Food Security in Kenya: The Impact of Building Rural Farmers’ Capacity through Agricultural Education in Secondary School

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Abstract
Many developing countries today face major challenges with regard to food security due to changes in rural land use, coupled with population pressure. One of the ways Kenya has responded to this is by teaching agriculture at various levels of education especially secondary school level. Little has been done, however, to establish whether or not there is any significant difference in agricultural productivity between farmers who graduate with secondary school agriculture knowledge and those without. The study adopted the proportionate sampling technique, where a sub-sample of farmers from a target population of those farmers with secondary school agriculture knowledge and those without this knowledge and a total of 200 farmers where interviewed. Results showed that farmers with secondary school agriculture knowledge performed significantly better than those without the secondary school agriculture knowledge and thus have higher levels of food security indicators in crop productivity, management and level of household food security. The study shows how secondary school agriculture knowledge not only broadens farmers’ capacity, but also makes them more effective, self reliant, resourceful and capable of solving farming problems and as a result, significantly improves their crop productivity and hence guarantee food security for the family. The challenge for the teaching profession is finding out the best teaching methods as approaches both in and out of class.

Keywords: food security, Kenya, impact, building rural farmers, capacity, agricultural education, secondary school

INTRODUCTION
Despite enormous efforts to industrialize, Kenya still remains an agricultural nation with the majority of its people (90%) living in the rural areas and depending on agriculture, either directly or indirectly for their income. It has also been noted that small-scale farmers who constitute majority of the rural crop producers have great potential in increasing agricultural production the Least Developed Countries (LDCs), Kenya included. This paper focuses on the contribution of secondary school agricultural knowledge to rural agricultural productivity. The rapidly growing population and steady expansion of the education system has resulted in the unemployment of those who complete school and cannot find access to further education. Students who cannot get into high paying jobs can engage themselves in agriculture, hence, the need for initiating agriculture in secondary schools in Kenya (Ominde, 1964). One of the general objectives of teaching agriculture in the 8-4-4 secondary school curriculum (KIE, 1992), is to ensure that schools take an active part in rural development by integrating agricultural activities in the curriculum. This has been done through provision of technical knowledge, reinforcing interest in and awareness of opportunities existing in agriculture among the secondary school graduates (RoK, 1976). However, little has been done to establish whether or not there is any significant difference in agricultural productivity between farmers who graduate with secondary school agriculture knowledge and those without. The main question is: does agriculture knowledge at secondary school level make any difference in agricultural productivity?

The purpose of this paper is to examine and determine the contribution of secondary school agricultural knowledge to rural agricultural productivity. Specifically, the paper seeks to determine the difference in crop productivity per unit area, determine and compare level of crop management, and the role of secondary school
agriculture knowledge on the level of rural household food security.

**Agriculture and National Development**
In recent years, agriculture production has not kept pace with population growth rate and the country has become a net importer of its two major staple foods, maize and wheat (Kliest, 1985). There is now an urgent need for agriculture expansion and development in order to reverse the current trend in agricultural productivity in the country.

Mosher (1971) describes various ways in which agricultural expansion and development can be purposefully accelerated. One of the ways is provision of agricultural education and training through schools, colleges and extension education, including youth clubs. According to a World Bank Report (1988), “without education, development will not occur. Only an educated person can command the skills necessary for sustainable economic growth”. The reduction in farm size due to increase in human population has led to reduction in farm output. There is, therefore, need to get more and more technical knowledge to maintain a viable and sustainable agricultural production through intensive farming. This needs a level of education that can assist the trainee to make certain critical decisions related to farming. This is because the education system of a country plays a major role in the development of human and natural resources, as well as crating attitudes which, inspire and dispose individuals towards change. Education provides participatory skills in people. Subsequently, this will enhance economic, political and social development (Mwangi, 1998).

Economic growth in Kenya is related to development within agriculture. Consequently, if agricultural development is stagnant, it offers only a stagnant market and inhibits the growth of the rest of the economy (Sheffield, 1971). Over 70% of those who live in rural areas derive their livelihood from farming (Bessey, 1972). The implication of this heavy dependence on agriculture is that any considerations about national development are likely to lean heavily on agricultural development, hence rural development. When knowledge, skills and attitudes are rationally utilized, they contribute greatly to social and economic development (Kathuri, 1990).

**Building Future Farmers’ Capacity through Practical Agriculture Skills in Secondary Schools**
Recommendations on the development and building of rural farmers’ capacity in Kenya has come from varied sources, most of which see the rural agricultural sector as holding the key to the present and future development of the country. Bessey (1972) advises the Government of Kenya that methods suited to the needs of small-scale intensive crop production be incorporated into agriculture education programme. The scholar has also suggested that school teaching facilities should include school crop and livestock enterprises to assist the learners gain the practical skills.

