AGRICULTURE TEACHERS' PERCEPTIONS ON THE INCLUSION OF INDIGENOUS TECHNICAL KNOWLEDGE IN SECONDARY SCHOOL AGRICULTURE CURRICULUM, IN NJORO SUB-COUNTY, NAKURU COUNTY, KENYA

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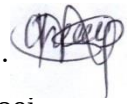
DECLARATION AND RECOMMENDATION

Declaration

This thesis is my original work and has not been submitted or published for the award of degree in this or any other university or college.

Signature……  …….Date…5th September 2024

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DEDICATION

This work is dedicated to my Dad and Mom whose sacrifice for my education inculcated in me the spirit of determination and quest for knowledge. This dedication also extends to my husband, Eric, whose encouragement and support has been my greatest source of inspiration. Lastly I dedicate it also to my esteemed daughters: Faith, Sharon and Precious.

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ABSTRACT

Indigenous knowledge had existed for centuries in Africa before the introduction of formal schooling by missionaries and British colonial. Unlike indigenous knowledge, formal education was not part of peoples' economic life and did not serve the African community. The current curriculum of 8-4-4 as well as the restructured curriculum of 2-6-3-3 has embraced less of indigenous technical knowledge yet this knowledge can be crucial in agricultural sector. This study generated information on teachers' perceptions on the inclusion of indigenous technical knowledge in crop and livestock production. The study employed Cross-sectional survey research design. It was carried out in Njoro sub-county, Nakuru County. The target population comprised of 90 agriculture teachers in Njoro sub-county. A questionnaire was used to collect data. In order to ascertain the content, construct and face validity, the instrument was subjected to scrutiny by peers, supervisors and other members of Egerton University in the department of agricultural education and extension. The instrument was pilot tested in Rongai sub-county with 30 agriculture teachers. The reliability of the instrument was estimated to be 0.785 which is above the 0.7 threshold hence it was considered acceptable. The data was analyzed using descriptive statistics. The findings of the study indicate that more than 50% of the agriculture teachers were aware of the different indigenous practices that are carried out in both crop and livestock production, the findings also reveals that more than 50% of the teachers agreed that ITK is: cheap, reliable, enriches students with a wide range of knowledge, friendly and easy to use. 82% of the teachers were of the perception that ITK should be included in secondary school agriculture curriculum because of its value, 18% were of the perception that agriculture curriculum was already bulky and that indigenous technical knowledge is outdated hence it should not be included in the curriculum. The results of the study reveal that most of the teachers were positive about taking ITK into consideration while teaching agriculture. Basing on the value of indigenous technical knowledge, the researcher suggests to curriculum developers to research on ideas and practices related to indigenous technical knowledge that could be beneficial to learners, develop them and incorporate them in the learning and teaching process.

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LIST OF ABBREVIATIONS AND ACRONYMS

ILRI	International Livestock Research Institute
ITK	Indigenous Technical Knowledge
KALRO	Kenya Agricultural Livestock Research Organization
MoA	Ministry of Agriculture
NACOSTI	National Commission for Science Technology and Innovation
SPSS	Statistical Package for Social Sciences
WCED	World Commission on Environment and Development

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Indigenous technical knowledge (ITK) refers to the sum of experience and knowledge within a given group in a specific geographical location, which forms the basis for decision making on familiar and unfamiliar problems and challenges (Vandebroek et al., 2011). It can also be defined as the local knowledge and practices that is unique to a given culture or society and is acquired by local people through the accumulation of experiences, informal experiments, and intimate understanding of the environment in a given culture (Chikaire et al., 2012). Agricultural indigenous technical knowledge includes and is not limited to the following areas; climatology, local soil and taxonomy, soil fertility, intercropping, agronomic practices, irrigation & water management, plant & animal protection and post-harvest technology (Nyong et al., 2007).

Indigenous Technical Knowledge adopted by different groups of individuals largely depends on traditional knowledge. Research shows that farmers possesses a vast pool of indigenous knowledge in both crop and livestock production. These practices play a major role in addressing nature conservation as well as in conservation of biodiversity. In order to conserve biodiversity, different governmental as well as non-governmental policies are designed, hence indigenous agriculture is one of the most important practices followed for biodiversity conservation (Sharma et al., 2020). Sultana et al. (2018), also agrees to the fact that indigenous system is very helpful in promoting and maintaining biodiversity which can help in promoting sustainable future through development of caring values.

Studies show that for a long time, farmers in the developing world have depended on ITK for improved agricultural production. The applicability of ITK takes place during different farming seasons and periods, and this knowledge spans from land clearing, tilling of the land, selecting seed varieties for planting, control of pests, harvesting and storage, and identifying weather patterns (Lwoga et al., 2010).

Kenya is currently predisposed to climate-related changes, predictions indicates that the impacts are likely to affect the country even more in the future , thus affecting agricultural productivity, culminating to a great challenge on food security. An option to this challenge could be turning to indigenous farming practices. In the recent past an increased consciousness has

risen on the failure of modern agricultural practices to be successfully applied to the different types of regions in which agriculture is practiced. Nevertheless, application of indigenous knowledge can help scale up sustainable agricultural intensification in order to increase production, for environmental protection and poverty reduction. Paying attention to Indigenous Technical Knowledge can enhance farming practices and help adapt to climatic changes and variability by small-scale farmers in Kenya, considering that farmers' capacity to cope with and adapt to the change in climate is dependent on the wider social and institutional context they live in (Muthee et al., 2019).

The United Nations Sustainable Development Goals aims to increase agricultural productivity for small scale farmers at least twofold and thereby double the income for the vulnerable groups such as women, pastoralists and those engaged in fishing, through safe and access to factors of production such as land, capital and extension services by the year 2030, this cannot be a reality unless social protection for the underprivileged and people susceptible to weather-related disasters is observed (United Nations General Assembly, 2015). This means that the role of agricultural indigenous knowledge systems in enhancing agricultural productivity cannot be ignored because its application can help to scale up sustainable agricultural intensification in order to increase production and reduce poverty. The United Nations Development Goals draws attention to the fact that the world is confronted by a deteriorating situation of starvation and therefore a greater need to improve the living standards for all. To solve this problem, it requires the incorporation of both indigenous and conventional methods in increasing agricultural productivity. The driving force to turn to Indigenous farming practices is as a consequence of climate change which is one of the greatest challenges to Kenya's achievement of its development goals as described in the vision 2030 (Muthee et al., 2019).

Through indigenous farming, drought-resistant crops and livestock breeds have been identified. These indigenous breeds have proved to be more sustainable leading to more research on indigenous breeds of cattle, sheep, goats and chicken. The result has seen the continued rearing of Ormo, Boran and Zebu cattle, the red Maasai sheep, the Galla goat, and the indigenous poultry breeds, besides the development and expansion of value chains on indigenous fruits and vegetables varieties production (Muthee et al., 2019).

In Kenya, the government through the Ministry of Agriculture in conjunction with Kenya Agricultural Livestock and Research Organization (KALRO) has embraced ITK by establishing

Farmers Training Centre for Indigenous knowledge in some parts of the country, for instance in Turbo Township in Uasin Gishu district (Chebutuk & Kiplangat, 2008). Farmers converge in the centers and are taught how to apply ITK in their farming activities. Through this trainings, farmers learn various uses of ITK which includes: use of animal and compost manure, sprinkling of hot pepper on vegetables to control pests, proper drying of selected seeds before planting, alternating of livestock and crops on a field portion to restore fertility and soaking of seeds in water before planting to hasten germination (Chebutuk & Kiplangat, 2008).

Traditional communities in Kenya have for ages depended on indigenous technical knowledge to exploit agroforestry for bio-pesticides and for medicinal purposes where diverse farm outputs have been tapped for better quality human subsistence, in circumstances where people have limited access to contemporary medications which are expensive, herbal medicine has been a better alternative (Muthee et al., 2019). Indigenous technical knowledge is crucial in both plant and animal production. This knowledge has been applied in maize production to curb post-harvest losses which are caused by poor handling, poor storage and destruction by pest and diseases. Through decreasing the losses emanating from crop pest and diseases checks on food security and economic growth in Kenya is assured. The prevailing crop and livestock pest and disease protection management systems that rely on artificial agrochemicals have had a negligible impact on the output of smallholder farmers who form an important section of agriculture in Kenya. This is mainly because of affordability, availability and ease of use of the said chemicals (Muthee et al., 2019).

A research carried out by Waithaka (2011) shows that farmers in Eastern part of Kenya use *Mexican marigold,* neem and *Lantana camara* on harvested maize to control storage pests. To control fungal growth harvested maize is dried very well before storage, maize cobs are also hanged over fire in order to preserve seeds. A solution to managing pest and diseases in farming lies on going back to harnessing of indigenous technical knowledge in pest and disease control. There is therefore need to evaluate biological control measures by tapping into the available indigenous technical knowledge systems such as use of beneficial insect, predators, and indigenous pesticides plant extracts.

Indigenous food production systems contribute significantly to enhancing agricultural productivity as well as in guaranteeing food security. This means that both the national and the county governments should emphasize the need of incorporating the knowledge into agricultural

research and community development programs for the promotion of sustainable agriculture. This implies that agricultural stakeholders should change their perceptions and attitudes towards various indigenous technical knowledge systems; this can be done by creating awareness on the importance of ITK through policy formulation and implementation in order to foster consciousness among smallholder farmers in Kenya (Muthee et al., 2019).

Warring (2018) defines curriculum as a formulated educational program through which the aims and objectives of a school or an institution are achieved. In order to keep up a curriculum with time, the curriculum should be dynamic. This means that it should be open to innovations and developments, so that it does not run out of scope from its set objectives. According to Msila (2016), the rapid and constant changes in the society necessitate a different kind of student who will respond to the current and future challenges. Mauley (2001) observes that since independence, education reform has been political rather than professional in developing countries like Kenya and South Africa.

The current system of education in Kenya which is in the process of being phased out is the 8-4-4 structure, the 8-4-4 system entails eight years of primary education, four years of secondary (form 1-4), and four years of university. This system was introduced in 1985 to promote man-power that is capable of performing white collar jobs (Kaviti, 2018). The proposal to scrap the 8-4-4 system was first contained in a 2012 report by a task force which recommended a 2-6-3-3 education system that would, amongst other factors ensure that learners acquire competencies and skills to meet the human resource aspirations of Kenya's vision 2030 blueprint for development (Kaviti, 2018). The Director of Kenya Institute of Curriculum Development (Jwan, 2017) in his report points out that the proposed 2-6-3-3 education system is expected to produce responsible citizens who are equipped with skills and knowledge. A cross examination of the proposed education system (2-6-3-3) shows that it has only embraced production of indigenous crops while leaving out ITK on crop protection, livestock production and soil conservation. In order to effectively incorporate indigenous knowledge in the school curriculum the relevant bodies should explore different ITK practices that can be included in the secondary school agriculture curriculum.

Since independence Kenya has changed its education system three times, this begun in the year 1977 whereby Kenya adopted a 7-4-2-3 curriculum system which later changed to 8-4-4 system in 1985 and it further changed to 2-6-3-3 system in the year 2016 (Murararaneza et al.,

2017). The mentioned changes are a proof that any curriculum is subject to change over time whenever it becomes outdated to an extend that it does not address the needs of the society adequately; when such a point is reached it is the duty of curriculum developers to initiate plans to revise the curriculum accordingly. National curriculum plays a very big role in the development of the economy of a country in that it addresses issues like environment, politics, and climate change among other roles; therefore it is developed according to the needs of a particular country so that it steers learners towards working to achieve the national goals (Kinuthia, 2009). Further, Kabita (2017) indicates that curriculum is a means that a country uses to empower its citizens with essential skills, knowledge, values and attitudes that allow them to be approved for both national and individual growth. Therefore inclusion of ITK in secondary school curriculum will equip learned with diversified agricultural skills which are necessary in boosting agricultural production.

Curriculum reform is a dynamic process that changes according to the needs of the society and the stakeholders of the education system. It is a planned sequence in which curriculum specialists (teachers inclusive) assist in; conducting needs assessment, identifying a problem, finding a solution, conceptualizing the required curriculum, pilot testing the revised curriculum on a small-scale basis then implementing it nationally (Kenya National Union of Teachers, 2017). All stakeholders plays a big part in terms of their contribution towards developing the school curriculum, teachers are among the primary stakeholders because they take part in its implementation. Their perception towards the developed curriculum is a key factor that should be taken into consideration for successful implementation of any curriculum. The quality of curriculum reform on its own doesn't guarantee a successful reception by teachers, their beliefs, values, and experiences play a vital role in the acceptance of the reforms (Bantwini, 2010). Neglecting teachers' involvement in curriculum reform usually creates frustrations and sends out a message that the Education Department lacks concern about its teachers and this can widen the gap between conception and implementation of the curriculum (Lemon, 2004)

Curriculum development is one of the most challenging practices, especially in developing countries like Kenya. Involvement of all stakeholders in curriculum development (for instance teachers) is also a challenge as the process is left to professionals who determine the content when developing the curriculum. One of the challenges facing the integration of ITK in

Kenyan agriculture curriculum arise from teachers' lack of faith that such a curriculum can actually contribute significantly in addressing the socio-economic needs of the country (Mwenda, 2003). Teachers' perception on the integration of ITK in the agriculture curriculum determines how they integrate this form of knowledge in the school curriculum (Gachanga, 2007). Agriculture teachers are directly involved in the implementation of the agriculture curriculum from the grassroots, they are in a better position to perceive the shortcomings of the current curriculum and thus propose positive amendments to the curriculum that can result to a successful curriculum implementation process. Mulongo (2017) also pose it that incomplete consultation of all stakeholders brings in a challenge in the curriculum implementation process causing the developed curriculum to be under perceived hence poor implementation.

While developing a curriculum, developers need to consider the different foundations of the curriculum such as cultural, philosophical sociological, environmental, and economical among others (CDC, 2007). In order to address all these foundations curriculum development process should be participatory and it should involve teachers as well (CDC, 2012). A teacher has a greater role in addressing the needs of students and community at large, since they are the primary agents dealing with curriculum activities. A strong curriculum should encompass a wide range of interests, prior knowledge and students' capabilities, such a curriculum gives results in developing effective skill based and competency based curriculum which could more readily engage students from all aspects considering their diverse background.

Inclusion of ITK in secondary school curriculum will help in equipping the learners with relevant knowledge that they interact with on daily basis; this will make what they learn in school to be more relevant to them. Rono (2017) in his study indicates that relevance of education is increased by having a curriculum that is environmentally related and is grounded on the community needs and conditions. School curriculum should be able to incorporate the learners' knowledge learnt at home and use this prior knowledge as the preparatory to enable learners understand the ideas in the curriculum-based textbooks , this will enhance application of concepts in learners lives that are in the curriculum (Mandikonza, 2019). This study therefore seeks to investigate the perception of agriculture teachers (stakeholders in curriculum implementation) on the inclusion of ITK in secondary school agriculture curriculum in Njoro Sub-county.

1.2 Statement of the Problem

Indigenous Technical Knowledge plays a key role in crop and livestock production. In crop production it entails, control of crop pests and diseases using locally available materials, production of traditional crops which are resistant to drought, pest and diseases and that can adapt to a wide range of soil characteristics among other practices. In livestock production the knowledge has been exploited in coming up with high performing breeds which are resistant to harsh climatic conditions, parasites and diseases, the knowledge has also been used in controlling livestock parasites and diseases and it has also been aplied in preservation of different livestock products for instance milk and meat. However, most of these agricultural indigenous practices have not been taken into consideration in the current curriculum. Despite the importance of ITK less of it has been captured in the Kenyan secondary school agriculture curriculum. Education is viewed as a tool through which the society can be changed for the better. This study focused on perceptions of agriculture teachers in Njoro Sub-county on the inclusion of indigenous technical knowledge on crop and livestock production in secondary school agriculture curriculum.

