0.05$) relationship between learning Agriculture subject and sitting for KCSE and farming practice of women farmers in Navakholo of Kakamega County.

IV. Conclusions

Agriculture knowledge gained in secondary school has positive impact on later agricultural productivity of many households. Girls should be encouraged to enrol for secondary school agriculture subject and persist to completion because the skills gained have influence on agricultural productivity. The study revealed that the proportion of former KCSE agriculture subject women farmers was lower than the proportion of the non-KCSE agriculture subject women farmers while the level of education of women farmers was found to be independent of their participation in farming. Learning of agriculture has influence on farmer productivity since former KCSE agriculture subject women portrayed better farming methods and had higher productivity. Spearman rank order correlation was significant at 0.01 level (P<0.01) relationship between studying agriculture and agricultural productivity (number of bags harvested per acre). Hence, the study of agriculture subject had a positive impact on respondents' agricultural productivity.

V. Recommendations

The following recommendations were made based on the findings and the conclusions of the study:
Secondary school Agriculture subject is needed as a tool in practising agriculture. Most women farmers in Navakholo sub-county practising agriculture are underperforming in crop management practices due to inadequate knowledge and skills hence reduced productivity The largest proportion of the women farmers have not learnt agriculture and sat for KCSE. There is need for the government to increase the funds to be used in teaching applied technology and innovations during the implementation of secondary school Agriculture subject syllabus. There is need for the Ministries of Agriculture and Education to jointly develop a curriculum that fully

implements a practical approach to the teaching and learning of agriculture as a subject in secondary schools so as to improve on food productivity, economy and implementation of agriculture subject education.

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