The Gachathi Commission (RoK, 1976) has also suggested that the curriculum for both primary and secondary schools should prepare learners for agriculture budgeting, the family welfare and community development. These suggestions, particularly those regarding the teaching of agricultural sciences, including the economics of production, have over the years been incorporated into the syllabus. The Gachathi Commission’s Report (ibid.) has recommended that secondary education be geared towards the rural and informal sector by diversifying the curriculum and giving priority to teaching agricultural sciences. This is a further emphasis on practical agriculture. It is from the above suggestions that the general objectives of teaching agriculture were developed and adopted. Although agriculture was taught before 1976, it was not as elaborate as it is currently. Education experts have argued that teaching of skills necessary for self-employment and self reliance is only possible where there are adequate and proper material and human resources (KIE, 1992). The resources include a viable school farm among other equipment and facilities. It is gratifying to note that the teaching of agriculture has improved over the years to reflect the practical oriented approach.

Among the steps undertaken by the Kenya Government, through the Ministry of Education, include ensuring that every school offering agriculture as an elective subject either own or here a farm for practical purposes as well as including project work (Agriculture practical Paper 3) in the Kenya National Examinations where students fully participate in developing their psychomotor skills through carrying out of project work in their individual allocated plots. The major aim is to reinforce the students’ interest in agriculture and development of the psychomotor skills so that they have positive attitudes towards the subject as well as developing their agricultural skills hence become better farmers after completing their formal education (KIE, 1992). Little is however known about the impact of building this capacity among secondary school granduands in rural areas where crop production is carried in Kenya. The objective of the study was to examine and determine the contribution of secondary school agricultural knowledge to rural agricultural productivity. Specifically, the study sought to determine the differences in crop productivity per unit area, determine and compare level of crop management, and the role of secondary
school agriculture knowledge on the level of rural household food security.

The contribution of Farmer’s Education to Agricultural Productivity

Education is cherished in all societies. Schooling is important where there is a rapid rate of technological change. Against this background, several countries and international agencies have supported farmer’s formal and non-formal education. In Africa, several studies have shown a positive relationship between education and agricultural productivity (Mwangi, 1998; World Bank, 1980). These works elaborate on the positive contributions education makes to agricultural productivity. No significant growth is possible in Kenya without substantial growth in agricultural productivity (Nyoro, 1994).

Farm Management

This is defined as the professional administration of skills or care of the farm for maximum production (Martin, 1978). Improvement in crop and livestock management accounts for a significant share in production and productivity. Farmers are producers of food and other useful commodities from plants and animals. Management describes the function of making decisions about how land, labour and capital resources should be used in carrying out these decisions. All production implies the taking of some risks, since decisions are made and inputs committed on the basis of expected yields and prices. Actual outcomes may be better or worse than projected outcomes because of either bad lack or bad decisions. In farming, the farmer himself takes the risks and bears the consequences of his decisions. The decisions about what do produces, how much to produce and what methods of production to use, can be found through agricultural sciences and technology. Thus the question of what to produce might be decided by considering the soils, natural vegetation and natural climate suitable for crops and livestock. The question of how much to produce might be decided by producing the highest possible yield. The method of production to use may depend upon the special field of interest of the farmer. These technical solutions provide the range of alternative choices open to farmers, from which they chose those courses of action which seem most likely to achieve their objectives. This needs a level of education that guides one to make such critical decisions (Martin, 1978).

Food Security

Food security can be defined as the ability of countries, regions or individuals to meet their year round target calorie food requirements through domestic production, storage and international trade (Dellere, 1988). Mwangi (1999), on the other hand, defines food security as the access to enough food by the people for active and healthy living. It is achieved when households produce enough staple crops for their own consumption or when they have enough disposable income to meet their food needs for the market. In general, a family has food security if it can consistently satisfy 80% or more of its nutritional requirements. Maize is the staple food for the majority of Kenyans; it is therefore, the chief source of energy and protein for both the rural and the urban populations. Poor households especially those with smaller land holdings, and a weaker resource base are more vulnerable to food stress than wealthier households. Such households begin to suffer earlier than the rest, when food shortages occur (Kagutha, 1995).

Poverty is a major cause of the inability of many individuals to acquire a calories adequate diet throughout the year. To be food secure, one needs a level of education that can enable him or her to be innovative and hence plant more, store more or purchase food for utilization (Dellere, 1988).