1.3 Purpose of the Study

The purpose of the study was to determine the perceptions of agriculture teachers on the inclusion of indigenous technical knowledge on crop and livestock production in secondary school curriculum. The outcome of the study was to indicate the gap in the current agriculture curriculum.

1.4 Objectives of the Study

The study was guided by the following objectives:

i) Investigate agriculture teachers' level of awareness on ITK pertaining to crop production in Njoro Sub-county.

ii) Investigate agriculture teachers' level of awareness on ITK pertaining to livestock production in Njoro Sub-county.

iii) Determine the perceptions of agriculture teachers in Njoro Sub-county on the inclusion of ITK on both crop and livestock production in secondary school agriculture curriculum.

1.5 Research Questions

The study sought to answer the following research questions:

i) What is the agriculture teachers' level of awareness on ITK pertaining to crop production in Njoro Sub-county?

ii) What is the agriculture teachers' level of awareness on ITK pertaining to Livestock production in Njoro Sub-county?

iii) What are the perceptions of Agriculture teachers in Njoro Sub-county on the inclusion of ITK pertaining to crop and livestock production in secondary school agriculture curriculum?

1.6 Significance of the Study

The study would help in generating information on teacher's perceptions on the inclusion of Indigenous Technical knowledge in secondary school agriculture curriculum. Inclusion of ITK in secondary school curriculum would give learners recognition of prior homegrown and local knowledge and experiences that yield intrinsic motivation, critical thinking, and meaningful learning. Teaching should progress from familiar agricultural practices (ITK) to the unfamiliar agricultural practices; learning should start from concrete to abstract. The research could be useful for other processes of curriculum development such as need assessment and policy formulation: the findings could also form the basis for further research in agricultural indigenous technical knowledge. The study hopes to add to the contemporary body of relevant knowledge by creating awareness on ITK on crop production and livestock production. Lastly, curriculum developers could use the results to decide on indigenous agricultural practices to include in agriculture curriculum as the country goes through the change of education system from 8-4-4 system to 2-6-3-3-3 system.

1.7 Scope of the Study

The study focused on investigating the perceptions of Agriculture teachers on the inclusion of ITK on crop production and livestock production in the secondary school agriculture curriculum. The study was carried out in Njoro sub-county and it involved Agriculture teachers in secondary schools of Njoro sub-county.

1.8 Assumptions of the Study

The study was based on the assumptions that:

(i) The respondents would express their sincere feelings in response to the questionnaire items.

(ii) The respondents were aware of ITK on crop and livestock production.

1. 9 Limitations of the Study

The study was anticipated to experience the challenge of collecting data from the respondents outside the term calendar for secondary schools since Agriculture teachers were only to be accessed when schools were on, and not during the school holidays. To overcome this challenge the work plan was realigned to match with the secondary school term dates for the year.

1.0 Operational Definition of Terms

Agriculture: It is the art and science of crop and animal production for economic purposes; it's the art of raising plant life from the soil for the use of mankind (Chandu, 2013). According to this study it is a practice which entails all the activities that are carried out in of growing of crops and keeping of livestock. Some of the activities include control of crop pest, control of parasites, seed selection and storage, livestock management practices among others.

Curriculum: It refers to a course of study offered in schools, colleges and other Institutions. It forms a link between institutions of learning, knowledge and the society (Potokri, 2016). According to this study it refers to all the topics covered under agriculture curriculum (topics on crop and livestock production).

Indigenous Technical Knowledge: Refers to cumulative strategies, techniques, practices, intellectual resources, tools, explanations, cultural beliefs and values of a group of people over time in a particular locality with less interference and impositions from external forces (Emeagwali, 2004), indigenous technical knowledge pertaining to agriculture includes but not limited to the following areas; climatology, local soil and taxonomy, soil fertility, intercropping, agronomic practices, irrigation & water management, plant & animal fertility, intercropping, agronomic practices, irrigation & water management, plant & animal protection and post-harvest technology (Nyong et al., 2007). According to this study indigenous technical knowledge refers to what indigenous farmers know and do, and what they have known and done for generations, for instance control of parasites using herbal medicine, control of crop pests using *Mexican marigold* among other practices

Inclusion: According to oxford dictionary inclusion refers to the act of making something to part of something else. In this research it refers to the act of making indigenous technical knowledge on crop and livestock production to be part of Kenyan secondary school agriculture curriculum, this inclusion is based on teachers' conversance and their opinions on the same.

Perception: This refers to the way one sees the world (Mcdonald, 2011). In the context of this research it refers to agriculture teachers' opinions on the inclusion of ITK topics on crop and livestock production in the secondary school agriculture curriculum i.e. the views of agriculture teachers on the inclusion of ITK in agriculture curriculum, these perceptions depends on whether

the agriculture teacher is aware of ITK pertaining to various crop and livestock production practices.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of literature related to the area of the study under different sub-headings which includes: the concept of Indigenous Technical knowledge (ITK), Global view on Indigenous Technical knowledge, African view on Indigenous Technical knowledge, ITK on crop and livestock production, integration of ITK into agriculture curriculum, teachers perceptions on inclusion of ITK in agriculture curriculum, challenges of including Indigenous Technical knowledge in agriculture curriculum, theoretical Framework and the conceptual framework.

2.2 The Concept of Indigenous Technical Knowledge

Indigenous technical knowledge is a growing field of inquiry, both nationally and internationally particularly for those interested in education innovation (Battiste, 2002. The word indigenous has been used to refer to specific groups of people defined by ancestral territories, collective cultural configuration, and historical locations (Angioni, 2003). Indigenous technical knowledge constitutes a critical component of a more realistic and comprehensive system of education (Assie-Lumumba, 2016). For the African child to learn with meaningful practical applications there is need to extend teaching in Africa beyond the current practice of knowledge transmission by integrating learners' indigenous technical knowledge in teaching/learning (Abah et al., 2015).

All people that westerners labeled as indigenous were viewed more the indigenous people saw themselves in that position, from implicit or explicit experiences, the more they accepted their knowledge and capabilities in value. This trend led to attenuation of some forms of practices and knowledge that indigenous people used for thousands of years prior to the arrival of the Europeans. A scan across several indigenous cultures reveals elements of knowledge, practices, artifacts that are closely associated with science and technology, but the colonialists did not often recognize them as worthwhile contributions to the global collection of knowledge and practices. Indigenous technical knowledge covers a wide range of practices such as agriculture, environment, biodiversity, health and nutrition among others (Ochola & Onyancha, 2005). Shizha (2006) in his studies found that the greatest reason for neglecting indigenous knowledge was power; since knowledge is power, money and prestige. Some schools of thought argues that recognition of indigenous knowledge would give indigenous people power agency

for identity. Therefore, to maintain power, the colonial masters' knowledge and voice had to remain superior to those of indigenous people (Sundar, 2002).

Research shows that in the recent years an increased consciousness has risen on the failure of the modern agricultural practices to be successfully applied to the different types of regions in which agriculture is practiced. Nevertheless, application of indigenous technical knowledge can help to scale up sustainable agricultural intensification in order to increase production for the purposes of reducing poverty. Paying attention to Indigenous Technical Knowledge can enhance farming practices and it can also help in adapting the current change in climate. One of the driving forces of turning to Indigenous Technical Knowledge is the drastic change in climate which is becoming a challenge to many farmers more especially in the arid and semi-arid areas, this compromises Kenya's achievement of its developmental goals as described in the vision 2030. (Muthee et al., 2019).

Knowledge disseminated to the learners through the curriculum shapes and guides the practice, perceptions and value system of the learners' lifetime long after it has been taught (Shava, 2016). Indigenous technical knowledge can play an important role in bringing local relevance to education process by bridging the gap between formal education system and the live experience within local community context (Shava, 2016), therefore there is a need to reform education system to make it relevant and suit the needs of the Kenyan society (Chang'ach & Muricho, 2013).

Appreciating learners' indigenous technical knowledge and integrating it into the school curriculum, where appropriate should provide multiple avenues for incorporation of locally recognized expertise and practice as the basis for learning about the larger world (Barnhardt, 2014). Despite the decades of self-rule, African scholars have not succeeded in empowering the continent to develop its own educational theoretical and methodological framework for knowledge, production and sustainable development (Kaya & Materecha, 2013). He further indicates that the basic problem is that educational structures inherited from colonialism are based on cultural values that are different from African indigenous technical knowledge.

Education is a key to any nation's development and for it to play this role, education reforms should be inclusive, clearly planned, protected from political dictates and owned by stakeholders (Chang'ach & Muricho, 2013). Culturally responsive education is directed towards culturally knowledgeable students who are well grounded in cultural heritage and traditions of

their community and are able to understand and demonstrate how their local situation and knowledge relates to other knowledge systems and cultural beliefs (Barnhardt, 2014). Colonialism and supremacy of the West have created a gap between indigenous technical knowledge and contemporary education, Educators should therefore find ways to negotiate this gap and reconcile the ITK of their students with the modern knowledge to enhance learning (Hewson, 2015). After all ITK has no contradiction with formal knowledge but instead different ITK features are complementary for scientific knowledge (Khodamoradi & Abedi, 2011).

Research shows that there have been few attempts by formal educational systems to integrate ITK into educational curricula more over conventional curricula and achievement tests do not support students' learning based on their ITK despite the fact that it can act as a powerful tool in teaching/learning Muya (2006). Integration of ITK into the educational curricula will ensure that its value and importance is understood and appreciated among learners who will be equipped with necessary intellectual and research tools (Kaya & Materecha, 2009). Research shows that teachers' perception on integration of ITK in agriculture curriculum determines how they integrate this form of knowledge in school curriculum (Gachanga, 2007).

2.3 Global View on Indigenous Technical Knowledge

Indigenous Technical knowledge system is a significant subject which is recognized worldwide. The first serious deliberation on this subject took place during the World Commission on Environment and Development (WCED), in the period 1984 to 1987. The report of this commission unveiled the value of traditional knowledge in sustainable development process (Cincin-Sain & Knetch, 1995). World Bank (1998) report also indicates that Indigenous Technical Knowledge is an underutilized resource in the development process; the report also indicates that knowledge and not capital is the main impetus behind sustainable social and economic development.

In some developed nations with minority indigenous populations such as Australia, New Zealand, Canada, and United States of America (USA), Indigenous Technical knowledge has been recognized as a valuable teaching resource (Michie 2005). Indigenous Technical Knowledge provides the basis for problem-solving strategies for local communities, especially the poor; it also represents an important component of global knowledge on development issues (World Bank, 2004).

In North America, there have been inputs from several indigenous people trying to resolve the tensions between the need to understand science in a developed world with their own cultural ancestry. Research done by Berkes (2018) indicates that soil and water conservation are among the main principles underlying several indigenous farming methods in North America. Another example of prevailing agricultural practice used by different indigenous communities is the 'Three Sisters'; this entails intercropping maize with beans and squash. The three sisters are intentionally planted, cultivated, and harvested to increase productivity of crop yields; they believe that the three sisters are stronger together than apart (Paden, 2021). Indigenous peoples from Northeast to the Southwest through the plains and southwest U.S. plant these crops to grow symbiotically in a shared space through "companion planting" (Marsh, 2021).

The 'Three Sister' practice begins with placing several maize seed in a hole, after two to three weeks bean seeds are then planted. Planting of beans introduces more nitrogen to the soil through nitrogen fixation which is an essential element for amino acids. Between the mounds of maize and beans someone cultivates a low growing plant like squash; this serves the relationship because the large leaves shade the ground, resulting in higher moisture retention and weed suppressor. Each crop also attracts beneficial insects and pollinators that further protect the sisters by feeding on other insects that are harmful to each plant, the three plants also create a nutritious balanced meal when eaten (Marsh, 2021)

In India, there has been a great interest on indigenous agriculture, this interest has been generated within communities for recording and preservation of their culture which is integrated in institutions and is used as valuable natural resource. Research shows that in all the states of India the native people practice their own agricultural practices which include seed processing, seed storing, field preparation among others. Indigenous systems in India has played a major role in promoting and maintaining biodiversity hence promoting future sustainability (Sultana et al., 2018)

2.4 African view on Indigenous Technical knowledge

Since time immemorial various forms of ITK have been used by societies in Africa for many different purposes as determined by the needs of the society in question (Chikaire et al., 2012). The potential role of ITK in improving agriculture performance is widely recognized in developing countries since the agriculture sector is the backbone of many economies in Africa

(Hart & Mouton 2007). Indigenous Technical knowledge of indigenous people is complementary in: meeting their food requirement, in areas of soil enrichment, land clearing, sowing, harvesting, weeding and ridge making (Akullo et al., 2007). ITK in Africa is often reflected in a community based on its religion and/or culture, ancestral worship and the belief that the ancestors can communicate with individuals (Kaniki & Mphahlele, 2002).

In order for local Governments and International Communities to find solutions to socioeconomic problems facing African states, there is a need to explore the contribution of the culturally based knowledge resources as alternatives to local sustainable development, this requires understanding the capability of Indigenous Technical knowledge in the development process of communities, and ways in which indigenous people strategize their own survival within specific settings (Dei, 2002). Rural communities in the developing countries have an extensive base of widely available knowledge which is ITK, this knowledge is unique to a given culture and it is predominantly embedded in practices and experiences of local people (Khashmelmous & Sen, 2006).

The United Nations Sustainable Development Goals aims at increasing agricultural productivity for smallholder farmers at least twofold and thereby double incomes particularly for the vulnerable groups through safe and impartial access to production resources such as land capital and extension services. This cannot be a reality unless social development goals propose ending poverty in all forms, this can only be possible if the underprivileged and those susceptible to weather related disasters are protected. This means that the role of indigenous technical knowledge systems in enhancing agricultural productivity cannot be ignored (United Nations General assembly, 2015).

Indigenous technical knowledge has been applied by local countries like South Africa in order to limit the negative impacts of climate change on crop production. The farmers use their indigenous practices to reduce problems associated with natural disasters (Harvey et al. 2014). Most subsistence farmers know and practice a wide range of cultural practices which are helpful in addressing the factors that appear to be a threat to their production. These cultural practices include taking precautions of early warning of rainfall availability or scarcity which is predicted by wind direction, the crescent moon and behavior of certain animals (Rankoana, 2016).

A research carried out by Ponge (2013) indicates that indigenous technical knowledge can be used to improve the productivity of crop production under erratic rainfall. This has been

made effective by supplementing scientific technology interventions such as the use of organic fertilizers and pesticides and meteorological data. Berkes (2012) also indicates that the impact of erratic rainfall on food production can be reduced by combining different knowledge systems; this is done by supplementing famers, indigenous practices with improved technologies. It has also been applied to control ticks in livestock, research shows that farmers use *Aloe ferox Mill* to control parasites such as ticks because of its laxative effect because of the presence of glycoside aloin (Eloff & McGaw, 2014) and it also possesses insect repellant properties and may also treat anaplasmosis and heartwater (Masika & Afolayan, 2003). In addition, farmers also use *Cissus quadrangularis* to control ticks; this is due to its inflammatory and antimicrobial effects on the parasite. *Cissus quadrangularis* is also reported to have fungicidal and antipyretic properties (Mkwanazi et al., 2019).

African Indigenous Technical knowledge varies within different groups of people and therefore needs to be examined so that knowledge that is considered useful and valuable is integrated in the school curriculum (Hodson, 2009). In the case of Kenya, it is as diverse as approximately as the 42 (plus) ethnic communities. Most of the inhabitants in Kenya live in rural places and therefore they depend on natural resources for their livelihood, Knowledge transmission among ethnic communities in Kenya occur within the context of family, community, clan tribe and cultural age groups (Wangoola, 2002).

