

Practice of Sustainable Agriculture in Kenya's Public Secondary Schools

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Abstract

The ultimate aim of education is to promote responsible citizenship behavior. Secondary school agriculture in Kenya is intended to make learners acquire useful agricultural skills for production and environmental protection. Despite agriculture subject being offered in most secondary schools in Kenya for over a quarter of a century the practice of sustainable agriculture in schools remains elusive and the use of agrochemicals is still a great threat. The objectives of this study was to assess the knowledge level of public secondary school agriculture teachers towards sustainable agriculture; to determine sustainable agriculture practices carried out in schools and to establish the perception of secondary school teachers of agriculture towards environmental sustainability. Structured Questionnaires were administered among agriculture examiners of Kenya Certificate of Secondary Education. The target population was six hundred teachers and a sample of 80 respondents was selected through stratified random sampling technique. The responses were analyzed using frequencies and percentages. Correlations were determined using Pearson's product moment coefficient and regression analysis used to determine cause-effect relationship. The major finding was that majority of the teachers have no knowledge of sustainable agriculture and do not engage in practices that promote environmental protection. The information from this study is significant to curriculum developers and agriculture teacher trainers to evaluate the content of agriculture education training to infuse sustainable agriculture and sustainable environmental development.

Key words: Agriculture teachers, agrochemicals, biodiversity, environmental education, sustainable agriculture

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Introduction

In third world countries about 2.3 to 2.6 billion people are supported by agricultural systems (Food and Agricultural Organization [FAO], 2008). Agriculture contributes 30% of the Gross Domestic Product (G.D.P), 75% of the employment and provides nearly all national food requirements in Kenya (Government of Kenya [GOK], 2001). Agriculture education is a key pillar of the economy of Kenya (Wanyama & Changach, 2013). Some benefits of agriculture education include: greater value of outputs, greater physical production and quality improvement.

Increased production of goods and services has been sought through different combinations of labour, raw materials, accumulated capital and available technology. Environmental concerns have emerged as an issue on a global scale. Highly industrialized societies realized the adverse consequences of varied practices and technology on the environment (Rebecca, 2013). Environmental issues are indeed of great importance to the developing countries and should be considered as an integral aspect of the development process (Orodho, 1991).

Environmental problems of developing countries have arisen largely from agriculture (Doorman, 2007). Some of the impacts of agriculture on environmental quality include among others; loss of soil through erosion, decline in water quality and loss of water resources, increased use of chemical fertilizers, increased use of herbicides and pesticides and the rise in energy intensive agriculture (Hans, 2005). Therefore technological and economic changes have led to changes in environmental quality.

Industrialized input intensive agriculture has increased production over the last decade but appears to be now running into fundamental ecological limits. Organic farmers and agro-ecologists continue to evolve and demonstrate a model of sustainable agriculture in many countries with a view to maintain biodiversity (FAO, 2000).

Pesticides, herbicides and animal wastes are heavily polluting. In both developing and developed countries, the social and economic impacts of plantation farming on rural economies and societies add to the costs (Rebecca, 2013). Making a transition from industrial agriculture to an ecologically based model will be a balancing process: phasing out unsustainable practices, piloting new practices, testing, and learning from experiences (Doorman, 2007). Policies to support this process should set broad objectives and not specific solutions.

Agriculture in the world is in a transition as researchers, educators, environmentalists and farmers take on the responsibility of developing agricultural production systems that are ecologically, economically and socially sustainable by adopting new policies, management plans, and technology (Minarovic, 1995). The agriculture syllabus review and improvement has direct implications on teaching resources. Any attempt geared towards agriculture syllabus review must involve the agriculture teachers who constitute the key implementers (Konyango, 2010).

Minarovic (1995) observes that an agricultural production system that is ecologically sustainable is one that conserves managed ecosystems and natural ecosystems surrounding the production areas by use of methods that restore the natural

resource base. A production system that is economically sustainable uses methods that are efficient and result in short and long term profitability for the producer. Socially responsible production systems use methods that are safe and healthy for the environment, farm workers and consumers, support the farmer and rural community and preserve farmland for future generations.