LIMITATIONS OF THE STUDY

The study focused on provision of agricultural education in secondary schools. It is probable that most of those who go through secondary schools in Kenya may or may not end up in farming, especially when one considers such factors as lack of land for farming that force people to seek alternative source of livelihood. As such, there is need not only to provide education for those in school, but also for those who are already practising agriculture. Government and stakeholders should provide educational extension services for farmers. The study has not considered this vital option of educational provision and perhaps there is need to explore it in future studies on the same area.

MATERIALS AND METHODS

The research design chosen for the study was the Ex-post facto research design. This design allowed the authors to examine the effects of the natural occurring influence of the independent variable (secondary school agriculture education) on the dependent variable (farmers’ agricultural productivity). In addition, the design allowed the authors to apply aspects of survey research to track agricultural productivity and thus relate secondary school agricultural knowledge to agricultural productivity. Each farmer was visited once to observe farm activities. An interview was conducted during the visit.

The study took a sample of 200 for the two divisions to ensure that the main characteristics of the farmers were captured. The sample size was also large enough to allow reasonably accurate interpretation of the results. First, the target population was identified and stratified according to the farmers’ secondary school agriculture knowledge. Secondly, the sample
size was determined by using proportionate sampling technique and, thirdly, simple random sampling technique was applied for each stratum.

For analysis, the responses from the respondents were coded and entered into a data sheet. The final data were then keyed into the computer for analysis. The Statistical Package for Social Sciences (SPSS) computer program was used to analyse the data. The T-test and Chi-square statistics were used to test the stated hypotheses. Quantitative method of data analysis was mainly used with both descriptive and inferential statistics being employed to explain the results of the study. The dependent variables that were analysed as follows:

i) **Crop Productivity**: This variable was measured by determining the percentage of crop output per unit area based on estimated agro-ecological zone potential productivity.

ii) **Food Security**: Food security is achieved when households produce enough stable crops for their own consumption or when they have enough disposable income to meet their food needs for the market. In general, a family has food security if it can consistently satisfy 80% or more of its nutritional requirements. This was measured by dividing the variable into three categories indicating the level of household food security as follows: a) Adequate food security b) fair food security.

iii) **Farm Management**: This was measured by determining the level of application of the skills in the production process of crops. A set of questions were put to the farmers and their level of farm management determined and by use of a rating scale, farmers’ responses on tier administrative skills were rated on a 4-point scale. The farmers’ average score indicated the level of his farm management skills. Chi-square was used to determine the association between the farmer’s agricultural knowledge and level of crop management.

**RESULTS AND DISCUSSION**

The study sought to determine the contribution of secondary school agricultural knowledge on rural agricultural productivity of small-scale farmers in Turbo and Kapsaret Division of Uasin Gishu District. The findings are presented and discussed below.

**Farmers’ Crop Production and Percentage Performance**

The crops mainly considered to compute the percentage crop production performance were maize and beans. Their productivity was measured by computing the output level of each crop per hectare compared with the average expected zone production and their percentage production performance determined. The results in Table 1 below indicate that farmers with secondary school agriculture knowledge with a mean percentage performance of 97.66 performed better compared to the farmers without secondary school agriculture knowledge whose crop percentage performance 92.16. The general observation and results from crop productivity as shown in Table 1 indicate that farmers with secondary school agriculture knowledge have a higher productivity in both crops.

<table>
<thead>
<tr>
<th>Farmers with Sec. Sch. Agric. Knowledge</th>
<th>Farmers Without Sec. Sch. Agric. Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage Performance</td>
<td></td>
</tr>
<tr>
<td>Cumulative Percent</td>
<td></td>
</tr>
<tr>
<td>&lt;50</td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>Percentage</td>
</tr>
<tr>
<td>5</td>
<td>5.0</td>
</tr>
<tr>
<td>50-100</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>51.7</td>
</tr>
<tr>
<td>&gt;100</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>43.3</td>
</tr>
<tr>
<td>Missing System</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Mean = 97.66</td>
<td>Mean 92.16</td>
</tr>
</tbody>
</table>

First, this could be as result of specialization by this group of manners compared to the farmers without secondary school agriculture knowledge. Secondly, better crop performance in crop productivity among the farmers with secondary school agriculture knowledge could be attributed to the knowledge gained in school in crop production to higher productivity.