A research undertaken by Mafongonya and Ajayi (2017) indicates that most of the African communities use their culture-specific measures to limit the negative effects of climate change which has been a menace on crop production in the recent past. Local farmers use their indigenous knowledge and practices to reduce problems associated with natural disasters (Harvey et. al., 2014). Examples of these cultural practices include taking precautions of the early warning of rainfall availability or scarcity which is predicted by wind direction, the shape of the crescent moon and the behavior of certain animals. On rainfall prediction, farmers observe a change in the onset and quantity of rainfall. They rely on this knowledge in order to plan their farming activities. The predictions of higher rainfall probability encourages the farmers to prepare for planting season well in advance to ensure that planting will coincide with good rains. Farmers associated low rainfall probability with strong winds which they believe that it drives away the rain bearing clouds; also the flowering of the acacia plants predicted the amount of rainfall that will be received (Rankoana, 2021).

2.5 Indigenous Technical Knowledge and practices in crop production

Indigenous Technical Knowledge and practices in crop production entails growing of traditional food crops and vegetables, protection of crops against pest and disease, and seed preservation and preparation. A research carried out by International Livestock Research Institute (2013) indicates that indigenous crops such as cassava, sorghum, millet and African peas have the potential to end severe food insecurity due to their tolerance to drought and ability to thrive under different soil types. Indigenous crops build a socio-economic resilience into the community in the sense that they guarantee poor communities to feed themselves.

The challenge associated with traditional crops is the isolated pockets of indigenous knowledge on growing of the crops as well as the best practices for each crop (Wollni & Qaim, 2014). Indigenous crops are well adapted to local climate and soil conditions and their relative importance differs from one locality to another, Some of the indigenous crops like arrow roots and yams are produced, traded and consumed locally, while others like sorghum, millet, cowpeas, pigeon peas, and sweet potatoes are consumed and traded in distant areas especially urban places (Kenya MoA & KARI, 2007).

Indigenous food production systems can significantly contribute in enhancing agricultural productivity as well as guaranteeing food security. Most communities in Kenya have traditional food crops which are rich in macro-nutrients, these includes: indigenous vegetables, fruits, cereals, pulses, tubers and roots. In the recent years, production and consumption of traditional leafy vegetables has increased due to increased awareness on their nutritive value and promotion by such organizations as KARI, the Kenya MoA and Non-governmental organizations (Mbugua et al., 2008). Hongo (2008) in his research indicates that if traditional crops are exploited there shall be a more sustainable means as well as long term solution to the elimination of some micro-nutrient deficiency, this is also agreed by Moyo et al. (2013) who pose it that plant products is a fundamental requirement for human well-being. According to Pretorius and Schonfeldt (2011), indigenous vegetables are inexpensive, easily accessible and provide health-promoting compounds such as vitamins, minerals, anti-cancers and even anti-oxidant factors which are needed to maintain human health and fight off infections. The minerals and vitamins found in indigenous vegetables exceed the level found in most exotic vegetables (Odhav et al., 2007).

With the realization of the nutritive value of indigenous vegetables so has their economic importance been appreciated, this has led to growth in demand for indigenous vegetables such as black nightshade, amaranthus, cowpeas, pumpkin leaves, pigweed among others. One of the advantages of traditional vegetables has been identified in improvement of soil fertility as well as in weed and pests suppression (Muthee et al., 2019).

Traditional communities in Kenya have for ages depended on indigenous technical knowledge to exploit agroforestry for bio-pesticides and for medicinal purposes. Under circumstances where people have limited access to contemporary medications which are expensive, herbal medicine has been an alternative and this can be seen in the growing space for organic and herbal product derived from medicinal plant extracts. Research shows that decreasing the losses emanating from crop pest and diseases will help in checking food insecurity thereby enhancing economic growth. The prevailing methods of controlling crop pest and diseases which relies on artificial agrochemicals has had a negligible impact on the output of many poor small holder farmers who from a very important section of the agricultural sector, this is mainly because of the affordability of the agrochemicals. In this case, a solution to managing pest diseases in farming lies in going to harnessing of indigenous technical knowledge in pest and disease control (Muthee et al., 2019).

Indigenous Technical Knowledge has also been greatly applied in maize production to overcome post-harvest losses. Maize is the most important food crop in Kenya and a major cash crop in some parts of the country. A research carried out in Eastern part of Kenya indicates the practices carried out by farmers in order to overcome losses which are associated with poor handling, poor storage and destruction by pest an diseases. Some of the practices include: placing *Mexican marigold* leaves or neem or *lantana camara* plants on the granary floor before placing maize and after maize have been placed in the granary, crashing hot chilies to powder and using it to dust cobs and grains to control insects and rats and lastly proper drying of maize seeds before storage to prevent fungal diseases (Waithaka, 2011). Studies shows that *Lantana camara* causes less mobility, dehydration, constipation, congested heart and lung nephrosis, and teratology to pests like mice (Mello et al., 2005). In Nakuru County some of the smallholder French beans farmers controls pests like spider and mites using botanical pesticides obtained from tobacco and Mexican marigold (Ogendo et al., 2014).

It is an agreed fact that decreasing the losses emanating from crop pests and diseases will help moderate food insecurity and hence enhance Kenya's economic growth, however, the prevailing crop pest and disease protection management systems that relies on agrochemicals has had a negligible impact on the output of smallholder farmers who form a most important section of agriculture in Kenya. This is mainly because of affordability, availability, and ease of use of these chemicals and therefore a solution of managing crop pest and diseases lies in going back to harnessing indigenous knowledge pertaining to control of crop pest and diseases. Indigenous knowledge on insect pest control is perceived as important because it was witnessed as useful in food security and survival of the users long before the invention of synthetic pesticides (Lodhi & Mikulecky, 2010). Indigenous farm practices for protection of seeds as well as grains by use of various plant parts, ash, oils etc. are very old and are based on some scientific principles. The silica in wooden and cow dung ash deters egg formation and larval feeding (Metha et al., 2012). Some plant parts emit a pungent smell because of the availability of essential oil in them; this pungent smell acts as a repellant of insects and deters their survival.

The advantages of biological pesticides outweighs synthetic pesticides to some extent, these pesticides are less toxic and they generally affect targeted pest unlike the synthetic pesticides that do not degrade easily and thus has a negative impact on the ecosystem, therefore are considered unsafe for use and are environmentally unfriendly. Application of indigenous knowledge in agriculture, therefore endows the farmers with a safer way to preserve nature while at the same time maximizing yields (Muthee et al., 2019).

The government through the Ministry of Agriculture in conjunction with Kenya Agricultural and Livestock Research Organization (KALRO) have established Farmers Training Centre for Indigenous knowledge in some parts of the country, for instance in Turbo Township in Uasin Gishu District. Farmers usually converge and are taught how to apply ITK in their farming activities. Through this training, farmers learn various uses of ITK which includes: use of animal and compost manure, sprinkling of hot pepper on vegetables to control pests, drying of selected seeds for planting, alternating of livestock and crops on a field portion to restore fertility and soaking of seeds in water before planting to hasten germination (Chebutuk & Kiplangat, 2008).

In Kenya, agricultural production is widely rain-fed. Emery (2000) singles out rainfall as a key determinant of climate change, yet rainfall forecasting is a difficult area. Communities

particularly those in drought and flood prone areas have generated a vast body of indigenous knowledge on disaster prevention and mitigation through early warning and preparedness (Anandaraja et al., 2008). In some countries like Tanzania, various environmental and astronomical indicators including plant phenology, behavior and movement of birds, animals and insects are widely used to predict rainfall (Changa et al., 2013). In spite of all the usefulness of ITK in weather and climate prediction, the art is under threat of disappearing due to lack of systematic documentation of the knowledge and lack of coordinated research to investigate the accuracy and reliability of forecasts (Kijazi et al., 2013)

2.6 Indigenous Technical Knowledge and Practices in Livestock production

The indigenous technical knowledge systems constitute the world's reservoir of knowledge that is utilized in indigenous livestock management practices and techniques. The use of ITK allows for the continuous livestock rearing all the year around, an exercise that has little or no chemical effects to degrade the environment (Fre, 2018). The ITK in livestock protection among farmers has largely depended on their past knowledge, experiences and practices (De Glanville et al., 2020).

Livestock productivity in Kenya is severely constrained by the presence of a wide range of animal diseases that affect both production and productivity of livestock, especially in the poor rural farming communities that don't have access to modern management skills. Rural Kenyans derive a range of financial benefits from livestock keeping; this includes provision of credit, insurance, and it's a means by which farmers share risks (IGAD Centre for Pastoral Areas and Livestock Development, 2013). Most Kenyan communities have also kept livestock for subsistence, prestige and as a form of insurance against drought; livestock also serves other social needs like paying bridal price and being used in traditional ceremonies (Kuti, 2008). In Kenya, animal genetic resources are inadequately and inefficiently managed and utilized because of incomplete inventory, characterization, and conservation. To address this problem, the Kenyan government will facilitate documentation and conservation of genetic resources as well as review of indigenous livestock genetic resource (Kuti, 2008).

Poultry production and in particular indigenous chicken production has been recognized as an avenue to improve livelihoods of the rural households by ensuring seasonal food security, provision of seasonal cash flow and organic meat. Mathialagan (2014) indicates that chickens empowers women socially, economically, psychologically and even technically, chickens are the

useful tool to empower rural women and in improving their social status. One of the constraints of poultry production is diseases attack. Due to high cost of conventional medicine coupled with lack of knowledge on their use, the drugs are usually out of reach from some small-scale farmers.

A research carried out in Western Kenya shows that farmers use herbal medicine to control diseases. The herbal medicine is prepared from different plants for instance; Aloe Vera, sisal, pepper, croton, among others. The farmers target symptoms of diseases which they encode them into specific diseases. They use aloe vera to treat Newcastle, *Croton megalocarpus* to treat *Coryza sinusitis*, and *Combretum mole* to treat intestinal worms (Nkurumah et al., 2007). Some farmers apply ITK in poultry production by hatching of eggs and subsequently rearing the chicks near the fire place. This technology involves the use of traditional hatchery which make use of fire place heat to brood and hatch chicks and subsequently rear the chicks using the same fire place until they are of age to be transferred to a different location (Chebutuk & Rotich, 2008). In order to improve future production and productivity in poultry, Kahi et al. (2010) and Ngeno (2011) have estimated genetic parameters for egg weight and body weight of indigenous chicken in Kenya that can be used to initiate chicken breeding program.

Indigenous technical knowledge has also been a great asset in goat farming. Goats contribute to economic, religious and socio-cultural enrichment; they remain predominant due to their low input requirements and ability to adapt to harsh environmental conditions. Although goats possess such worthy attributes , their productivity in resource limited areas is very much constrained, the prevalence of drought impacts negatively on goat productivity hence affecting the nutrition and immunity of goats and the life cycle of the helminthes parasites (Mdletshe et al., 2018). To date 80% of the world population predominantly relies on indigenous technical knowledge for the welfare of their livestock, goats inclusive. For example, when goats are infested with parasites, plants such as *Agapanthus praecox* are used to control parasites (Sanhokwe et al., 2016). Plants produce a wide range of secondary metabolites that play several roles, such as controlling diseases and parasites. Use of indigenous ways of controlling parasites has played a vital role in overcoming the effects of resistance of pests to pesticides. To date, the growing world populations predominantly rely on indigenous technical knowledge for the welfare of their livestock (Wanzala, 2017).

Indigenous technical knowledge provides the basis for problem solving strategies for household food security in many African countries. Processing and preservation of food products

greatly increases the value of perishable food stuffs by making them available for longer periods of time (Osunbitan et al., 2000). The traditional food processing techniques are low-cost and aim at long storage of foods. The technologies are based on indigenous knowledge and are adaptable to the culture of the people and the environment. These processing techniques help in preventing growth of microorganisms that cause foods to decay and food can be kept at ambient temperatures for long periods. Studies show that fermentation is one of the simple techniques for improving both the nutritional and functional properties of traditional staple food grains and animal products (Belton & Taylor, 2004). The beneficial effects associated with fermented foods includes reduced loss of raw materials, reduced cooking time, improvement of protein quality and carbohydrate digestibility, increased shelf life and microbiological safety of food and improved bioavailability of micronutrients, general improvement in the texture, taste, aroma and elimination of toxic and anti-nutritional factors (Mortajemi, 2002). In addition, some fermented foods like fermented milk contain high concentration of probiotics which have health benefits, some of the beneficial effect of lactic acid bacteria consumption includes; improvement of intestinal tract health; enhancement of immune system, reduced symptoms of lactose intolerance and lastly reduced risk of certain cancers (Parvez et al., 2006). Drying is also one of the traditional methods of preserving animal products such as meat. Research shows that in some African communities, meat from slain animals like sheep, goats, cattle and camel is first cut in long pieces, smeared with salt and then dried for about a week (Metha et al., 2012).

Indigenous technical knowledge has played a big role in conservation of biodiversity. Biodiversity refers to the variety and variability of life on earth, biodiversity has been under assault all over the world due to rapid and accelerating anthropogenic activities causing persistent decline in species diversity. It is typically a measure of variation at the genetic, species and ecosystem level while indigenous technical knowledge is the local knowledge which is exclusive to a given culture. The current use of biological pesticides in agriculture, soil fertility management practices as well as improvement of local breeds has greatly tampered with biodiversity (Sharma et al., 2020)

2.7 Integrating Indigenous Technical Knowledge into Secondary School Agriculture Curriculum

Education is the transmission of values and accumulated knowledge of the society (Zulu, 2006); it is a societal instrument for the expansion of human culture. Education is not limited to

accumulating knowledge and skills; it involves acquiring ways of interpreting and giving meaning to concepts, forming links and understanding ideas. Education also entails ways of knowing, perceiving and interpreting the world (2013). Assie-Lumumba (2016) states that education defines the whole human being as a member of a given society with its worldview, ethos, and social representation, in all its forms education is the primary instrument of enculturation. It is therefore believed that any change brought about by education is through the structure of the school curriculum and success of its implementation (Nhalevilo, 2013).

Curriculum is defined as a course of study offered in schools, colleges and other institutions. It forms a link between institutions of learning, knowledge and society (Potokri, 2016). Danmole (2011) describes the curriculum as a set of learning experiences planned to influence learners to bring about the objectives of education. Curriculum is a vehicle that transports education (Gumbo, 2016) and changes in the curriculum changes the knowledge discourse (Dyck, 2005).

The purpose of education in Kenya during the colonial period was mainly for religious conversion, economic exploitation, and the assimilation of Africans into the western cultures, values, and practices. This eroded Kenyan ethnic communities' indigenous learning structures a condition that denied individuals their cultural identity and sense of the past (Woolman, 2001). After independence, Kenya adopted the colonial type of education and 50 years after independence, Kenya has continued to reconstruct the country's formal curriculum in order to incorporate the multiple indigenous ways of knowing in the school system (Owuor, 2007). Seepe (2000) argues that a radical restructuring of education in Africa which makes education relevant to African challenges can hardly be complete without a serious consideration of ITK. This ITK provides an opportunity to bring forth an inclusive approach to education (Msila, 2016). The objective of curriculum reconstruction has been to explore alternative solution by utilizing local resources as a way of addressing socio-economic and political problems that face Kenya as a country; this includes integrating Indigenous Technical knowledge and western knowledge into school system (Republic of Kenya, 2005).

