The place for Dry Land Agriculture in Kenya's Secondary School Agriculture Curriculum

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Abstract

Purpose: The paper set out to document the extent to which secondary school agriculture curriculum addresses competencies on Dry Land Agriculture (DLA) and the possible ways of bridging the gaps. **Approach**: This is a historical paper based on desktop review of various education commission reports and policy documents as well as secondary school agriculture syllabus over time and other related research literature. **Findings**: The review revealed that soil and water conservation sub theme had the highest number of learning objectives addressing DLA while minimum soil disturbance had the least. Only 29.4 percent of the learning objectives focus on skill acquisition. **Practical implication**: To tap the agricultural potential in ASALs, learning objectives in the curriculum must focus more on competency acquisition since learning objectives inform the learning experiences that learners are subjected to. Learning objectives focusing on knowledge encourages theoretical implementation of the curriculum denying agriculture graduates the opportunity to learn through practice. Thus with few skills on DLA practices, secondary school graduates are less competent and lack the skill to transform the ASALs into food baskets. **Theoretical implication**: This study is informed by Competency based theory, Edgar dale and Kolb's experiential learning theory. These theories emphasize on skill acquisition for various competencies through active participation of learners in related learning experiences; in this case, exposing agriculture students to DLA practices. **Originality**: The paper constitutes unique contribution towards the need to refocus agriculture curriculum content in Kenya secondary schools to address the societal needs in this case ASALs.

Key words: Dry Land Agriculture, Agricultural education, Competency, Agriculture curriculum, Arid and Semi Arid Lands, implementation.

Introduction

Competent human resources are an asset in the economy of any country world over. Education is seen as a tool for empowering human resource (Mulder, 2017). In Kenya, agriculture sector is the leading domestic and foreign income earner. The sector not only supplies the county's food but also provides industrial raw materials and offers employment opportunities. The sector's need for competent human resources cannot be underestimated. This is so especially in Arid and Semi Arid Lands (ASALs) whose agricultural potential has not been met; as available resources remain under utilised (Republic of Kenya, 2017) . The agriculture sector requires skilled human resources capable of exploiting the ASALs interms of production, processing and marketing agricultural produce. Introduction of agricultural education in Kenya's secondary school agriculture curriculum was thus an endeavor in meeting the developmental needs of the surrounding communities and the country at large (Konyango, 2014).

Secondary school level produces the largest number of agriculture graduates of whom few proceed to the higher leaning institutions. Thus majority of these agriculture graduates exiting secondary schools need to be prepared for work and the existing opportunities in the agriculture sector. A past study indicated that 22.5 percentage of farmers practicing indigenous chicken rearing have secondary school education (Kyule, Nkurumwa, Konyango, 2015). In addition, 92.7 percent of farmers with secondary school education performed better in agricultural production that those without.

The challenge faced by secondary school education system in Kenya is that students are taught theoretically and too narrowly. Teaching is strictly academic and with little reference to students' future employment and labour market needs. There are no active linkages and communication between employers and secondary schools. Although the government has had a number of programmes to revive agriculture in ASALs, there have been no attempts to involve secondary schools in such programmes. Creating a situation where it is difficult for agriculture teachers to identify and implement specific skills expected by employers or for self employment. This study thus sought document the extent to which secondary school agriculture curriculum addresses competencies on Dry Land Agriculture (DLA) and the possible ways of bridging the gaps.

Literature Review

Importance of Agriculture to Kenya's Economy

Agriculture sector dominates the world's economy accounting for most of the African countries' gross domestic product up to 40 percent, 17 percent of exports and 60–80 percent of employment (Farauta & Amuche, 2013). Yet Africa is the only continent where hunger and poverty are projected to worsen in the 2020s with the number of malnourished children projected to increase correspondingly (FAO, 2013). To alleviate hunger and poverty, a well trained human resource in the agriculture sector is vital. Agriculture therefore remains important for sustainable development and poverty reduction in the continent. In Kenya, agriculture is critical to national food security and it is expected to play an economic role the country envisages its transformation into a rapidly industrializing, middle-income nation by the year 2030 (UNESCO, 2017). However, to achieve the expected transformation in the agriculture sector, the education sector needs to play its role by preparing human resource who are competent through experiential learning in schools.