**Farmers’ Crop Management Competence**

The farmers’ crop management performance was determined by asking farmers when they performed the following basic agricultural practices: ploughing, planting of the crop controlling of weeds, controlling of pests, preventing and controlling crop diseases and harvesting the crop. The crops which initially were under consideration were wheat, maize and beans but the farmers producing wheat were negligible, therefore maize and beans were the only crops considered. The farmers’ responses were noted down and based on when the management practices were done within the zone of study, the responses were rated on a 4-point rating scale as follows: 1 for “very late”, 2 for “late”, 3 for “fairly early” and 4 for “early or on time”. The ratings for the two crops were summed up and an average score value determined that was used to indicate the rating score of the
A general observation of Table 2 indicates that farmers with secondary school agriculture knowledge had a higher percentage of good and very good farmers (57.1 + 14.3 = 71.2 whereas the percentage for those farmers without this knowledge was 70.7.

The mean overall score for the farmers with secondary school agriculture knowledge was 2.78 whereas the mean score value for those farmers without this knowledge was 2.65. Thought higher for the former, the approximate mean score value for the two groups of farmers was 3, indicating that the two groups of markers were good in tier crop management performance.

Farmers’ Percentage Level of Food Security
The percentage level of food security per farmer was determined by noting down the amount of maize (as the main food crop) consumed per day for each of the farmers and also the amount of maize (in kgs) that the farmer kept for the family for the whole year.

Table 3: Farmers’ Percentage Level and Food Security

<table>
<thead>
<tr>
<th>Farmers with Sec. Sch. Agric. Knowledge</th>
<th>Farmers without Sec. Sch. Agric. Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td>Poor</td>
<td>4</td>
</tr>
<tr>
<td>Fair</td>
<td>24</td>
</tr>
<tr>
<td>Good</td>
<td>56</td>
</tr>
<tr>
<td>V. Good</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>98</td>
</tr>
</tbody>
</table>

Mean = 140.57

The amount of food consumed per day per family is multiplied by 365 (days in a year). This gives the value of the amount of food required by a family for the whole year in kilogrammes. The amount of food stored was compared to the amount consumed in a year and computed in percentages to determine the percentage level of food security per family. Their frequencies were determined and the summary was as shown on Table 3.

The results Table 3 show that only 1% of the farmers with secondary school agriculture knowledge lacked food security; whereas there was 3.9% of the farmers without secondary school agriculture knowledge who lacked food security. Farmers with secondary school agriculture knowledge had 14.3% of them who were fairly food secure whereas their counterparts had 15.7%. Farmers with secondary school agriculture knowledge had 84.4% of the members with adequate food security. The percentage mean level of food security was 140.57% for farmers with secondary school agriculture knowledge whereas those farmers without this knowledge had a percentage mean level of food security of 124.39.

Impact of Secondary School Agriculture Knowledge on Crop Productivity
It was postulated that there is no significant difference in crop productivity between farmers with secondary school agriculture knowledge and those without this knowledge. The inferential statistical analysis of the results yielded the t-test values presented on table 4.

This was done to test the validity of the hypothesis that there is no significant difference in crop productivity between farmers with secondary school agriculture knowledge and those without this knowledge. The results of the analysis on Table 4 show that there was statistically significant difference in crop productivity between farmers with secondary school agriculture knowledge and those without this knowledge. Table 4 indicates that the calculated value of 20.078 for farmers with secondary school agriculture knowledge and those without it, with 97 degrees of freedom, was statistically different. This difference is significant at 0.05 level of significance. Therefore, the null hypothesis was rejected.
These findings imply that secondary school agriculture knowledge prepares the student to be better in agriculture productivity after going through the secondary school agricultural curriculum. It can be concluded that the original objective of introducing agriculture in secondary schools in Kenya is being met.

**Farmers’ Secondary School Agricultural Knowledge and Level of Crop Management**

It was hypothesized that there is no significant association between the level of crop management and farmers’ secondary school agricultural knowledge. This hypothesis was tested using the Chi-square ($\chi^2$) statistic. The indicators used to build up the level of crop management include ploughing of the field on time, planting the crop on time, controlling of weeds on time, controlling of pests, preventing and controlling crop diseases and harvesting the crops on time.

The results of the analysis in Table 5 show that Chi-square calculated value of 9.46 is statistically significant at 0.05 level of significance. Therefore, the null hypothesis which stated that there is no significant difference was rejected. The assumption is that agricultural education instils a favourable attitude as well as, some skills in the use of improved farm practices which in turn increases the productivity. A conclusion can be reached that the objective of introducing agriculture in secondary school in Kenya is being met. That is to expand knowledge of the basic principles and practices in agriculture among the learners.