Curriculum reconstruction in post-colonial Kenya became part of the process which aimed at reclaiming cultural identity, it involved the inclusion of Kenyan diverse cultures, histories, oral literature in high schools and innovation in teaching that would incorporate Indigenous Technical knowledge and methods into curriculum (Ominde, 1964). Education is

perceived to function as an agency of cultural transmission, economic, and political development, thus the education system in Kenya is expected to play a mediating role in the relationship between the diverse cultures, the national culture, and the global needs of the nation (Republic of Kenya, 2005). Indigenous Technical Knowledge constitutes a critical component of a more realistic and comprehensive system of education (Assie-Lumumba, 2016). Therefore, promoting greater awareness of ITK is not enough: its application creates and elicits more meaning; hence debates of preservation can be encouraged because it makes no point to preserve non-used knowledge.

Though ITK is important, there are few programs designed to collect, document, develop and disseminate such knowledge. There have been few attempts by formal educational systems to integrate ITK into educational curricula more over conventional curricula and achievement tests do not support students' learning based on their ITK despite the fact that ITK can act as a powerful tool in teaching and learning (Muya, 2006). Integration of ITK into the educational curricula will ensure that its value and importance is understood and appreciated among learners who will be equipped with necessary intellectual and research tools to recognize, conserve and develop it (Kaya & Materecha, 2009).

Education is a key to any nation's development, and for it to play this role, education reforms should be inclusive, clearly planned, protected from political dictates, owned by stakeholders, adequately financed, and subjected to periodic technical consultations to achieve innovation (Chang'ach & Muricho, 2013). Agricultural education is supposed to change the way learners think about solving agricultural problems but not separate them from their daily lives. ITK forms the basis upon which knowledge is built on, this agrees with teaching principle whereby teaching should start from the known to unknown. For education to be effective it is therefore imperative to start with knowledge of the local area that students are familiar with, and gradually move to the knowledge pertaining to regional, national and global environments. Indigenous people have developed enormous volumes of knowledge over centuries by directly interacting with local environment; this readymade knowledge system may easily be used in formal education as long as appropriate measures are taken to tap it from the memories of the local people (Muya, 2006).

Indigenous education approaches can augment learning process in the formal education contexts and contribute to the transformation of our educational curricula to make it relevant to

the African context (Shava, 2016). While the value of ITK in education has been recognized, this recognition is yet to translate into practical curriculum process. Indigenous Technical knowledge has great potential in providing solutions to some of the problems inflicting Kenya's communities, therefore educators need to examine what implications the inclusion of this form of knowledge has for teaching and learning of Agriculture and its sustainability in the current classroom settings even as they avoid putting together Kenyan ways of knowing under one category of Indigenous Technical knowledge. This is because of the diverse nature of Kenya's ethnic communities and centuries of dominance of the country's education system by western epistemologies (Angioni, 2003)

Msila (2016) argues that teacher education which embraces African philosophy will reflect hope in the future of African child. Diversity of knowledge should be valued and need not to be reduced to the standards to the standards of western perspectives of knowledge base (Owuor, 2007).Teaching and learning in schools presents a natural rallying point for tapping the ITK present in all communities through its infusion into the school curriculum (Mavhunga, 2008), however where the inclusion of this knowledge has not been actively developed in schools, learners are being continuously immersed in the western educational values. Inclusion of ITK into secondary school agricultural curriculum will enhance curriculum relevance and better understanding of concepts through building on what the learners already possess, it will also form the basis for connecting what students learn at school with their daily life at home. Therefore, there is need to find a place for agricultural Indigenous Technical knowledge in the current Western-based curriculum.

Awuor (2007) indicates that inclusion of indigenous knowledge in the Kenyan school curriculum necessitates the need to review indigenous knowledge content to be included in the general school curriculum, what is taught, at what level or grade it should be taught, in which environmental context and how it is taught in order to bring developments in the livelihoods of those who practice it. She also points out that the central questions that need to be explored when integrating indigenous knowledge in curriculum reforms are; what aspects of indigenous knowledge needs to be incorporated in the integration process; what other ways of knowing and methods of learning are common across the diverse indigenous cultures, and which ones are unique to particular ethnic groups.

2.8 Teachers Perceptions on Inclusion of ITK in Agriculture Curriculum

One of the challenges facing the integration of ITK in the Kenyan agriculture curriculum arise from teachers' lack of faith that such a curriculum can actually contribute significantly in addressing the socio-economic needs of the country (Mwenda, 2003). Teachers' perception on the integration of ITK in the agriculture curriculum determines how they integrate this form of knowledge in school curriculum (Gachanga, 2007). The quality of curriculum reforms on its own does not guarantee a successful reception by teachers, teachers' beliefs, values and experiences plays a vital role in the curriculum reform (Bantwini, 2010). Neglect of teachers' perceptions creates frustrations and sends out a message that the Education department lacks concern about its teachers (Lemon, 2004).

Teachers being one of the major stakeholders in teaching/learning, their perceptions and attitudes towards ITK curriculum content will either support or hinder its inclusion and implementation. While it may be assumed that such stakeholders are aware of ITK in particular communities, and they have perceptions of the importance of ITK practices, there is little evidence as to whether the above assumption is actually the case (Webb, 2013). In order for teachers to effectively incorporate ITK into curriculum content there is a need to transform individuals' perceptions of what constitutes valuable school knowledge, learning, and teaching. Teachers need to examine their teaching practices and develop ways to authentically engage Indigenous Technical knowledge into the formal education system. For the curricula to positively respond to the needs of individuals there is need to make teaching and learning more culturally inclusive; in that case a shift from the current predominantly Euro-centric curricula and school systems of Africans is of great essence (Pene, 2000). This shift from Eurocentric curriculum poses a challenge for teachers who are expected to mediate the interface between the different cultural systems of meanings and values that continue to exist in their schools (Thaman, 2009). As cultural mediators, our teachers in the African context occupy an important but culturally ambiguous position. While their professional training commits them to the rationale and practices of a western-derived school curriculum, their personal identities, together with those of their students, are rooted in their own cultures and traditions. At school, teachers often de-emphasize the values of the students' home cultures, especially if they conflict with the values that the school is trying to promote (Thaman, 2009).

2.9 Challenges of including Indigenous Technical Knowledge in Agriculture Curriculum

Despite emerging interests in ITK, not enough is known about how ITK is managed, particularly in developing countries like Kenya. For example, issues relating to ITK policies and legislation, structures, research, literacy, education and training that reflect on ITK recognition, appreciation and protection, are not readily known or available (Dororthy, 2010*)*. Part of the problem stems from the realities of living in a developing country; most indigenous people live in rural and marginalized areas where modern forms of communication are relatively unavailable. This problem is compounded by high levels of ignorance and illiteracy (Mbeva, 2000). Issues pertaining to the recognition, protection and appreciation of ITK are therefore very crucial at national level because it can only be included in the Kenyan agriculture curriculum if it is first recognized.

Western-based schooling system recognizes teachers' professionalism as central in facilitating the process of classroom knowledge construction; this does not give room for the exploitation of experiences from members of local community elders in formal classroom knowledge construction. Transmission of ITK to students poses a challenge in that this knowledge is incorporated in individuals' life hence it is not easy to identify the components to be implemented in innovations (Republic of Kenya, 2005). Therefore for this knowledge to be passed on to the learners there must be a context of personal relationship between the learners and the elders who are actively involved in day-to-day socio-economic activities.

Indigenous Technical knowledge and practices is considered unscientific, this poses challenges to the current debates of indigenous approach to education which feature discourses on possibilities of effective involvement of indigenous community members in the integration of ITK into the formal education system. (Mwenda, 2003)

Kenya being a third world country suffers from national dependency syndrome. Its dependence on foreign assistant to support Kenyan education reforms has led to education policies being influenced by external agents, forcing the government to focus on meeting the goals of globalization above the local needs and interests; in that case, attracting donor funding to support research in education that would provide adequate information for implementation of the integration of indigenous technical knowledge in school curriculum has suffered setbacks (Gachanga, 2007). In most cases donors are inclined towards the support of research in education that is based on their conception of what constitutes education or what they validate as important

topics and approaches to education, their findings are not likely to support the incorporation of traditional knowledge in the formal education.

The education programs in colonized countries are often influenced by theories of knowledge construction and education development. Western-based education values have therefore continued to dominate the Kenyan school system; creating contradictions to traditional values, as the priorities to scientific methods, research, and development which dominate the knowledge construction process that inform Kenyan education system. A study carried out by Abdi (2006) reveals that the expansion of western formal education created a situation where traditional education in colonized societies was portrayed by colonial powers as ineffective in managing the lives and welfare of colonized people and communities. The emerging global economies have made it difficult for the education stakeholders such as parents, curriculum developers and policy makers to have difficulty coping with the demands and obligations of indigenous practices.

2.10 Theoretical Framework

This study is based on constructivism learning theory by Jean piaget, this theory explains how people construct their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences (Bereiter, 1994).

Constructivism is an approach to teaching and learning based on the premise that learning is the result of mental construction. In other words, students learn by fitting new information together with what they already know. Constructivists believe that learning is affected by the context in which an idea is taught as well as by students' attitudes and what they believe in. Teachers cannot simply transmit knowledge to students, but students need to actively construct knowledge in their own minds; they need to discover and transform information, check new information against old, and revise rules when they do not longer apply (von Glasersfeld, 1995).

The theory is linked to this study because the researcher considers that learners construct new knowledge from what they are taught in classroom basing on what is already known to them through real life experiences and hands on activities. Therefore it is important for learners to be exposed to learning opportunities that link agricultural concepts and principles with their applications encountered in everyday life.

2.11 Conceptual Framework

The independent variables are the perceptions of agriculture teachers towards ITK pertaining to crop and livestock production. The dependent variable is inclusion of ITK in the secondary school agriculture curriculum. Both the independent and dependent variables were measured by the extend to which they agreed or disagreed with some statements about ITK presented on a Likert scale. By generating various statements about inclusion of ITK on crop and, livestock production and seeking the teachers' views about those statements, it was possible to measure the teachers' perceptions. The intervening variable is agriculture teachers' level of awareness on Indigenous Technical Knowledge on crop and livestock production, their awareness will inform their perceptions towards inclusion of indigenous technical knowledge in secondary school agriculture curriculum. A teacher who is well informed about different indigenous practices on both crop and livestock production is in a better position to give his/her opinion on the inclusion of ITK on both crop and livestock production in the secondary school agriculture curriculum unlike the one with low or no knowledge on ITK practices. The intervening variable is controlled by selecting a study area with teachers from wide range of cultural backgrounds.

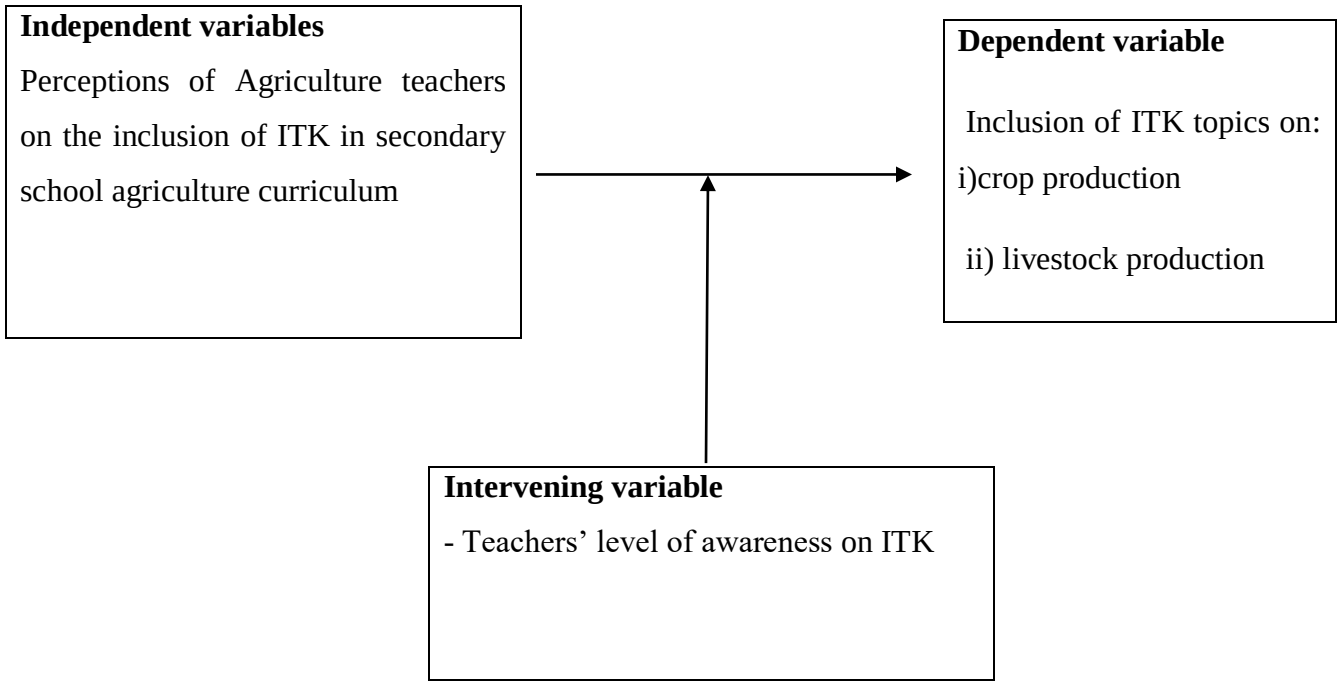

Figure 1: The Conceptual Framework showing the Relationship between Variables in the Study.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the methods and techniques that were applied in the study. It is discussed under the following sub-titles: research design, location of the study, target population, sampling procedure and sample size. Other issues discussed in the chapter include the instrumentation, data collection procedures, data analysis and expected outputs from the study.

3.2 Research Design

A research design is a plan or blue print that helps in conducting research (Kombo & Tromp, 2006). Research design guides the researcher on the processes of collecting data. The study used cross-sectional survey research design. This design is faster and cost effective. Here, data is collected on one occasion and it represents a snapshot of the respondents' responses at that specific point in time. Besides, cross-sectional survey research design is effective for seeking information about the respondents' perceptions (Cooper & Schindler, 2003). This study therefore used cross-sectional design to seek for the information on the perceptions of secondary school agriculture teachers on the inclusion of indigenous technical knowledge (ITK) in secondary school agriculture curriculum and whether that knowledge would be relevant for inclusion into secondary school agriculture syllabus. The information on their perceptions was captured using a semi-structured questionnaire.

3.3 Location of Study

The study was carried out in all secondary schools of Njoro sub-county in Nakuru County. Njoro sub-county has an average temperature of 17°C – 22°C and an average rainfall of about 1000mm per year. This conducive climatic condition has made both small scale and large scale farming, horticulture and dairy farming to be the mainstay of Njoro's economy. Some of the agricultural activities carried out here includes: beef farming, wheat farming, potato farming, fruit farming, dairy cattle farming, and poultry farming among others. Njoro Sub-County has drawn teachers from different parts of the country with different cultural backgrounds hence making the area fit for collecting data on the perception of Agriculture teachers on the inclusion of ITK in the secondary agriculture curriculum.

3.4 Population of Study

Target population refers to all members of a real or hypothetical set of people, events, or objects to which a researcher wishes to generalize the research results. The target population for the study was secondary school agriculture teachers of Njoro sub-county. There are approximately 90 agriculture teachers in Njoro sub-county (as indicated in Njoro sub-county's records), distributed in the 47 secondary schools. The study focused on agriculture teachers because they are key stakeholders in curriculum implementation.

3.5 Sampling Procedure and Sample Size

Sampling is seeking of knowledge or information about a population by observing part of the population referred to as a sample, in order to extend the findings to the entire population (Mugenda & Mugenda, 2003). Since the accessible population for the study is small, the entire population was included in the study. Therefore, the accessible population (90 agriculture teachers) was included in the study. The distribution of agriculture teachers in the various schools of Njoro sub-county is as shown in the table below.