In Kenya's effort to develop and transform agriculture sector, the Government came up with the Strategy for Revitalizing Agriculture 2004-2014 (Ministry of Agriculture, 2005) and the first Medium Term Plan (MTP) for implementation of Vision 2030. The key policy goals included: raising agricultural productivity through increased resource allocations, exploiting irrigation potential, commercializing agriculture, reviewing comprehensively the legal and policy framework for agriculture and improving the governance in key agriculture institutions, especially cooperatives and farmer organizations. However, the agriculture production has not kept pace with the population growth rate and the country has become a net importer of its two major staple foods, maize and wheat (FAO, 2014). Therefore there is urgent need for agriculture expansion and development in order to reverse the current trend in agricultural productivity in the country. Though the policy goal on exploitation of irrigation potential is of great importance to the ASALs as a Dry Land Agriculture (DLA) practice but little has been achieved and ASALs continue being agriculturally underutilized. Haphazard implementation of the agriculture curriculum in schools may have contributed to the incompetency of our human resource in improving agricultural productivity in ASAL areas. Such in competencies include inability to apply DLA knowledge and skills to utilize ASALs for food production. This has then culminated

to over reliance on foreign human resource in implementing Kenya's agricultural projects like the Galana irrigation project. Hence, since the foreign investors do not share in Kenya's vision and are income driven, such projects never achieve their ultimate goal and the ASALs remain agriculturally under developed. Empowering the youth in high schools with knowledge and skills that promote practical agriculture would make them informed of the ways of enhancing agricultural productivity in ASALs. According to Kipkemei, Kipsat, Sulo, Korir and Inyanje (2012) a positive relationship exists between education and agricultural productivity. Given the importance of the agriculture sector to the economy, agricultural education cannot be ignored for it prepares the human resource that runs the sector. Emphasis on agriculture curriculum implementation for human resource who are adequately trained and equipped with relevant skills to keep agriculture at the top as the highest Gross Domestic product earner is paramount.

Linking the Curriculum to Dry Land Agriculture Practices

Globally, agricultural education has recorded massive successes in defeating food shortages amidst wide environmental catastrophes (David & Lavinia, 2003). A multi-disciplinary agriculture curriculum has a place to play in achieving this global aspiration. According to McCarthy, Lipper and Branca (2011), dryland agriculture incorporates a wide range of agricultural practices aimed at minimizing soil disturbance, soil bareness, maximizing soil moisture retention and increasing soil fertility. However, for good results DLA has to be carried out as a holistic and multi-disciplinary agriculture. DLA practices include, zero tillage which ensures that there is minimal soil disturbance. Zero tillage has a significant impact on soil, water and air quality, which leads to dramatic reductions in soil erosion. Studies have shown that zero tillage can reduce soil erosion by 90 to 95 percent or more compared to conventional tillage practices and continuous zero tillage can make the soil more resistant to erosion over time (Towery & Werblow, 2010). The same study established that conventionally cultivated areas lose on average 1.5 to 6 times more soil than no-tillage. In zero tillage type all cultivation is replaced with herbicides so that soil disturbance occurs only at sowing time when the planting implement engages the soil.

Mulching is another DLA practice. It plays a vital role in promoting the uptake and recycling of plant nutrients, creates a conducive environment for increase of beneficial soil microorganisms,

improving soil structure reducing the force of rain drops hence minimise soil erosion and increasing soils' capacity to hold water and nutrients (Nyende, Nyakuni, Opio & Odogola, 2007). In addition it regulates soil temperature and slows down the speed of runoff water giving it more time to percolate in the soil as well as reducing evaporation rate hence it's made available to the crops for a longer time (Marongwe et al., 2011).

Different cropping patterns also serve to improve soil and water conservation (Matata, Ajayi, Oduol & Agumya, 2010). Cover cropping and alley cropping provide a continuous cover between main crops reducing soil erosion, building soil organic matter and improving the water balance, leading to higher and more stable yields in the ASALs. Cover crops ensure that the soil is not left bare after harvest, lowers soil surface temperature and suppress weed growth. Crop rotation, use of sunken beds and ridge furrow are also DLA approaches aimed at soil water retention (FAO, 2013). Improved fallows which refer to the deliberate planting of fast growing species, usually legumes that quickly utilize available moisture, produce easily decomposable biomass and replenish soil fertility can also be adopted (McCarthy et al., 2011). According to USAID (2014), cereal transplanting has also been found to improve cereal production in ASALs by 85 percent when transplanting is properly timed. In addition, DLA requires timely planting to be observed so that these crops maximally benefit from the available rainfall (CARE International and Adaptive Learning programme [ALP], 2010). Thus if agriculture teachers interpreted the agriculture curriculum correctly, ASALs would only ask for logistic support in embracing DLA practices.