The Constitution of Kenya chapter 5 Article 69 (1) and (2) emphasizes on obligations in respect of the environment (GoK, 2010). It is therefore imperative that farmers practice sustainable farming methods. Production methods used by teachers of agriculture in secondary schools to ensure increased production involve use of agrochemicals and stiff competition for arable land which interferes with the fragile ecosystem (Thornton, 2008). Use of agrochemicals emerges as a great threat towards sustainable agriculture. As such the challenge of practicing sustainable agriculture will persist with its adverse consequences on the communities within the country. The study investigated the perception of agriculture teachers in public secondary schools towards sustainable agriculture in order to bridge the gap between economical production and environmental sustainability.

Literature Review

Agriculture is described as the science and art of crop production and livestock production. Agricultural production accounts for 67% of land globally and has a range of associated footprints (Sherr, 2008). Furthermore the use of land for agriculture may

likely increase with time due to increasing demands for food as the current human population is projected to increase to 7.2 billion, 8.3 billion and 9.3 billion by years 2015, 2030 and 2050 respectively (FAO, 2000). Added to this ecological stress is the fact that over 1.1 billion people most of whom are dependent on agriculture, reside within the locations of the 25 globally identified hotspots (Muir, 2011). Muir (2011) observes that conventional agriculture is a method in which the use of genetically modified organisms, chemical pesticides / herbicides and chemical fertilizers is considered a normal practice.

Sustainable agriculture is an integrated system of plant and animal production practices having a site specific application that will over the long term (a) satisfy human food and fiber needs, (b) enhance environmental quality and the natural resource base upon which the agricultural economy depends, (c) make the most efficient use of non-renewable and on-farm resources and integrate, where appropriate, natural biological cycles and controls and (d) sustain the economic viability of farm operations and enhance the quality of life for farmers and society as a whole (GoK, 2007).

Secondary school agricultural education knowledge if infused with relevant agro-technologies can cushion farmers against hardships that they encounter in their livelihoods (KIE, 2008). This can be achieved through a number of technologies such as harvesting and storage of rainwater and runoff water, trapping solar radiation for lighting, heating and operating electrical gadgets, trapping wind via windmills to run dynamos (Mutiso, Kibett & Obara 2014). Agriculture knowledge can also enhance

technological skills on conversion of animal wastes into biogas through anaerobic digesters to which can be subsequently be used for heating and lighting. The carbon sink in the soil can be enhanced by minimum tillage. In developed world faecal sludge is one major source of fertilizer as well as a source of energy. It can be transformed into compost in sustainable organic livelihood where temperature is monitored and samples from final product tested for *Escherichia coli* and coliform environmental safety (Tirop, 2014).

According to Beus and Aunlap (1992), there are two competing perspectives among agricultural stakeholders; proponents of “alternative agriculture” or sustainable agriculture, and proponents of “conventional agriculture”. Alternative agriculture proponents believe the agriculture system has many problems and must be reviewed to solve ecological economic and social issues. Conventional agriculture proponents believe the existing system works well and any problems can be solved through research and technology (Quddus & Mia, 2010). Sustainable and feasible agriculture in vision thinking is one that is capable of achieving food security, competitive in the local and foreign market through an optimal use of resources as part of a comprehensive development program (FAO, 2010).

Farmers, environmentalists and community groups are increasingly interested in contributing to the sustainability agenda (GoK, 2010). Organizations however counterbalance individual needs, corporate greed and resource depleted institutions.

They face difficulty in changing cultural attitudes particularly in poverty stricken areas (Diamond, 2005).

Human development of sustainable agriculture comprises the process of enlarging people's choices at three essential capabilities; to lead a long and healthy life, to be knowledgeable and to have a decent standard of living (McKinney & Schoch, 2003). Viederman (1990) points out that sometimes we are self-satisfied with our wisdom in moving ahead with sustainable agriculture. However sometimes that wisdom is difficult to transfer and requires not only speaking but also understanding the meaning of sustainable agriculture for different stakeholders to satisfy their needs. Knowledge management can be used to understand sustainable agriculture. Laukkanen (2000) explores the notion of the structure and dynamics of diverse agricultural processes. Boone, Hersman, Boone and Gartin (2007) reported about the knowledge that agriculture educators have concerning the dimensions of sustainable agriculture.