Table 1. Distribution of Agriculture Teachers in Njoro Sub-county Schools

Number of schools	**Number of agriculture teachers per school**	**Total number of agriculture teachers**
20	1	22
17	2	34
6	3	18
2	4	8
2	5	10
Total = 47		**Total = 90**

3.6 Instrumentation

A semi-structured questionnaire was used to collect data from the respondents. The instrument was developed by the researcher thorough review of literature on indigenous crop and livestock production practices. The questionnaire required the respondents to reflect on their understanding

of indigenous technical knowledge on both crop and livestock production. The instrument was developed guided by the objectives of the study. The questionnaire was divided into three sections numbered A to C. Section A captured the respondent's personal information and consisted closed ended questions. Section B captured information on teachers' conversance with ITK pertaining to crop and livestock production, this section consisted a four point Likert scale in which the respondent was required to respond to statement as High (where the respondent has interacted with the practice indicated), Moderate (where the respondent observed the indicated practice being undertaken), Low (where the respondent did not interact with the practice but he has some knowledge about the indicated practice) and None (where the respondent is not aware of the existence of the indicated practice). Section C captured data on perception of secondary school agriculture teachers on ITK and its inclusion in secondary school agriculture curriculum, this section consisted of a five point Likert scale in which the respondent was required to give statements as Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), and Strongly Agree (SA). Section B consisted of both closed ended and open ended questions.

3.6.1 Validity

Validity is an important criterion that is used to evaluate the degree to which an instrument measures what it is supposed to measure in terms of accuracy, soundness and effectiveness (Kothari, 2004). The instrument was subjected to scrutiny by peers in the field of Agricultural Education, the supervisors and members in the Egerton University's Department of Agricultural Education and Extension to ascertain the questionnaire's content, construct and face validity before administering it for the pilot study. This was further ascertained by other researchers from Egerton University to ensure that the items adequately represented concepts that covers all relevant issues under investigation.

3.6.2 Reliability

Reliability is a measure of how consistent the results from an instrument are (Kombo & Tromp, 2006).The instrument was pilot-tested with 30 agriculture teachers in Rongai sub-county. Hill (1998) suggests a sample size of 10 to 30 participants for pilot study in survey research, a sample size of 30 which is on the upper limit is selected in order to take care of non- response during the study. Rongai sub-county neighbours the study area and was found convenient for piloting without interfering with the outcome of the study because it has the same variables as the study

area. The reliability of the instrument was estimated by use of Cronbach-alpha coefficient which is a measure of internal consistency. This was deemed to be appropriate because it requires only a single administration and it provides a quantitative estimate of reliability for the given administration. The value of the coefficient of the reliability falls between 0 and 1. An instrument with no reliability will score 0 while an instrument with high reliability will score 1. The Cronbach-alpha coefficient of the instrument was 0.785 which is above the 0.7 threshold hence the instrument was considered reliable.

3.7 Data Collection

The researcher's proposal was cleared by the Egerton University Graduate School which enabled the study to be undertaken through authorization of the National Commission for Science Technology and Innovations (NACOSTI). Upon obtaining the research permit, the researcher visited the Njoro sub-county Director for authorization and support.

The researcher visited the schools in person and explained to the principal the purpose of the study. With the permission of the school principal the researcher took the questionnaires to the agriculture teachers (the respondents) in the school and explained the purpose of the study to them before allowing them to fill the questionnaires.

3.8 Data Analysis

Data analysis refers to a variety of activities and processes that a researcher administers to make certain decisions regarding the data collected from the field, in order to get meaning and be able to explain various features from raw materials (Mbwesa, 2009). The data collected was cleaned first to identify the errors made by the respondents. Once the data had been cleaned, the questionnaires were coded and the data entered into the computer using Statistical Package for Social Sciences (SPSS version 2021). Data was analyzed using descriptive statistics. Frequencies and percentages were used to analyze the results. The data was presented using tables, bar graphs and pie charts.

Table 2. Summary of Data Analysis.

Research Questions	Independent variable	Dependent variable	Method of data Analysis
What are the agriculture teachers' levels of awareness on ITK pertaining to crop production?	Agriculture teachers' perceptions of ITK on crop production	Inclusion of ITK on crop production in the curriculum	-Descriptive Statistics (percentages and frequencies)
What are the agriculture teachers' levels of awareness on ITK pertaining to livestock production?	Agriculture teachers' perception on ITK pertaining to livestock production	Inclusion of ITK on livestock production in the curriculum	-Descriptive Statistics (percentages and frequencies)
What are the perceptions of Agriculture teachers on the inclusion of ITK on crop and livestock production in secondary school agriculture curriculum?	Perception of agriculture teachers towards inclusion of ITK on crop and livestock production in secondary school curriculum	Inclusion of ITK on livestock production topics in the curriculum	-Descriptive Statistics (percentages and frequencies)

3.9 Ethical Considerations

Ethical considerations refers to the steps undertaken by the researcher to ensure that the process of data acquisition does not violate any legal procedures and policies and also it does not expose the information collected from the research to malicious use by third parties (Connelly, 2014). One of the ethical considerations employed by the resaecher is on identifying and referencing all the secondary data from secondary sources, this enabled the identification and acknowledgement

of the owner of original information. Data collected from the respondents was analysed and used strictly for the purpose for which it was collected. The study also avoided the use of studies with identifying information on the respondents to ensure that no ethical restrictions were broken.

CHAPTER FOUR

RESULTS AND DISCUSION

4.1 Introduction

This chapter presents the results obtained from the respondents. The results included responses from structured questionnaires which were administered to agriculture teachers. The questionnaires were used to investigate teachers' perception on the inclusion of Indigenous Technical Knowledge in secondary school agriculture curriculum. The study sought to answer the following questions:

i) What is the agriculture teachers' level of awareness on ITK pertaining to crop production in Njoro Sub-county?

ii) What is the agriculture teachers' level of awareness on ITK pertaining to livestock production in Njoro Sub-county?

iii) What are the perceptions of Agriculture teachers in Njoro Sub-county on the inclusion of ITK pertaining to crop and livestock production in secondary school agriculture curriculum?

The results are presented in the following order; demographic information of teachers (gender of the respondents, teaching experience of the respondents and academic qualifications of Agriculture teachers); teachers' conversance on indigenous technical knowledge (teachers' conversance with ITK on crop production practices and teachers' conversance with ITK on livestock production practices) and lastly teachers' perceptions about Inclusion of ITK in secondary school agriculture curriculum for Kenyan secondary schools.

4.2 Demographic Information of Teachers.

This section discusses the characteristics of the respondents based on question items that is: gender, teaching experience and teacher qualification. This information sought to establish the insight on respondents' characteristics and also find out whether their characteristics has any impact on their perceptions towards the inclusion of ITK in secondary school agriculture curriculum.

4.2.1 Gender of the Respondents

The gender of the respondents was sought since its findings would assist the study in categorizing respondents based on gender and their perceptions on the inclusion of ITK in secondary school agriculture curriculum. Basing on the data collected 55% of the respondents were males while 45% were females. The findings are as shown in the table below.

Table 3. Gender of the Respondents

Gender	Frequency	percentage
Male	46	55
Female	37	45
Total	83	100

The findings above indicate that Majority of the teachers were males with 55%, while females were 45%. This implies that most of the agriculture teachers in Njoro sub-county are males. Quite a number of studies have shown that there are differences in the beliefs held by females and males towards agriculture; Eshun (2004) in his study indicates that females show a lower science self-concept than males. Studies also indicates that not many women pursue a career in the science , technology, engineering and mathematics courses, the proportion of females in these fields has remained consistently low over the last decades (Ihsen et al., 2013). The proportion of women in a given field is a critical variable; it appears that personal attitudes, assessments and characteristics are related to enrolment in subjects with lower or higher proportions of women (Erti et al, 2014). The motivation to enroll in science courses and stay on a chosen career path usually results from a combination of both intrinsic and extrinsic motivations, with males student's' motivation mostly exceeding that of females (Ihsen et al., 2013)

4.2.2 Teaching Experience of the Respondents.

The respondents teaching experience indicated that 48% of the teachers have taught for 0-5 years, 21 %for 6-10 years, 13% for 11-15 years, 4% have been in teaching field for 16-20 years and 14% above 20 years. Most of the teachers have taught for 0-5 years this is contributed by increased recruitment of teachers by the Teachers Service Commission in the recent past. The results are as shown in figure 2 below.

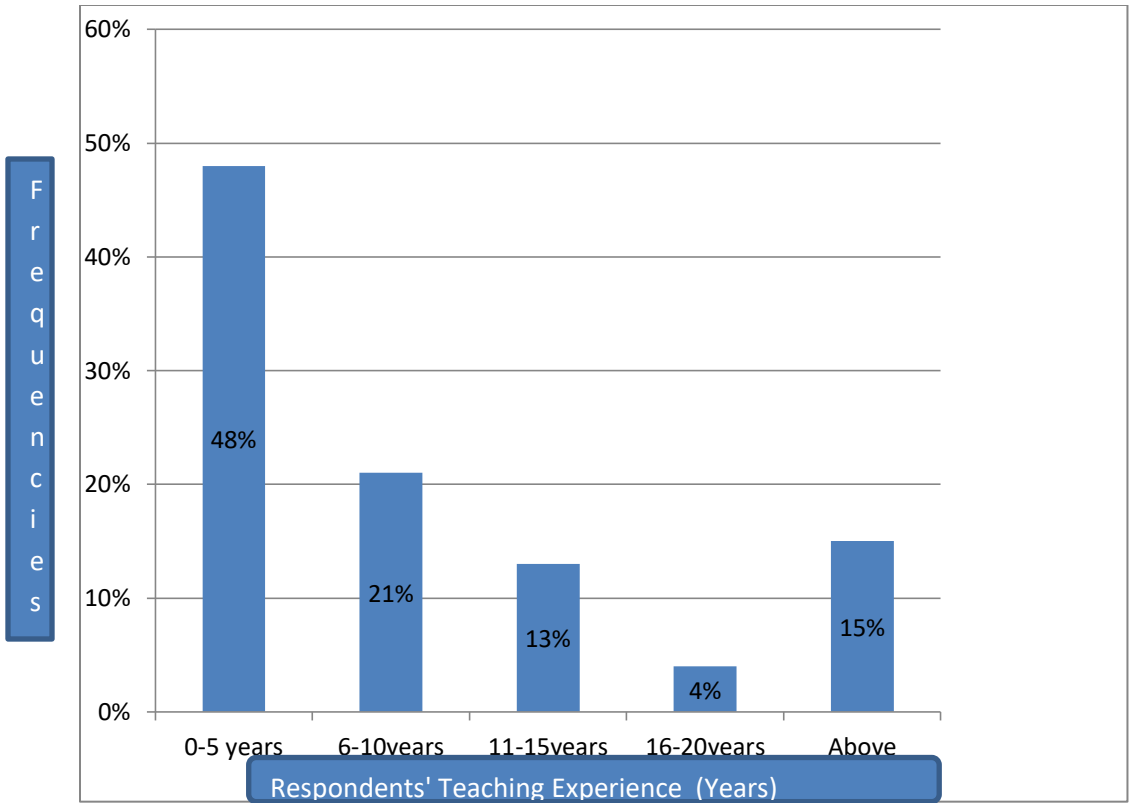

Figure 2. Agriculture Teachers' Teaching Experience

The research believes that experiential knowledge is always acquired through personal exploration and practicality based on everyday lived experiences. Agricultural indigenous education involves the expertise of teachers given their multiple nature of roles and responsibilities through which the youths need to be mentored and guided, Dei et al. (2002) reiterates that the communal responsibility of education forms the basis for indigenous pedagogy in most Kenyan ethnic communities.

4.2.3 Academic Qualifications of Agriculture Teachers

The researcher also sought to establish agriculture teachers' qualifications. The data collected indicates that 29% of the teachers are diploma holders, 63 % are degree holders, 6% have done masters and 2% of the teachers have done other courses related to agriculture. The findings are as shown below.

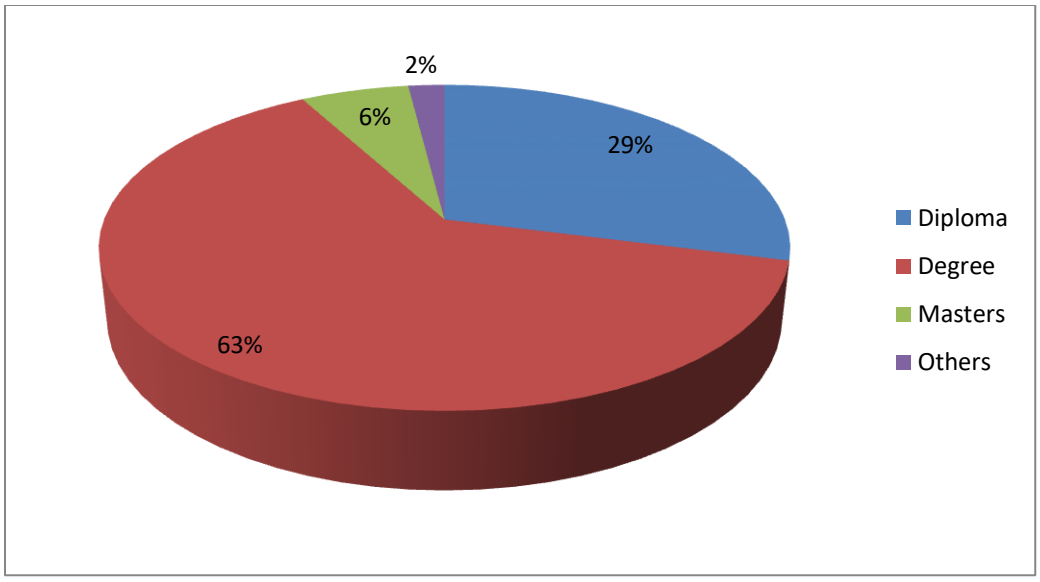

Figure 3. Agriculture Teachers' Qualification

These findings show that most teachers are qualified to teach agriculture in secondary schools of Njoro Sub-county. Few of the teachers have masters but with time and changing trends most teachers are likely to be holders of Masters Degrees. The study noted that the secondary schools have employed and retained trained staffs for effective dissemination of agricultural knowledge.

4.3 Agriculture Teachers' level of awareness on ITK pertaining to Crop Production Practices

This section discussed the Agriculture teachers' level of awareness on ITK pertaining to crop production practices, the respondents were asked to indicate their level of awareness on different ITK on crop production practices provided. The levels of awareness were grouped into three i.e. moderate to high, low level and none (for those who were not aware of the practice at all). The results were as indicated in the table 4 below.

Table 4. Teachers' Level of Awareness on ITK pertaining to Crop Production Practices

Crop production practices	Moderate to high %	low %	None %	Total %
Observing sprouting and flowering of certain plants which indicate onset of rain	74%	22%	4%	100%
Storing healthy seedlings above fire place to preserve them for planting	74%	15%	11%	100%
Storing seeds in the kitchen ceiling for proper drying of the seeds	70%	23%	7%	100%
Selecting seeds (e.g. harvested maize seeds, beans peas etc.) of good size and shape	93%	7%	0%	100%
Use of ash on vegetables to control aphids	74%	20%	6%	100%
Dusting granaries with ashes to control weevils.	64%	29%	7%	100%
Use of pepper and ashes to control maize stalk borer.	54%	34%	12%	100%
Use of Mexican marigold and Lantana camara to control storage pests	41%	35%	24%	100%
Intercropping crops with tobacco in order to control crop pest	41%	28%	31%	100%
Use of scarecrows to control crop pests like birds	93%	6%	1%	100%
Winnowing crops to remove thrush before storage	99%	1%	0%	100%
Use of basket granaries which are well aerated to prevent dumpy environment.	70%	19%	11%	100%
Soaking seeds in water overnight to bring forward germination date.	78%	18%	4%	100%

The findings presented on table 4 indicate that 74% of the respondents had moderate-high level of awareness on farmers' indigenous way of predicting the onset of rains by observing the sprouting and flowering of certain plants while 4% were aware of the practice. In the past indigenous people predicted the onset of rainfall using various environmental and astronomical indicators such as: fruit production of certain trees at the onset of rainy season, behavior and movement of birds, animals as well as insects (Chang'a et al., 2010). Environmental indicators that farmers use to predict the coming rainy season became available for observation at different times of the year, beginning immediately after harvest and continuing into the new rainy season (Ingram et al., 2002). Though majority of the teachers were familiar with this practice, research shows that the practice is under a threat of disappearing due to lack of systematic documentation of the knowledge and lack of co-ordinated research to investigate the accuracy and reliability of forecasts (Kijazi et al., 2013).