In-field and in-situ water harvesting techniques have also been used to improve crop yields in ASALs. There is need to extend such techniques to schools to exploit teachers' skills in implementing the curriculum. In-situ water harvesting involves the use of methods that increase the amount of water stored in the soil profile by trapping the rain where it falls and it involves little movement of rainwater as surface runoff (Ministry of Agriculture India, 2013). This has been possible through structures that reduce runoff in farms and hold water long enough to allow it to infiltrate. Such structures include the: terraces, vegetated strips and farm ponds. Harvested runoff can sustain crop production during the dry spells and this will reduce crop failures and ultimately lead to improved household food production. Improved in-field and in-situ water harvesting can increase the time required for crop moisture stress to set in and thus can result in

improved crop yields boosting food security. Structures like green houses have also been found to promote DLA in ASAL areas (African Conservation Tillage Network [ACTN], 2008).

In extensive dry land agriculture, livestock are an integral part of the production system. According to ILRI (2012), Kenyan ASALs support most of the livestock kept in the country. However, these animals die in masses whenever drought strikes ASAL areas. A lot of research is being done by research and higher learning institutions to come up with hardy livestock that are high yielding and can withstand the harsh environment in ASALs (KEVEVAPI, 2011). The livestock kept in ASALS include: cattle, sheep, goats, chicken, donkeys, camels, rabbits and bees. Use of multi-purpose fodder crops has been found to supplement livestock feeding during drought period in ASALs (Care International and ALP, 2010). Agricultural practices serving dry land agriculture that can be of use in improving agricultural production status in Kenyan ASALs have been covered in secondary school agriculture curriculum. However, the extent of coverage has not been determined. In addition, the researcher has not come across any study on how these DLA practices in the curriculum are implemented in ASALs. Determining the extent to which the secondary school agriculture curriculum covers content on DLA practices is thus paramount.

Theoretical Analysis and Application

This study is guided by the competency theory which defines competency as the capabilities needed to demonstrate knowledge, skill and ability acquisition (Bernikova, 2017; Mulder, 2017). The theory presumes that competence is an individual's ability to carry out an activity on the basis of life experience and acquired knowledge and skills (Makulova, Alimzhanova, Bekturganova, Umirzakova, Makulova & Karymbayeva, 2015). Thus, secondary school agriculture students in ASALs need to be exposed to learning experiences that are relevant to DLA in order that they may function out of life experiences. Teachers should therefore interpret the curriculum objectives in a manner that they address agricultural production in ASALs in order to prepare human resource that can function actively in such areas. The competencies acquired will manifest themselves in agriculture graduates' ability to exploit the agricultural potential in ASALs thus contributing to sustainable livelihoods and poverty alleviation.

Edgar Dale's theory on Cone of Educational experiences also informs this study. Dale's theory supposes that, learning by doing appears at the lowest band of the cone. It's the most concrete learning experience and therefore least abstract. Learners are able to analyse, create, evaluate and remember 90 percent of the learning activities. Edgar emphasized on purposeful learning experiences that provide the learner with a physical resemblance to the actual object or idea. This makes learning experiences less abstract and learners become more of participants than spectators. This theory was further enhanced by John Dewey (1859-1952) who accentuated on the importance of continuity of learning experiences from schools into the real world. Thus for better preparation of a competent human resource in agriculture at the secondary school level, there is need for teachers to embrace purposeful learning experiences as they implement the agriculture curriculum. Real and concrete learning experiences are necessary in providing a permanent learning foundation. Active involvement of learners in agricultural activities that are relevant to ASAL environment will equip them with agricultural knowledge and skills they can replicate after school hence participate in exploiting the agricultural potential in ASALs.

Kolb's (1984) experiential learning guides this study. He defined experiential learning as the process in which knowledge is created through the transformation of experience. It focuses on "doing" in addition to the "hearing" and "seeing" that occur in traditional learning (Rizk, 2011). Additionally, experiential learning is participative, interactive and applied allowing contact with the environment. It involves active participation of the learner and learning takes place on the affective, behavioral as well as on the cognitive dimensions. Thus if the secondary school agriculture curriculum could be implemented through experiential learning, learners especially those in ASALs could gain the competency of exploiting agricultural potential in ASALs. This could improve the agricultural production in ASALs and the ASAL community could experience the benefits associated school agriculture.