Gardner and Stern (2002) agree that human activity is the cause of several environmental threats but they further insist that the cognitive or mental dimension gives more insight to people's alignment to sustainable agriculture. The Tbilisi intergovernmental conferences on environmental education identified 5 objectives of environmental education which may be used to define a responsible citizen as one who has:

- i) An awareness and sensibility to the total environment and its allied issues.
- ii) A basic understanding of the environment and its allied issues.

- iii) Feelings for concern for the environment and motivation for actively participating in environmental improvement and protection.
- iv) Skills for identifying and solving environmental issues.
- v) Active at all levels in working towards resolution of environmental issues (Hungerford, Volk, Dixon, Markinkowski & Sai, 1990).

In the past two decades Kenya has relied more heavily on the use of pesticides, fertilizers and modern methods of husbandry to boost her agricultural production and achieve higher levels of agricultural development (GoK, 2001). The consequences include among others:-Loss of soil, decline in water quality and loss of water resources, increased use of chemical fertilizers, increased use of herbicides and pesticides and rise in energy intensive agriculture (World Health Organization[WHO], 2013) Therefore technological and economic changes have led to changes in environmental quality (Lunt, Winsemius, McDonald, Morgan .& Dehaan, 2010).

Residues of pesticides contaminate soil and water, persist in crops and enter the food chain, and are finally ingested by humans with foodstuffs and water. Furthermore pesticides can be responsible for contributing to biodiversity losses and deterioration of natural habitats (Sattler, Kacheler & Verch, 2006). There have been reported instances of pest resurgence, development of resistance to pesticides, secondary pest outbreaks and destruction of non-target species (Karlison, 2004). Despite the fact that pesticides are also applied in other sectors, agriculture can undoubtedly be seen as the most important source of adverse effects (Sattler *et al.*, 2006).

Research Approach

The study used descriptive survey methodology to collect and analyze information on sustainable agricultural activities in the school farm to establish current practice and the perception of agriculture teachers based on their recommendation. Stratified random sampling was used to identify one hundred and fifty agriculture teachers from across the country based on position within the service, length of service, education level and geographical diversity within Kenya. The study was guided by Durkeim's theory (Konyango, 2010) which looks at education as the transmission of society's norms, values and accumulated technologies to the schooling generation. It was further reinforced by Pragmatist theory by John Dewey which emphasizes on technological direction of curriculum change to vocational education. The farming activities in the school farm in terms of diversity was used as a measure of how much the agriculture teacher embraced sustainable agriculture while the recommendation was used to objectively assess the teachers' knowledge and perception on sustainable agriculture.

Results and Discussion

Of the teachers interviewed 41.5% had diploma as their initial qualification while 58.5% had bachelor's degree qualification. Of these only 15.9% had worked in other sectors other than teaching. As at the time of the interview only 15.9% had diploma qualification while 74.4% had degree and post graduate qualifications. This is an indication of very high level training among the teachers of agriculture. On the basis of

distribution of personnel interviewed 64.6% held the position of Head of Department, Deputy Principal and Principal who are the policy makers at the school level while 34.1% were teachers as shown in table 1.

Table 1: Percentage of Teachers Interviewed by Position held in the Institution.

Positions	Frequency	Percentage	Cumulative percentage
Principal	6	7.3	7.3
Deputy principal	14	17.1	24.4
Head of department	33	40.2	64.6
Teacher	28	34.1	98.8

Objective One

To assess the knowledge level of public secondary school agriculture teachers towards sustainable agriculture, participants were presented with questionnaires that demanded 'yes' or 'no' answers. The question was followed by another that demanded for response on how to improve knowledge on sustainable agriculture which was open-ended. This question was analyzed qualitatively to determine if they had knowledge or not.

The results obtained indicate that only 22% had knowledge on sustainable agriculture while 78% had no knowledge on the same. This indicates that despite the high level of training and being people of great influence on school policy, majority of the agriculture teachers were not knowledgeable about sustainable agriculture.