From the data collected, 93% of the respondents had moderate to high level of awareness on the practice of how farmers select seeds for planting, 97% were conversant (moderate to high level) with farmers' practice of storing the selected seeds on kitchen ceiling in order to preserve them and lastly 96% of the teachers had moderate to high level of awareness on soaking of seeds to bring forward germination. Traditionally rural subsistence farmers store their maize cobs (containing seeds) over fire place in their huts; this caused the seeds to come into contact with large quantities of smoke. Modi (2002) in his study of using two traditional maize varieties showed that the seeds exposed to smoke had a higher germination rate and final germination than untreated seeds. The smoke treated seeds produced significantly more vigorous seedlings than untreated seeds. According to Chebutuk and Rotich (2008), farmers prepare seeds for planting by selecting seeds which are of good health and size for planting. The selected seeds were then placed in baskets and hanged in kitchen ceilings so that smoke and heat would dry and preserve them. Prior to planting some indigenous farmers soak seeks overnight in order to bring forward germination. Indigenous farming practices for protection of seeds as well as grains by using various plant parts, ash; oils etc. are very old and are based on some scientific principles.

On dusting of granaries to control weevils, 64% of the teachers had moderate to high level of awareness on the practice while 7% were not aware of the practice. Research shows that ash from wooden and cow dung is used to control pests because of its silica content which deters egg formation and larva feeding (Metha et al. 2012). A research carried out by Lodhi, and

Mikulecky (2010) indicates that Indigenous Knowledge on insect pest control is perceived as important because it was witnessed as useful in food security and survival of the users long before the invention of synthetic pesticides, this could be the reason why majority of the respondents were well conversant with this practice.

On the use of pepper and ashes to control maize stalk borer, 88% of the respondents had moderate to high level of awareness on the practice while 12% were not aware of the practice at all. The use of various plant parts emits a pungent type of smell because of the availability of essential oil in them. The emission of the pungent smell acts as a repellant of insects and thus deters their survival (Methal et al., 2012).

On the use of *Lantana camara* and *Mexican marigold* to control pest, 76% of teachers were aware (low- high) of the practice while 24% were not aware of the practice. Research shows that *Lantana camara* has toxicity effects to animals and it is also a noxious plant that has been cited as invasive and it needs monitoring (Baars &Nesser, 1999). Literature also reports that *Lantana camara* causes less mobility, dehydration and constipation, congested heart and lung nephrosis, and teratology to pests like mice (Mello et al, 2005). Further research indicates that *Lantana camara* has been used for the control of insect pests in stored grains (Rajashekar et al., 2013). Other than using *Lantana camara* to control field pests, farmers can also use cats to control pests like birds and rodents as well as use of scarecrows to scare away pests like porcupines and birds. On the use of scarecrows 99% of the teachers were well conversant (moderate to high) with the practice.

Further; 41% of the teachers had moderate to high level of knowledge on control of crop pests by intercropping crops with tobacco. Crop pests can also be controlled by intercropping crops with tobacco. Intercropping refers to the practice in which two or more species or genotypes grow together at the same time in the same field, it can either be done where the second crop is cultivated before the earlier matures or the two crops are grown together in strips. The main advantage of this is maintenance of soil conditions, control of diseases as well pests (Brooker et al., 2015). This practice is majorly done in cocoa plantation where tabacco plays a role of preventing insects from attacking cocoa crops (Sharma et al., 2020). The results indicates that majority of the teachers had not interacted with the practice, Chota et al. (2010) suggests that all Indigenous Knowledge Systems related to Agricultural practices which have something to do

with plant and animal production should be protected and continued to be used since they have a lot of advantages over the Western practices.

The findings of the study also indicates that 99% of the respondents had moderate to high level of awareness on winnowing of crops before storage while 89% were aware (moderate – high) of the practice of storing farm produce using basket granaries which are well aerated to prevent dumpy environment. One of the post-harvest practices in crop production is threshing; this is carried out on cereal crops like maize. The purpose of threshing is to detach the grains from the panicle. The cleaning process is performed after threshing to separate whole grains from broken grains and other foreign materials such as straw, stone, chaff and weed seeds. Winnowing is one of the most common methods used for cleaning farm produce in developing countries (Kalita & Kumar, 2017). Once the farm produce is cleaned it is then ready for storage. Traditionally rural subsistence farmers store their produce using traditional storage structures which are made up of bamboo. The woven bamboo mat-like structure is rolled into a cylinder form and is first smeared with mustard seed cake to make it pest repellent; the structure is made air tight by plastering it with rice cow dung, mud or mustard cake (Kafle et al., 2021). On average more than 50% of the agriculture teachers are conversant with different ITK practices carried out in crop production.

4.4 Agriculture Teachers' level of awareness on ITK pertaining to Livestock Production Practices.

This section discussed the Agriculture teachers' level of awareness on ITK pertaining to various livestock production practices, the respondents were asked to indicate their level of awareness on different ITK on practices provided. The levels of awareness were grouped into three i.e. moderate to high, low level and none (for those who were not aware of the practice at all).

Below are respondents' responses on their level of awareness on various livestock production practices.

Table 5. Teachers' Level of Awareness on ITK pertaining to Livestock Production Practices.

Livestock production practices	**Moderate - High** %	**Low %**	**None** %	**Total** %
Use of traditional brew to control worms	29%	46%	25%	100%
Controlling ticks by extracting blood from an animal heavily infested with ticks in order to make the skin hard	20%	31%	49%	100%
Use of guard/calabash kept in cold places to preserve milk	79%	18%	3%	100%
Preserving meat by smoking	72%	22%	6%	100%
Keeping boiled meat in honey containers for long storage	48%	25%	27%	100%
Use of fire place to hatch and brood chicks	59%	30%	11%	100%
Rearing of hatched chicks near the fire place for sometimes (fire place provides warmth).	75%	20%	5%	100%
Extracting juice from aloe vera plant and adding to water to control coccidiosis in poultry	84%	10%	6%	100%
Choosing of a bull from a highly	93%	7%	0	100%

productive mother in order to get a good quality calf				
Borrowing a bull from another village for breeding.	85%	10%	5%	100%

The findings of the study shows 29% of the respondents were conversant with ITK on the use of traditional brew to control worms (internal parasites). Research shows that most traditional farmers practice free range system where by farm animals are allowed to graze freely in the field, they are left to graze on shrubs and herbs which are medicinal in nature. To control internal parasites, cows are dewormed using traditional brew which is prepared by the farmers who believe that the brew has the ability to clear worms in the digestive system (Chebutuk & Rotich, 2008). The brew is given to animals whose droppings are observed to be having eggs, larval stages of parasites or even the adult parasites.

On controlling ticks by extracting blood from an animal which is heavily infested, 51% of the respondents were aware of the practice, while 49% were not aware; this reveals that the practice is not widely practiced among the different Kenyan communities. Due to scarcity of veterinary services in many developing counties, farmers depend on ITK to control ticks (Byaruhanga et al., 2015). This is done by extracting blood from the neck region of an animal heavily infested with ticks in order to make the animal skin hard, this makes the ticks to fall off and hence discourage ticks from invading.

Fermentation is one of the oldest methods of food processing, according to Van Hylckama Vlieg (2011), fermented foods and beverages are estimated to make up approximately a third of the human diet. Fermentation process represents a food preservation technique particularly well suited to the climate of arid and semi-arid areas. Fermentation is an important food processing technology usually developed by women in most African countries (Methal, 2011). Research shows that the traditional food processing techniques are very important in preventing growth of micro-organisms that causes food to decay hence food can be kept at ambient temperature for long periods. Processing and preservation of food products helps in increasing the value of perishable food stuffs by making them available for longer periods of time (Osumbi et al., 2000). Fermentation also enhances the nutritional quality of foods and it

contributes to food safety particularly where refrigeration and other processing facilities are not available (Motarjemi, 2002). In addition, some fermented foods like fermented milk contain high concentration of probiotics which have health benefits, some of the beneficial effect of lactic acid bacteria consumption includes; improvement of intestinal tract health; enhancement of immune system, reduced symptoms of lactose intolerance and lastly reduced risk of certain cancers (Parvez et al., 2006). In conclusion processing techniques such as soaking and fermentation have been found to reduce significantly the levels of phytates and tannins by exogenous and endogenous enzymes formed during processing (Nuha et al., 2010). Most of indigenous food processing and preparation methods are well known to most households in rural and urban areas alike (Metha et al., 2012) this could be the reason why majority of the teachers (97%) were well conversant with the different methods of food preservation methods.

The data collected also indicates that 79% of the respondents were conversant with the practice of preserving meet by smocking while 5% were not aware of the practice. Research shows that in some African communities, meat from slain animals like sheep, goats, cattle and camel is first cut into very long pieces, smeared with salt and then dried for about a week (Methal et al., 2012).

The traditional methods of hatching and rearing of chicks as well as control of poultry diseases such as coccidiosis seemed to be well understood by majority of the respondents since 89% of them agreed that they were conversant with traditional way of brooding and rearing chicks, and 94% were conversant with the practice of treating poultry against coccidiosis using aloe-Vera juice. Some farmers apply ITK in poultry production by hatching of eggs and subsequently rearing them near the fire place. This technology involves the use of traditional hatchery (near the fire place) which make use of fire place heat to brood and hatch chicks and subsequently rear the chicks using the same fire place until they are of age to be transferred to a different location. Once the chicks have grown they are treated against coccidiosis in case of an attack using aloe-Vera juice which is extracted from the aloe-Vera plant (Chebutuk & Rotich, 2008).

Lastly the data collected revealed that most of the responded seemed to be well conversant with ITK on selection and breeding of livestock, more than 90% responded positively. Research shows that indigenous farmers choose a healthy bull with desirable physical features to be used for siring. In order to avoid in-breeding, bulls with desirable traits may be

brought from other villages for breeding purposes (Chebutuk & Rotich, 2008). On average 86% of the respondents were well conversant with different ITK practices carried out in livestock production.

4.5 Agriculture Teachers' Perceptions on ITK on Crop and Livestock Production and its Inclusion in Secondary School Agriculture Curriculum

Objective two and three sought to determine the perception of Agriculture teachers on the inclusion of ITK on crop and livestock production in secondary school agriculture curriculum. Teachers are at the forefront in implementation of agriculture curriculum, to investigate their perception they were required to indicate whether they strongly agree, agree, disagree or strongly disagree to various statements pertaining to ITK. Their responses are as indicated below.

Table 6. Agriculture Teachers' Perceptions on ITK and its Inclusion in Secondary School Agriculture Curriculum

Statements about ITK	SA %	A %	U %	D %	SD %	Total %
Control of crop pests using ITK methods is cheap	35%	58%	7%	0%	0%	100%
Control of livestock parasites using ITK methods is cheap	30%	53%	13%	5%	0%	100%
Indigenous technical knowledge and practices are reliable	12%	49%	25%	18%	3%	100%
Inclusion of ITK in secondary school curriculum will enrich students with a wide range of knowledge	47%	49%	3%	1%	0%	100%
ITK is friendly and easy to use	34%	51%	10%	6%	0%	100%
ITK on crop production	31%	48%	10%	10%	1%	100%

should be included in agriculture curriculum						
ITK on Livestock production should be included in agriculture curriculum	27%	47%	14%	11%	1%	100%

The findings on table 6 show that more than 93% of the respondents agreed that the use of ITK practices in both crop and livestock production is cheap, reliable and easy to use. Research shows that despite the increased influence of modernization and economic changes, a few traditional agricultural management and knowledge systems are predominant in many African countries (Akullo et al., 2007). Many small scale farmers in Kenya utilize Indigenous Knowledge Systems because it is cheaper as compared to modern techniques, they are also available locally and are easy to adapt and use (chebutuk & Rotich, 2008). Chandola et al. (2011) also reports that Indigenous practices of pest management are effective without having a deteriorating effect on the environment; they also indicate that the practice is quite cheap. Further; Emeagwali (2003) in his research observes that Indigenous Knowledge Systems is cost effective and relevant and therefore it should be noted that the basic component of any country's' knowledge system is its indigenous knowledge.

According to the data collected majority of the respondents (96%) agreed that ITK enriches the learners with a wide range of agricultural knowledge. This is in agreement with Msila, (2007) who argues that there is great wealth of knowledge in the local Indigenous Knowledge System.

The findings on table 6 indicates that 79 % of the respondents agreed that indigenous technical knowledge in crop production should be included in secondary school curriculum while 74 percent of the respondents agreed that indigenous technical knowledge on Livestock production should be included in secondary school curriculum. Reid et al. (2004) indicates that Indigenous knowledge goes hand in hand with old age and the loss of the accumulated knowledge through death hinders the perpetuation and passing on of the knowledge from generation to generation. Such sentiment strongly supports the inclusion of ITK in the Kenyan secondary school agriculture curriculum in order to maintain its continuity from one generation

to another. The result on table 6 shows that 82% of the teachers were positive about the different statements concerning ITK.

4.6 Teachers' Perceptions about Including ITK in Agriculture Curriculum for Secondary Schools

Respondents were required to give (with a reason) their opinions on the inclusion of ITK on crop and livestock production in secondary school agriculture curriculum. 82 percent of the respondents were of the perception that ITK in both crop and livestock production should be included in secondary school curriculum while 18 percent of the respondents were of the perception that ITK should not be included in secondary school agriculture curriculum.

Their responses are indicated in the table below.

Table 7. Teachers, responses on their perceptions on the Inclusion of ITK on crop and Livestock production in Secondary school Curriculum

Teachers, responses on Inclusion of ITK in Secondary school Curriculum	**Frequency**	**Percentage**
Teachers' who agreed that ITK should be included in the curriculum	68	82
Teachers' who did not agree on the inclusion of ITK in secondary school curriculum	15	18
Total	**83**	**100**

The practice of including ITK into secondary school agriculture curriculum is a way of empowering the indigenous people through the learners and the future generation since ITK is a resource that provides a firm foundation of sustainable and sound approaches to agriculture. Despite the fact that Indigenous Africans had their own sustainable agricultural practices before

colonization, Western agricultural practices still dominates the school agriculture curriculum in Kenya (Mapara, 2009). ITK provides an opportunity to bring forth an inclusive approach to education (Msila, 2016) and thus it is important that ITK be recognized and valued in the level of the school curriculum and that it should be incorporated in teaching and learning process (Semali & Kinchebe, 1999). From the research, majority of the teachers (82%) are of the opinion that ITK on crop and livestock production should be included in secondary school agriculture curriculum. Agriculture teachers' opinion on the inclusion of ITK in secondary school agriculture curriculum is very relevant since they are the implementers. Shizha (2006) reports that the top down approach in which the curriculum is designed and implemented seems to underrate teachers' role in curriculum planning and implementation. Shava (2016) also indicates that knowledge dissemination to learners through the curriculum shapes and guides the practice, perceptions, and value system of the learners' lifetimes long after it has been taught and thus education stakeholders (teachers inclusive) should be concerned about the kind of knowledge learners receive, its value and relevance to their contextual challenges .When teachers fail to take account of their students' diverse cultures, the students often fail to learn (Hewson, 2015). Therefore it is very clear that time has come to rethink the local content of subject area and by changing the curriculum in order to accommodate agricultural indigenous technical knowledge.