Methodology

This is a historical paper based on desktop review of various education commission reports and policy documents as well as secondary school agriculture syllabus over time and other related research literature. Content analysis check list was used to collect data on the extent to which secondary school agriculture curriculum covers content on DLA. Content deemed to address

DLA was placed categorised under four sub-themes. These sub-themes were soil and water conservation, minimum soil disturbances, rearing adaptable livestock and growing adaptable crops which were coded as A1, A2, A3 and A4 respectively.

Findings

The secondary school agriculture curriculum presents its content in form of topics. It has 33 topics broadly covering crop production, livestock production, farm power and machinery, farm structures, agricultural economics and agroforestry. This study however sought to find out the extent to which the topics presented in the curriculum cover content on DLA practices that serve to improve agricultural production in ASALs. These learning objectives were put under four sub themes namely; those aimed at soil and water conservation, minimum soil disturbance, rearing of adaptable livestock and growing of adaptable crops. Learning objectives in each topic were analysed focusing on those aimed at addressing the subject of concern. The focus on learning objectives was key since they specify what the learner is expected to achieve and be able to do after the learning process. General content on DLA may be meaningless unless the objectives of including it in the curriculum are clear. The results on data codification were as shown in Table 1.

Table 1

Data Codification in terms of the Sub-themes Codes and Frequency

Sub theme	Code	Frequency of objectives on the sub-theme
Soil and water conservation	A1	53
Minimum soil disturbance	A2	5
Rearing adaptable livestock	A3	46
Growing adaptable crops	A4	38

The results in Table 1 indicate that soil and water conservation had the highest number of objectives deemed to address DLA knowledge and skills followed by rearing of adaptable livestock while minimum soil disturbance had the least. It is also important to note that, learners' acquisition of DLA knowledge and skills reflected is subject to the teacher's interpretation of the objectives and choice of relevant learning experiences.

The topics, from which the relevant learning objectives were obtained, were grouped per the sub-themes. Out of the 33 topics, 29 of them had objectives aimed at equipping learners with knowledge and skills to use to improve agricultural production in ASALs. It should be noted that some of the topics and objectives would address more than one sub theme. Topics and objectives that appeared more than once across the sub themes were only factored once to avoid duplication. The curriculum has a total of 228 objectives out of which 58.7 percent promote DLA. According to Shiundu and Omulando (1992) the learning objectives formulated during curriculum development process dictate the content to be developed. Though the secondary school agriculture curriculum has learning objectives aimed at addressing DLA, a closer scrutiny at the content in the curriculum indicates neglect to the ASALs.

The researcher identified the following topics as among those whose objectives seem to address DLA but the emphasis on the content is contrary. The topic on livestock breeds gives a lot of emphasis on exotic breeds especially on cattle. Hardy livestock like camels and donkeys are only mentioned and very scanty details are given about them yet they are a source of livelihood to those in ASALs. The topic on livestock production VI (cattle) as well emphasizes on management of exotic cattle breeds which may not survive well in ASAL areas. The topic on livestock production V (Poultry) has emphasized on layers and table birds which may not do well in ASALs besides the high cost of production associated with them. A lot of research has been done on indigenous chicken that can be economically viable in ASALs. Egerton University is among the institutions that have engaged in research on indigenous chicken through the Indigenous Chicken Improvement Programme (INCIP) project (Menge, Kosgey & Kahi, 2010). Such information can be of use to farmers in ASAL areas if only shared to them. There is need to incorporate such information in the curriculum for the benefit of not only the ASAL regions but entire farming community. The topic on forage crops gives no emphasis on those fitted to ASALs as it has given emphasis on those grown in high and medium altitude areas. On crop production VI (Field practices II), little emphasis has been given on the management practices for annual crops suited to ASALs.

In addition, root crops have not been covered in the curriculum yet most of them are hardy and are a main source of food in ASALs. The topic on vegetable production does not give any attention to indigenous vegetables most of which do well in ASALs. Crop production III

(Nursery practices) requires a learner to be able to prepare a nursery bed, however the content focuses only on raised nursery beds which are not applicable in ASALs. The topic on farm power and machinery emphasizes on mechanization yet over 80 percent of the farmers in ASALs are small scale to whom mechanization would not be economically viable. With increasing population in urban areas, urban farming has been neglected. There is no single topic that stands out in covering land reclamation. Dry and ASAL lands are categorized as waste lands and their reclamation methods vary. Reclamation is necessary if such lands are to be brought back to agricultural productivity. Thus, in future agriculture curriculum review process, the topics identified may be priority areas for consideration. With these shortcomings in mind, the teacher of agriculture in an ASAL school has the responsibility of interpreting the curriculum objectives and exposing learners to learning activities that make the curriculum relevant to their ecological conditions.