**Impact of Secondary School Agricultural Education of Household Food Security**

It was hypothesized that there is no significant differences in level of household food security between farmers with secondary agriculture knowledge and those without this knowledge. This hypothesis was tested by use of T-test statistics. The frequencies showing the percentage household-food security were also used to determine the relationship between the two variables. This was done to test the validity of the hypothesis that there is no significant difference in level of household food security between farmers with secondary school agriculture knowledge and those without it. The results of the showed that there was statistically significant difference in the percentage level of food security between farmers with secondary school agriculture knowledge and farmers without this knowledge.

It was indicated that the T-calculated values of 19.15 for farmers with secondary school agriculture knowledge and those without it. The results of the analysis showed that there was statistically significant difference in the percentage level of food security between farmers with secondary school agriculture knowledge and farmers without this knowledge. The results also indicated that the T-calculated values of 19.15 for farmers with secondary school agriculture knowledge and those without it, with 97 degrees of freedom show that the food security for the two groups of farmers were statistically different. This difference was significant at 0.05 level. Therefore, the null hypothesis that stated that there is no significant difference in the level of household food security between farmers with secondary school agriculture knowledge and those without this knowledge was rejected.

These findings are consistent with the objectives of the secondary school agriculture syllabus (KIE, 1985). It is expected that as a result of completing the four-year agriculture course, the learners are expected to develop self-reliance, resourcefulness and problem solving abilities, such as ensuring that there have enough food for the family throughout the year by planting enough and storing enough for the family.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Calculate t-value</th>
<th>Mean differences</th>
<th>df</th>
<th>Significant t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentages</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crop yield (with agric)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crop yield (without agric)</td>
<td>20.078</td>
<td>97.65</td>
<td>97</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Table 5: Cross-tabulation of Status of Agricultural Knowledge by Level of Crop Management

<table>
<thead>
<tr>
<th>Level of Crop Management</th>
<th>Status of Agricultural Knowledge (ALL)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With Agricultural Knowledge</td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Fair</td>
<td>24</td>
<td>53</td>
</tr>
<tr>
<td>Good</td>
<td>56</td>
<td>124</td>
</tr>
<tr>
<td>Very Good</td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Without Agricultural Knowledge</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>98</td>
</tr>
</tbody>
</table>

$X^2 = 9.459$  DF = 3  Sign 0.05
CONCLUSIONS

It is concluded from the study that the farmers’ secondary school agriculture knowledge positively contributes to the farmer’s crop percentage performance. Those farmers with secondary school agriculture knowledge perform significantly better than those without the secondary school agriculture knowledge. This implies that agriculture should be made more practical than before by emphasizing practical aspects in instil more knowledge in productivity among the learners, especially the development of the psychomotor skills.

On level of crop management, the observations showed that farmers with secondary school agriculture knowledge performed better compared to farmers without the secondary school agriculture knowledge. The implication is that farmers with secondary school agriculture knowledge perform better because of the knowledge they acquired in school either theoretically or practically. When the Chi-square values were run to determine whether or not there was any significant association between the secondary school agriculture knowledge and farmers level of crop management, it was found that there was a significant association between the two variables.

Furthermore, it was concluded that farmers with secondary school agricultural knowledge perform significantly better as compared to farmers without the secondary school agricultural knowledge as far as food security was concerned. This implies that farmers with secondary school agricultural knowledge have developed the ability to be self-reliant, resourceful and problem solvers, such that they ensure they have enough food for the family throughout the year. In general, agriculture knowledge at secondary school level, indeed contributes positively and significantly to rural agricultural productivity in Uasin Gishu District.

RECOMMENDATIONS

On the basis of the results obtained, conclusions and implications of the study discussed above, the following recommendations are made:

1. Since farmers with secondary school agricultural knowledge perform significantly better in most of the aspects looked into in crop production, it is more appropriate to make agriculture subject compulsory for all the students in this country as a way of diversifying was of rural poverty alleviation. It is therefore instructive of teachers, planners and even policy makers that teaching of agriculture in secondary schools develops self-reliance, resourcefulness, problem-solving abilities, and occupies the learners in agricultural enterprises which may not necessarily require a lot of capital to start, but significantly improve the economy of this country.

2. There is need to ensure that time set for practical in agricultural lessons indicated in the timetable is actually sued for the purposes intended, because the results of the study strongly indicate that the learners are handy in most of the crop management skills. If the time set for agriculture practical is not enough then the syllabus should be revised so that only very important topics are taught and more time created for the practical agriculture.

3. The Ministry of Education, Science and Technology should also ensure that schools offering agriculture own or hire land to enhance the crop management practical skills. This will ensure that those students completing the fourth form, having done agriculture in secondary school, become better farmers and hence agents of change in rural areas who can significantly contribute to poverty alleviation as it is a common knowledge in our country that agriculture is the backbone of Kenya’s economy.

REFERENCES