The negative attitudinal view of some teachers towards ITK (n=18%) that the practices are out of date and unreliable is also amplified by Sibanda (1998) who observed that many young people may view Indigenous knowledge as being obsolete and out of date when compared with Western Agricultural practices. Ogunyi (2007) in his research discovered that teachers opposes indigenization and contextualization of Euro-centric curriculum due to the historical and traditional preparation of teachers who were schooled in western curriculum and hence are more familiar with that world view than that of indigenous knowledge. 18% of the teachers were of the opinion that ITK should not be included in secondary school agriculture curriculum because of such reasons as; the knowledge is out of date, new farming technologies should be invented, ITK methods are not reliable among other reasons. This study was therefore viable since the majority of the respondents agreed that there is ITK that could be integrated in teaching of Agriculture in secondary school curriculum.

CHAPTER FIVE

SUMMARYOF FINDINGS, CONCLUSIONS AND RECOMMENDATION

5.1 Introduction

The purpose of this study was to determine the perception of agriculture teachers on the inclusion ITK in secondary school agriculture curriculum. This chapter therefore, presents the summary of the findings, conclusions and the recommendations which were made basing on the objectives of the study. It concludes by indicating the suggested areas for further research.

5.2 Summary of the Findings

This section will give a brief summary of the findings on every objective of this study. The study focused on the following objectives: Investigating agriculture teachers' level of awareness on ITK pertaining to crop and livestock production; determining the views of agriculture teachers on the inclusion of ITK on livestock production in secondary school agriculture curriculum and lastly determining the views of Agriculture teachers on the inclusion of ITK on crop production in secondary school agriculture curriculum.

The study was based on constructivism learning theory. It adopted a cross-sectional research design and Questionnaires were used to collect data from the respondents. The sample population comprised 90 agriculture teachers of Njoro sub-county and finally, the data collected was analyzed using descriptive statistics.

i. Agriculture Teachers' level of Awareness on ITK pertaining to Crop Production

The respondents were asked to indicate their level of awareness on different ITK practices pertaining to crop production. The findings in table 4 indicate that 74% of the respondents had moderate to high level of ITK on what farmers observe as an indication of onset of rain. On storing healthy seedlings above fire place to preserve them for planting 74% of the respondents had moderate to high level of ITK on the practice. Also, 70% had moderate to high level of ITK on farmers' practice of storing seeds in the kitchen ceiling for proper drying before planting. In addition, majority of the respondents (93%) had moderate to high level of ITK on indigenous ways of selecting seeds for planting. Pertaining pest control practices, 74% of the respondents had moderate to high level of ITK on the use of ash on vegetables to control aphids. 64% of the respondents had moderate to high level of ITK on the indigenous practice of dusting granaries

with ash in order to control weevils. On the use of pepper and ashes to control maize stalk borer 13% had high level of ITK, 41% had moderate level of knowledge. On the other hand, 17% of the respondents had high level of ITK on the practice of controlling pests using *Mexican marigold* and *Lantana camara*, 24% had moderate knowledge, 35% had low level and 24% were not aware of the practice. Majority of the respondents (31%) had no knowledge on control of crop pests by intercropping crops with tobacco and 63% of the respondents had high level of knowledge on the use of scarecrows to control crop pests like birds.

Finally, on storage of crops majority of the respondents (83%) had high level of knowledge on winnowing of crops to remove thrush before storage. On the use of basket granaries which are well aerated to prevent dumpy environment, 70% had moderate to high level of knowledge. Lastly, on planting systems, 41% of the respondents had high level of knowledge on the practice of soaking seeds in water overnight to bring forward germination date while 37% had moderate knowledge on the practice.

ii. Agriculture Teachers' Level of Awareness on ITK pertaining to Livestock Production Practices

The findings tabulated on table 5 indicate that 29% of the respondents had moderate to high level of knowledge on the use of traditional brew to control worms (parasites). Majority of the respondents (41%) had no knowledge on control of ticks by extracting blood from an animal that was heavily infested with ticks in order to harden its skin. On preservation of animal products, 79% of the respondents had moderate to high level of ITK on the use of calabash which is kept in cold places to preserve milk while 72% had moderate to high level of ITK on preservation of meat by smoking. Concerning preservation of meat using honey, 49% had moderate to high level of ITK on the practice.

In addition 59% of the respondents had moderate to high level of ITK on the use of fire place to hatch and brood chicks. On the other hand, majority of the respondents (75%) had moderate to high level of ITK on rearing of hatched chicks near fireplace for sometimes. On the use of aloe vera juice to control coccidiosis, most of the respondents (84%) were well conversant with the practice.

Pertaining to selection and breeding, more than half of the respondents (64%) had knowledge on choosing of a bull from a highly productive mother in order to get a good quality

calf. Lastly, on borrowing of a bull for breeding from another village, 85% of the respondents had moderate to high level of ITK on the practice.

iii. Agriculture Teachers' Perceptions on different Statements about Indigenous Technical Knowledge

Findings indicate that 35% of the respondents strongly agreed that control of crop pests using ITK is cheaper, 58% agreed and 7% were neutral on the statement. 29% of the respondents strongly agreed with the statement that control of livestock parasites using ITK method is cheaper, 53% agreed, 13% were undecided while 5% disagreed. On ITK being reliable, 12% of the respondents strongly agreed with the statement, 42% agreed, 25% were undecided while only 3% strongly disagreed.

In addition, 47% of the respondents strongly agreed that ITK enriches students with a wide range of knowledge, 49% agreed, 3% were undecided while 1% disagreed. 34% of the respondents strongly agreed that ITK is easy to use, 50% agreed with the statement, 10% were undecided and 6% disagreed. Also 31% of the respondents strongly agreed that ITK on crop production should be included in secondary school agriculture curriculum, 48% agreed with the statement, 10% were undecided and 10% disagreed with the statement. Lastly on the statement that ITK on livestock production should be included in secondary school agriculture curriculum, 27% strongly agreed, 47% agreed, 14% were undecided, 11% disagreed while 1% strongly disagreed with the statement.

iv. Teachers' Perceptions on the Inclusion of ITK on Crop and Livestock Production in Secondary School Curriculum

Majority of the agriculture teachers (82%) were of the perception that ITK on both crop and livestock production should be included in secondary school agriculture curriculum because of such reasons as: inclusion will widen the learners' scope of knowledge, ITK gives learners affordable options to problems that affect agricultural production, Its inclusion will equip learners with more knowledge on crop and livestock production which will enhance agricultural production, to preserve ITK practices which are cheaper and environmentally friendly, to enhance teaching and learning, to enhance transfer of indigenous agricultural practices from one generation to another, to equip learners with diversified crop and livestock production practices, to help learners correlate their traditional farming practices and modern farming hence boost positivity towards farming, to equip learners with appropriate skills to venture in agriculture, ITK encourages the use of locally available resources which could be easily acquired /accessed by farmers, ITK encourages organic farming, to enable learners to relate what

they are taught with what they practice in real life, to acquaint the new generation with traditional methods of crop and livestock production practices lastly ITK entails practical activities which can improve learners' psychomotor skill.

The few teachers who were of the perception that ITK should not be included in secondary school agriculture curriculum had the following reasons: agriculture curriculum is already too wide to integrate ITK, agricultural indigenous practices have been overtaken by time and events, agricultural indigenous practices are time consuming and unreliable, learners can learn the practices conventionally or informally, ITK is no longer important because of the advancing technology and lastly the current small sizes of farms calls for modern technology in order to boost production.

5.3 Conclusions

Current literature highlights how ITK have been greatly neglected at the curriculum implementation level despite curriculum Policy documents providing for it (Gumbo, 2016). Motivated by believe that agriculture teachers have a significant influence on the agriculture curriculum implementation, this study focused on investigating the perceptions of agriculture teachers on the inclusion of ITK in secondary school agriculture curriculum. From the study findings the following conclusions were drawn:

i) Half of the agriculture teachers (50%) were aware of Indigenous Technical Knowledge applied in crop production.

ii) Most of the agriculture teachers (86%) were aware of Indigenous Technical Knowledge applied in livestock production.

iii) A greater percentage of the agriculture teachers (82%) were of the perception that indigenous technical knowledge on both crop and livestock production would be useful if it's included in secondary school agriculture curriculum. This implies, perhaps, ITK on crop and livestock production should be included in secondary school agriculture curriculum.

5.4 Implication of the Study

This study was able to explore teachers' perception on the inclusion of Indigenous Technical Knowledge on both crop and Livestock production in secondary school agriculture curriculum; this was done by use of questionnaires. The study was able to determine teachers' level of awareness on various ITK practices on crop and livestock production as well as their perceptions towards various statements pertaining ITK and its inclusion to secondary school curriculum.

The data collected indicates that more than 65% of the teachers were conversant with different indigenous technical knowledge on crop production while more than 70% of the respondents were conversant with ITK on livestock production except for the control of tick by extracting blood where only 51% were aware of the practice. This implies that majority of the teachers were well conversant with the indigenous practices that were provided by the research instrument. Most of the teachers (77%) responded positively about ITK statements that were provided; further, 82% of the teachers were of the perception that Indigenous technical knowledge on both crop and livestock production should be included in secondary school agriculture curriculum. This shows that teachers are positive about ITK and its inclusion in secondary school curriculum; it seems if the knowledge is included in the curriculum, teachers will be more than willing and ready to disseminate the knowledge to learners since they are already conversant with it. In that case the curriculum developers should rethink revising the secondary school agriculture curriculum to include Indigenous Technical Knowledge. This also implies that further research should be carried out in this area to find out the ideas and practices related to indigenous technical knowledge that could be beneficial to learners, in specific geographical and social contexts.

Despite the provision for integration of ITK in curriculum policy documents, it appears that it is still not clear to teacher educators what Indigenous Technical Knowledge practices should be taught, where and when it should be taught. There appears to be no underpinning pedagogical structure to curriculum development that includes Indigenous Technical Knowledge in agriculture curriculum, as such, it would be probably helpful for teacher educators to consider including or finding a place of integrating Indigenous Technical Knowledge in school curriculum in the agriculture teacher training programs.

5.5 Recommendations

This study was able to explore the perception of agriculture teachers on the inclusion of ITK on both crop and Livestock production in secondary school agriculture curriculum using a questionnaire.

Despite the fact that there is wide range of agricultural indigenous technical knowledge on both crop and livestock production, it has not been included in secondary school agriculture curriculum, yet if included, it could enrich learners with a wide range of agricultural knowledge.. The study therefore recommends the following:

i. Curriculum developers should research on ideas and practices related to indigenous technical knowledge on crop and livestock production that could be included in secondary school agriculture curriculum.
ii. Curriculum should be continuously revised from to time to keep up-to-date for relevancy and also to keep up-to-date with prevailing situations. Curriculum developers should rethink and consider inclusion of Indigenous Technical Knowledge about crop and livestock production topics into the secondary school agriculture curriculum.
iii. Curriculum developers should also develop learning materials which integrates Indigenous Technical Knowledge on both crop and livestock production.

5.6 Recommendations for Further Research

This study is not fully exhaustive and in order to achieve greater understanding, the researcher recommends the following for further research:

i) Similar research to be done in other counties of Kenya to determine the perception of Agriculture teachers in other counties on the inclusion of ITK in secondary school agriculture curriculum.
ii) Further research should be carried out in this area to find out how indigenous technical knowledge could benefit learners in specific geographical and social contexts.

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APPENDICES

APPENDIX A: QUESTIONNAIRE FOR THE TEACHER

My name is Monica Samoei, a student from Egerton University carrying out a research on perceptions of Agriculture Teachers on inclusion of indigenous technical knowledge (ITK) in the secondary school agriculture curriculum in Njoro sub-county. This questionnaire seeks to determine your perception on the inclusion of indigenous technical knowledge on crop production and livestock production in secondary school agriculture curriculum. Kindly complete the questionnaire as accurately as you can, the information provided will be used for academic purpose only and will be treated with the confidentiality it deserves. Thank you for your cooperation.

SECTION A: Background Information

Kindly tick in the brackets as appropriate

1. Gender Male [ ] Female [ ]

2. Teaching experience.

   a) 0-5 years [ ]

   b) 6-10 years [ ]

   c) 11-15 years [ ]

   d) 16-20 years [ ]

   e) Above 20 years [ ]

3. Teacher qualification

   a) Diploma in Agricultural education and extension [ ]

   b) Bachelor of science in Agricultural education and extension [ ]

   c) Masters of science in Agricultural education and extension [ ]

   d) Others (specify)……

SECTION B

4. Kindly indicate your level of familiarity with the ITK on crop production indicated in the table below by ticking (√) your choice in the column.

Examples of ITK practices in crop production	**Level of ITK on crop production**			
	High	Moderate	Low	None
Timing cultivation -Observing sprouting and flowering of certain plants which indicate onset of rain				
Seed preparation -Storing healthy seedlings above fire place to preserve them for planting				
-Storing seeds in the kitchen ceiling for proper drying of the seeds				
Seed selection -selecting seeds (e.g. harvested maize seeds, beans peas etc.) of good size and shape				
Pest management and control -use of ash on vegetables to control aphids				
-dusting granaries with ashes to control weevils.				
-use of pepper and ashes to control maize stalk borer.				
-use of *Mexican marigold* and *Lantana camara* to control storage pests				
-intercropping crops with tobacco in order to control crop pest				

-use of scarecrows to control crop pests like birds				
Storage of crops -Winnowing crops to remove thrush before storage				
-use of basket granaries which are well aerated to prevent dumpy environment.				
Planting systems -Soaking seeds in water overnight to bring forward germination date.				

5. Kindly indicate whether you are familiar with the ITK on Livestock production indicated in the following Table by ticking (√) your choice in the column.

ITK in Livestock Production	**Level of ITK on Livestock Production**			
	High	Moderate	Low	None
Control of parasites -use of traditional brew to control worms				
-Controlling ticks by extracting blood from an animal heavily infested with ticks in order to make the skin hard				
Preservation of animal products -Use of guard/calabash kept in cold places to preserve milk				
-Preserving meat by smoking				
-Keeping boiled meat in honey containers for long storage				
Hatching and rearing of chicks -Use of fire place to hatch and brood chicks				
Control of diseases				

-Rearing of hatched chicks near the fire place for sometimes (fire place provides warmth).				
-extracting juice from aloe vera plant and adding to water to control coccidiosis in poultry.				
Selection and control of breeding -choosing of a bull from a highly productive mother in order to get a good quality calf				
-borrowing a bull from another village for breeding.				

6. Below are the statements about agricultural indigenous knowledge. Use the key/scale given to tick (√) against your level of agreement to the statements.