According to Academic Technology Centre (2013), learning occurs through the cognitive domain in which the learner is expected to obtain outcomes related to knowledge, skill and attitude. Informed by the Bloom's taxonomy, the learning objectives under each sub-theme were categorized as per the expected outcome either under knowledge or skill acquisition. A summary of the distribution of the learning objectives focusing on knowledge and skills in each sub-theme is presented in Figure 1.

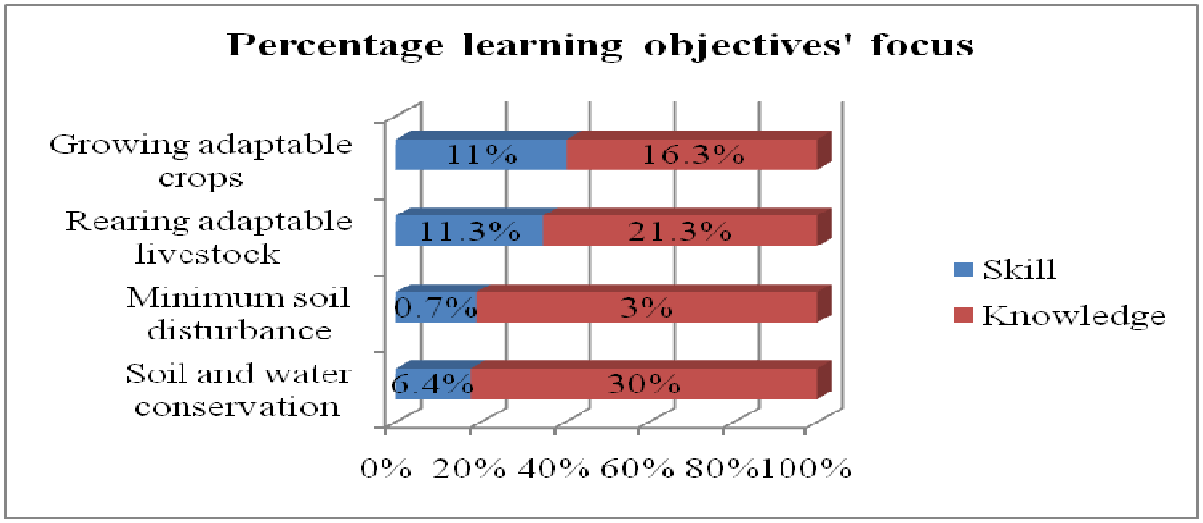

Figure 1: Distribution of learning objectives towards DLA skill and knowledge acquisition

The results in Figure 1 show that only 29.4 percent of the learning objectives focus on DLA skill acquisition. The focus on knowledge acquisition is overwhelming with 70.6 percent of the learning objectives. Curriculum implementation is guided by the learning objectives. Learning objectives also determine the choice of learning experiences. Thus the curriculum's inclination towards knowledge as opposed to skill acquisition makes implementation to focus more on theory and little of practical work. This inclination contradicts the expectation that introduction and implementation of agriculture in secondary schools would equip learners with skills and knowledge for problem solving and self-reliance (Konyango & Asienyo, 2015).

Conclusion

More than half of the learning objectives in the secondary school agriculture curriculum are related to DLA. However, over 70 percent of those learning objectives focus on knowledge acquisition this in turn influences the nature of learning experiences learners are subjected to.

Agriculture students will gain the competence on DLA practices if they practically engage in them hence gaining the skills. Therefore framing of the learning objectives in the agriculture curriculum may need to be reviewed to focus more on skill acquisition. This is necessary especially now that the Ministry of education is in the process of transiting to a new competency based curriculum. Emphasis on DLA skills will enable learners to gain the competencies they require to exploit ASALs agriculturally.

Recommendations

The Ministry of Education (MoE) and Kenya Institute of Curriculum Development (KICD) through the curriculum development panels need to rethink of restructuring the agriculture curriculum learning objectives to focus more on skill acquisition.

The MoE should reinforce the holiday farm attachment as a way of providing not only a linkage to the farming profession and employers but also a linkage to the reality and the practicality of farming.

Teachers of agriculture should embrace learners' participation in community based projects as proposed in the new 2-6-6-3 education system which will go a long way in exposing the youth to community development vital in improving the community livelihoods.

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