Objective Two

To determine sustainable agriculture practices carried out in public secondary schools, selected practices for sustainable agriculture were identified. A few practices that do not promote sustainable agriculture were also included such as use of inorganic fertilizers, use of inorganic pesticides and practices that lead to environmental degradation. Table 2 shows the practices on the school farm.

Table 2: Practices carried out in the School Farm

Practices	Frequency	Percent	Cumulative Percentage
1.Tree nursery for agro forestry	20	9.8	
2.Tree nursery for multiple uses	10	4.9	14.7
3.Tree nursery with edible parts	6	2.9	17.6
4.Harvesting of rainwater	42	20.5	38.1
5.Sale of manure ,biogas or nitrogen fixing crops	9	4.4	42.5
6.Diversified crop farming for income	43	21.0	
7.Use of inorganic pesticides	24	11.7	32.7
8.Use of inorganic fertilizers	38	18.5	51.2
9.Brick making, sand harvesting or stone harvesting	4	2.0	53.2

Despite not being aware that these practices imply sustainable agriculture 38.1% of the schools were engaged in activities that promote sustainable agriculture. 53.2% of the schools were focused on raising income rather than practising sustainable agriculture.

Curiously, 32.2% of the schools engaged in outright practices that promote environmental pollution and degradation.

Objective Three

To establish the perception of secondary school agriculture teachers towards environmental sustainability and biodiversity, participants were asked open ended questions which demanded statements on environmental concern.

In order to determine the correlation between sustainable agriculture practices Pearson's Product Coefficient was used. Predictor variables used were length of service, knowledge based on level of education and perception. The study assumed that teachers who have a good perception of sustainable environmental development are more likely to adopt sustainable practices in the school farm. The linear correlation between perceptions towards sustainable agriculture and practiced sustainable agriculture showed a moderate positive (i.e. $r=0.543$ $p=0.001$), length of service and practice of sustainable agriculture showed strong positive ($r=0.710$, $p=0.001$) while knowledge level correlated to practice of sustainable agriculture showed moderate positive correlation ($r=0.588$ $p=0.001$). Only 15% of the secondary school agriculture teachers interviewed showed concern to environmental sustainability. The remaining 85% did not have much regard for sustainable environmental practices.

A regression analysis was performed to determine the extent to which perception, experience and education level influenced the practice of sustainable

agriculture at 95% confidence level. The t statistics, their associated p- values at $\alpha = 0.05$ and their interpretations are in Table 3

Table 3: Sustainable Agriculture Practices in Kenya's Public Secondary Schools

Independent variable vs dependent variable	Unstandardized coefficients	T	P value	Interpretation
Length of service/Experience vs Practice of sustainable agriculture	-0.083	6.037	0.000	The more experience one gains the less they practice sustainable agriculture
Training level completed/Knowledge vs Practice of sustainable agriculture	-0.116	4.598	0.000	The higher the training level of teachers the less they practice sustainable agriculture
Perception towards sustainable agriculture vs practice of sustainable agriculture	0.28	8.870	0.001	The more positive the environmental protection perception the higher the practice of sustainable agriculture

Increasing population pressure and socio-economic activities has resulted to changes in land use patterns and intensity which has created changes in water quality, biodiversity, wetlands and fisheries. Whereas the Environmental Management and Coordination Act 1999, establishes a link between environmental protection and the right to a healthy and clean environment for all, education apparently is the primary agent of transformation towards sustainable Development (Otieno, 2012). Education should provide scientific and technical skills, motivation, justification for social support and applying them.

Conclusion

Sustainable agriculture and sustainable development requires interdisciplinary approach through open-ended learning and problem solving. The study demonstrates that teachers of agriculture lack knowledge on sustainable agriculture. A significant percentage are engaged in sustainable agriculture practices but focus more on income since their perceptions about environmental conservation is poor. This paper recommends that:

- i. Local environment action and learning should be put at the centre of education to enhance sustainable lifestyles.
- ii. Action should be taken to solve environmental problems.
- iii. Micro-projects on sustainable agriculture should be undertaken as linkages with communities to promote sustainable development.
- iv. Sustainable agriculture practices should be infused at all levels of training and in service workshops for agriculture teachers

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