(**SA=Strongly Agree, A=Agree, U= Undecided, D=Disagree, SD= Strongly Disagree)**

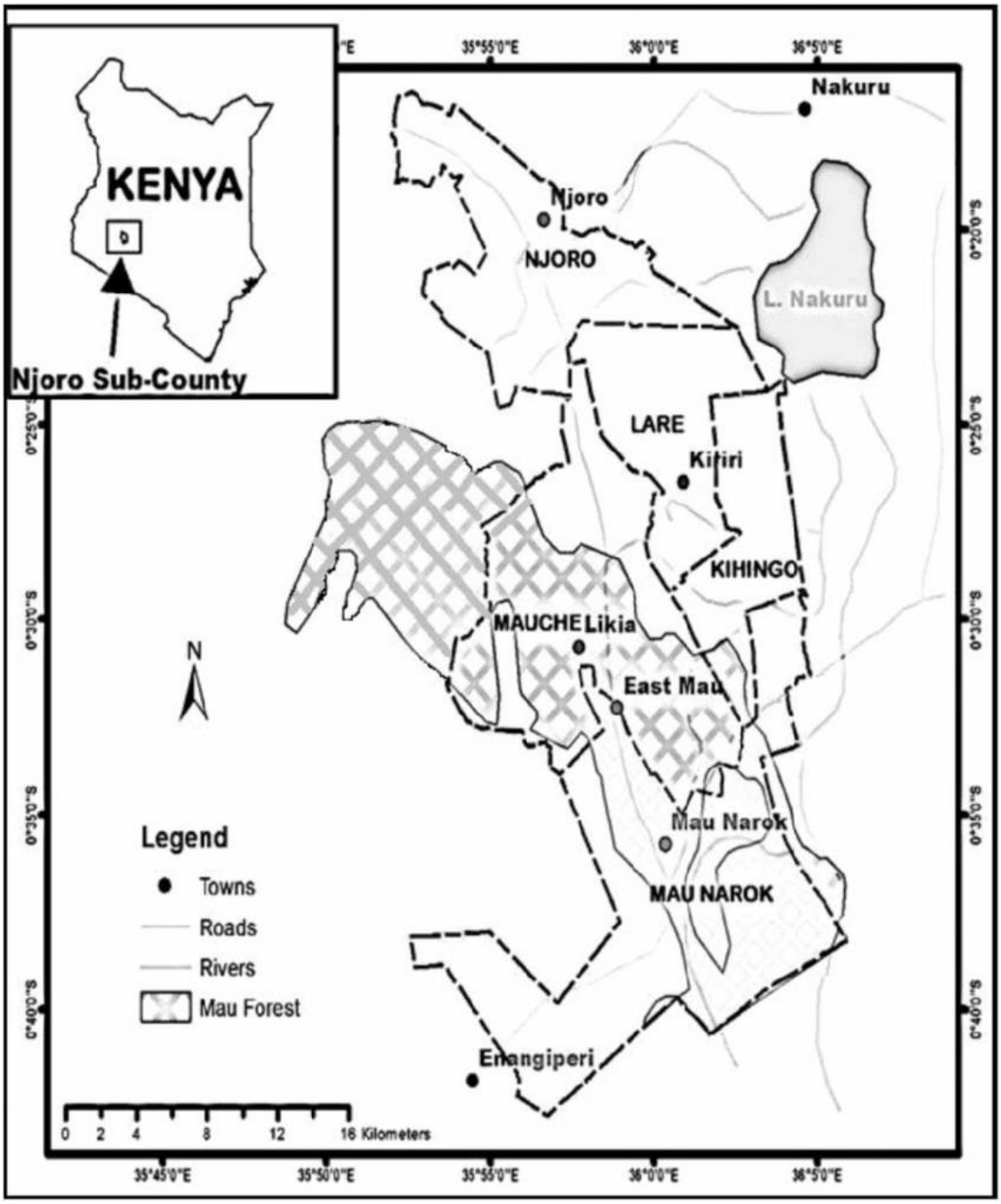
Statements about ITK	**SA**	A	U	D	SD
Control of crop pests using ITK methods is cheap					
Control of livestock parasites using ITK methods is cheap					
Indigenous technical knowledge and practices are reliable					
Inclusion of ITK in secondary school curriculum will enrich students with a wide range of knowledge					
ITK is friendly and easy to use					
ITK on crop production should be included in agriculture curriculum					
ITK on livestock production should be included in agriculture curriculum					

7. Please give your own opinion about including ITK in the agriculture curriculum for secondary schools.

THE END

Thank You for your co-operation and participation..

APPENDIX B: MAP OF NJORO SUB- COUNTY



Source: http://www.maphill.com/kealleynya/rift-v/baringo

APPENDIX C: RESEARCH AUTHORIZATION PERMIT

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **439938**

Date of Issue: **26/October/2020**

RESEARCH LICENSE

This is to Certify that Ms.. Monica samoei Chepngetich of Egerton University, has been licensed to conduct research in Nakuru on the topic: AGRICULTURE TEACHERS' PERCEPTIONS ON THE INCLUSION OF INDIGENOUS TECHNICAL KNOWLEDGE IN SECONDARY SCHOOL AGRICULTURE CURRICULUM, IN NJORO SUB-COUNTY, NAKURU COUNTY, KENYA for the period ending : 26/October/2021.

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APPENDIX D: OUTPUT OF THE ANALYSED DATA

Demographic characteristics

Gender of the Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	46	55.4	55.4	55.4
	Female	37	44.6	44.6	100.0
	Total	83	100.0	100.0	

Teaching Experience of the Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-5 years	40	48.2	48.2	48.2
	11-15 years	11	13.3	13.3	61.4
	16-20 years	3	3.6	3.6	65.1
	6-10 years	17	20.5	20.5	85.5
	Above 20 years	12	14.5	14.5	100.0
	Total	83	100.0	100.0	

Teachers' Academic Qualification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-5 years	24	28.9	28.9	28.9
	11-15 years	5	6.0	6.0	34.9
	16-20 years	2	2.4	2.4	37.3
	6-10 years	52	62.7	62.7	100.0
	Total	83	100.0	100.0	

Teachers' Conversance with ITK on Crop Production Practices

Observing sprouting and flowering of certain plants which indicate onset of rain

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	12	14.5	14.5	14.5
	Low	19	22.9	22.9	37.3
	Moderate	49	59.0	59.0	96.4
	None	3	3.6	3.6	100.0
	Total	83	100.0	100.0	

Storing healthy seedlings above fire place to preserve them for planting

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	26	31.3	31.3	31.3
	Low	12	14.5	14.5	45.8
	Moderate	36	43.4	43.4	89.2
	None	9	10.8	10.8	100.0
	Total	83	100.0	100.0	

Storing seeds in the kitchen ceiling for proper drying of the seeds

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	36	43.4	43.4	43.4
	Low	19	22.9	22.9	66.3
	Moderate	22	26.5	26.5	92.8
	None	6	7.2	7.2	100.0
	Total	83	100.0	100.0	

Selecting seeds (e.g. harvested maize seeds, beans peas etc.) of good size and

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	50	60.2	60.2	60.2
	Low	6	7.2	7.2	67.5
	Moderate	27	32.5	32.5	100.0
	Total	83	100.0	100.0	

Use of ash on vegetables to control aphids

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	29	34.9	34.9	34.9
	Low	17	20.5	20.5	55.4
	Moderate	32	38.6	38.6	94.0
	None	5	6.0	6.0	100.0
	Total	83	100.0	100.0	

Dusting granaries with ashes to control weevils.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	12	14.5	14.5	14.5
	Low	24	28.9	28.9	43.4
	Moderate	41	49.4	49.4	92.8
	None	6	7.2	7.2	100.0
	Total	83	100.0	100.0	

Use of pepper and ashes to control maize stalk borer.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	11	13.3	13.3	13.3
	Low	28	33.7	33.7	47.0
	Moderate	34	41.0	41.0	88.0
	None	10	12.0	12.0	100.0
	Total	83	100.0	100.0	

Use of Mexican marigold and Lantana camara to control storage pests

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	14	16.9	16.9	16.9
	Low	29	34.9	34.9	51.8
	Moderate	20	24.1	24.1	75.9
	None	20	24.1	24.1	100.0
	Total	83	100.0	100.0	

Intercropping crops with tobacco in order to control crop pest

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	12	14.5	14.5	14.5
	Low	23	27.7	27.7	42.2
	Moderate	22	26.5	26.5	68.7
	None	26	31.3	31.3	100.0
	Total	83	100.0	100.0	

Use of scarecrows to control crop pests like birds

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	52	62.7	62.7	62.7
	Low	5	6.0	6.0	68.7
	Moderate	25	30.1	30.1	98.8
	None	1	1.2	1.2	100.0
	Total	83	100.0	100.0	

Winnowing crops to remove thrush before storage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	69	83.1	83.1	83.1
	Low	1	1.2	1.2	84.3
	Moderate	13	15.7	15.7	100.0
	Total	83	100.0	100.0	

Use of basket granaries which are well aerated to prevent dumpy environment.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	25	30.1	30.1	30.1
	Low	16	19.3	19.3	49.4
	Moderate	33	39.8	39.8	89.2
	None	9	10.8	10.8	100.0
	Total	83	100.0	100.0	

Soaking seeds in water overnight to bring forward germination date.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	34	41.0	41.0	41.0
	Low	15	18.1	18.1	59.0
	Moderate	31	37.3	37.3	96.4
	None	3	3.6	3.6	100.0
	Total	83	100.0	100.0	

Teachers' conversance with ITK on livestock production practices.

Use of traditional brew to control worms

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	6	7.2	7.2	7.2
	Low	38	45.8	45.8	53.0
	Moderate	18	21.7	21.7	74.7
	None	21	25.3	25.3	100.0
	Total	83	100.0	100.0	

Controlling ticks by extracting blood from an animal heavily infested with ticks in order to make the skin hard

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	7	8.4	8.4	8.4
	Low	26	31.3	31.3	39.8
	Moderate	9	10.8	10.8	50.6
	None	41	49.4	49.4	100.0
	Total	83	100.0	100.0	

Use of guard/calabash kept in cold places to preserve milk

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	35	42.2	42.2	42.2
	Low	15	18.1	18.1	60.2
	Moderate	31	37.3	37.3	97.6
	None	2	2.4	2.4	100.0
	Total	83	100.0	100.0	

Preserving meat by smoking

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	35	42.2	42.2	42.2
	Low	18	21.7	21.7	63.9
	Moderate	25	30.1	30.1	94.0
	None	5	6.0	6.0	100.0
	Total	83	100.0	100.0	

Keeping boiled meat in honey containers for long storage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	14	16.9	16.9	16.9
	Low	21	25.3	25.3	42.2
	Moderate	26	31.3	31.3	73.5
	None	22	26.5	26.5	100.0
	Total	83	100.0	100.0	

Use of fire place to hatch and brood chicks

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	30	36.1	36.1	36.1
	Low	25	30.1	30.1	66.3
	Moderate	19	22.9	22.9	89.2
	None	9	10.8	10.8	100.0
	Total	83	100.0	100.0	

Rearing of hatched chicks near the fire place for sometimes (fire place provides warmth).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	34	41.0	41.0	41.0
	Low	17	20.5	20.5	61.4
	Moderate	28	33.7	33.7	95.2
	None	4	4.8	4.8	100.0

	Total	83	100.0	100.0	

Extracting juice from aloe vera plant and adding to water to control coccidiosis in poultry

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	42	50.6	50.6	50.6
	Low	8	9.6	9.6	60.2
	Moderate	28	33.7	33.7	94.0
	None	5	6.0	6.0	100.0
	Total	83	100.0	100.0	

Choosing of a bull from a highly productive mother in order to get a good quality calf

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	53	63.9	63.9	63.9
	Low	6	7.2	7.2	71.1
	Moderate	24	28.9	28.9	100.0
	Total	83	100.0	100.0	

Borrowing a bull from another village for breeding.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	48	57.8	57.8	57.8
	Low	8	9.6	9.6	67.5
	Moderate	23	27.7	27.7	95.2
	None	4	4.8	4.8	100.0
	Total	83	100.0	100.0	

Teachers' Agriculture Teachers' Perception on ITK and its inclusion in secondary school Agriculture Curriculum

Control of crop pests using ITK methods is cheap

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	48	57.8	57.8	57.8
	Strongly Agree	29	34.9	34.9	92.8
	Undecided	6	7.2	7.2	100.0
	Total	83	100.0	100.0	

Control of livestock parasites using ITK methods is cheap

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	44	53.0	53.0	53.0
	Disagree	4	4.8	4.8	57.8
	Strongly Agree	24	28.9	28.9	86.7
	Undecided	11	13.3	13.3	100.0
	Total	83	100.0	100.0	

Indigenous technical knowledge and practices are reliable

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	35	42.2	42.2	42.2
	Disagree	15	18.1	18.1	60.2
	Strongly Agree	10	12.0	12.0	72.3
	Strongly Disagree	2	2.4	2.4	74.7
	Undecided	21	25.3	25.3	100.0
	Total	83	100.0	100.0	

Inclusion of ITK in secondary school curriculum will enrich students with a wide range of knowledge

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	41	49.4	49.4	49.4
	Disagree	1	1.2	1.2	50.6
	Strongly Agree	39	47.0	47.0	97.6

	Undecided	2	2.4	2.4	100.0
	Total	83	100.0	100.0	

ITK is friendly and easy to use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	42	50.6	50.6	50.6
	Disagree	5	6.0	6.0	56.6
	Strongly Agree	28	33.7	33.7	90.4
	Undecided	8	9.6	9.6	100.0
	Total	83	100.0	100.0	

ITK on crop production should be included in agriculture curriculum

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	40	48.2	48.2	48.2
	Disagree	8	9.6	9.6	57.8
	Strongly Agree	26	31.3	31.3	89.2
	Strongly Disagree	1	1.2	1.2	90.4
	Undecided	8	9.6	9.6	100.0
	Total	83	100.0	100.0	

ITK on Livestock production should be included in agriculture curriculum

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	39	47.0	47.0	47.0
	Disagree	9	10.8	10.8	57.8
	Strongly Agree	22	26.5	26.5	84.3
	Strongly Disagree	1	1.2	1.2	85.5
	Undecided	12	14.5	14.5	100.0
	Total	83	100.0	100.0	

APPENDIX E: ABSTRACT PAGE OF THE PUBLISHED PAPER

Agriculture Teachers' Perceptions on the Inclusion of Indigenous Technical Knowledge in Secondary School Agriculture Curriculum, Nakuru County, Kenya

Monica Chepngetich Samoei[1]

[1] Egerton University

Abstract

Purpose: This paper explores agriculture teachers' perceptions of the inclusion of indigenous technical knowledge in secondary school curriculum. Design/methodology/approach: This study used a cross-sectional research design to determine the perceptions of agriculture teachers on the inclusion of indigenous technical knowledge in secondary school agriculture curriculum. Findings: The findings of the study indicate that more than 50% of the agriculture teachers were aware of the different indigenous practices that are carried out in both crop and livestock production, also more than 50% of the teachers agreed that ITK is; cheap, reliable, enriches students with a wide range of knowledge, is friendly and easy to use. 82% of the teachers agreed that ITK should be included in secondary school agriculture curriculum because of its values, 18% were of the opinion that agriculture curriculum is already bulky and the knowledge is outdated hence it should not be included in the curriculum. Practical implications: This study highlights the essence of including indigenous technical knowledge in secondary school curriculum, little of the said knowledge has been taken into consideration by the curriculum developers yet the knowledge can equip the learners with diversified agricultural knowledge which is crucial in crop and livestock production, the knowledge is cheap and readily available. Theoretical implications: The results of the study reveal that most of the teachers were positive about taking ITK into consideration while teaching agriculture. Based on the values of ITK the researcher suggests to curriculum developers to research on ideas and practices related to ITK that could be beneficial to learners and develop learning materials to suit their needs. Originality/value: There are limited studies that highlight the value of indigenous knowledge and its inclusion in secondary school agriculture curriculum.

Keywords: Perceptions, Indigenous Technical Knowledge, Agriculture Curriculum

1. Introduction

Indigenous technical knowledge (ITK) refers to the local knowledge that is unique to a given culture or society and is acquired by local people through the accumulation of experiences, informal experiments, and intimate understanding of the environment in a given culture. These are practical, personal and contextual units which cannot be detached from individuals, their community or the environment (Chikaire, Ejiogu-Okereke, Ihenacho, Oguegbuchulam, Obi & Osugwa 2012). Agricultural indigenous technical knowledge includes but is not limited