DETERMINING INSTITUTIONAL CAPACITY OF VOCATIONAL TRAINING CENTERS TO PROMOTE AGRICULTURAL MECHANIZATION AMONG SMALL HOLDER FARMERS IN KISUMU COUNTY, KENYA

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A Thesis Submitted to the Graduate School in Partial Fulfillment of the Requirements for the Master of Science Degree in Agricultural Education of Egerton University

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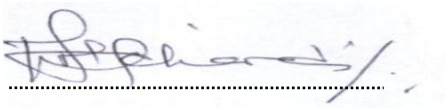
DECLARATION AND RECOMMENDATION

Declaration

This thesis is my original work and has not been submitted for the award of a degree or a diploma in this or any other University and where other peoples' work are cited, they are referenced.

Signature  Date: 14/3/2024

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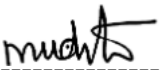
Signature  Date: 15/3/2024

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DEDICATION

This thesis is dedicated to my family whose love, patience, encouragement, advice, facilitation, understanding and above all, Prayers, enabled me to complete this thesis.

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ABSTRACT

The global emergence of vocational education worldwide remains a strategy of creating relevance in education and Kenya is not excluded. Despite the benefits offered by vocational education including skills about agricultural mechanization, Small Holder Farmers are yet to benefit from vocational training centers with regard to agricultural mechanization. The purpose of this study was Determining Institutional Capacity in Vocational Training Centers to promote agricultural mechanization among Small Holder Farmers (SHF) in Kisumu County. The study objectives examined were courses in curriculum, qualifications of tutors, facilities in training centres, equipment owned by SHF and outreach services by public Vocational Training Centers (VTC). Target population consisted of 149,983 SHF in the County, 23 VTC principals selected by census and 109 heads of departments (HoDs) selected purposively. The accessible population were 138 SHF made up of 3 male and 3 female (to balance gender viewpoint), selected within radius of 5 kilometers from a VTC and who had demonstrated interest in training and agricultural mechanization. The Sample size was 110 SHF, 21 principals and 21 HoDs respondents. Piloting involved 40 participants, comprising of 30 SHF who are not among accessible population, 5 principals and 5 HoDs purposively selected from non-public VTCs to prevent contamination. Cronbach's alpha coefficient was used to calculate the data. The reliability coefficient of instrument was 0.713. The data collected was modified to improve their reliability. A coefficient of 0.70 was accepted as reliable. Interview guides for principals and Focus Group Discussion, facilities observation guides, questionnaires for HoDs were used to collect data. Descriptive statistics of mean, frequency and percentages were applied to analyze data. Findings can enable VTCs to empower SHF, get more facilities and to form income generating units. Study established that VTCs curriculum offer fourteen courses that are related to promotion of agricultural mechanisation. Findings also established that qualifications in terms of highest level of training, professional qualification, competencies, experience of tutors was relevant. It also determined that hand tools, equipment, machinery and physical facilities in VTCs were relevant but inadequate, that SHF used hand tools for manual labour whereas electricity was the most available facility while wheelbarrows, petrol pumps, chicken drinkers and knapsacks were the most available equipment. Finally, study established that outreach and awareness of services offered by VTCs is very minimal among SHF.

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LIST OF ABBREVIATIONS AND ACRONYMS

ATVET	Agricultural Technical Vocational Education and Training
AU	African Union
BTVET	Business Technical Vocational Education Training
CAADP	Comprehensive Africa Agriculture Development Programme
CBC	Competency Based Curriculum
CDACC	Curriculum Development Accreditation and Certification Council
CDCP	Centers for Disease Control and Prevention,
DfID	Department for International Development, United Kingdom
DFWED	Division of Foodborne, Waterborne, and Environmental Diseases
ESSP	Education Sector Strategy Plan
FAO	Food and Agriculture Organization of the United Nations
FARA	Forum for Agricultural Research in Africa
GIZ	German Society for International Cooperation (Deutsche Gesellschaft für internationale Zusammenarbeit)
ILO	International Labor Organization
KES	Kenya Shillings
KNQF	Kenya National Qualifications Framework (Act, 2014)
NCEZID	National Center for Emerging and Zoonotic Infectious Diseases
NEPAD	New Partnership for Africa's Development
NORAD	Norwegian Agency for Development Cooperation
OECD	Organisation for economic Cooperation and Development
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
SDC	Swiss Development Cooperation
SPSS	Statistical Package for the Social Sciences
SHF	Small Holder Farmer
TVET	Technical and Vocational Education and Training
TVETA	Technical and Vocational Education and Training Authority
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
VTC	Vocational Training
WB	World Bank

CHAPTER ONE
INTRODUCTION

1.1. Background of the Study

Agricultural Education is the educational process involving, in addition to general education, the study of technologies and related sciences and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in agriculture (Jones, 2013). Topics in Agricultural Education (AE) are production, processing and occupations related to the mechanization and maintenance of agricultural machinery among others. However young people are not interested in agriculture because of lack of appropriate technology (White, 2012). Attracting adults and youth to agriculture can be achieved through Agricultural Education in Technical and Vocational Education and Training (TVET) institutions. Leavy (2014) argues that agriculture can be more appealing to youth if it is modernized.

Historically, Agricultural Education provided static skills for agricultural systems that were mostly disconnected from more dynamic sectors. Over the past ten years, however, there has been growing emphasis on agricultural value chains to stimulate economic growth (Maguire et al, 2013). There is also general consensus that the benefits of TVET transcend economic boundaries and influences individuals, society social and environmental facets (Majumdar, 2016). It can also influence AE skill sets.

In the United States of America, according to Wit et al. (2014), through agricultural education courses that integrate curriculum with hands-on learning, students are more apt to cultivate skills that result in positive attitudes for success. The AE institutions employ theory and practical instruction and also link their curricula to workforce and community needs like in Puerto Rico (Roberts, 2016). In the year 2013 the United Nations International Center for Technical Vocational Education and Training – United Nations Educational, Scientific and Cultural Organization (UNICTVET-UNESCO) observed that there is need for training institutions' capacity building on technology in preparation for building youth capacity in agriculture through TVET.

In Nigeria, Ayodele et al. (2023) observes that if the right and appropriate curriculum, equipment and manpower are in place, then Agricultural Education and Training (AET) will occupy its right place in reducing poverty and hunger.

The Kenya Vision 2030 (2008), Kenya Agricultural Development Policy (KADP) and Kenya Agricultural Sector Development Strategy (KASDS) acts of parliament of the year 2010 and 2013 respectively, aimed to raise technical capabilities and innovation in Vocational Training Centres (VTC), build human resource base through life long training and education and to establish new TVET institutions as well as enhance closer collaboration between farmers, industry and training institutions. The Kenya Agricultural Sector Development Strategy (KASDS, 2010), proposed the development of an effective human resource for agricultural training and skills development and investment in Agricultural Education and Extension (AEE). It's against this background of the government's determination to involve VTCs and other TVET institutions in capacity building that inspired this study. According to Nyerere (2009), Kenya can reorient itself towards development, using the institutional capacity in VTCs to empower adults and the youth through Agricultural Education curriculum.

Sims et al, (2015) described one aspect of Agricultural Education, namely, Agricultural Mechanization, as the application of mechanical and mechatronics technology in farming to increase the productivity beyond the capacity of human labour by use of tractors, animal and human-powered implements, combustion engines, electric motors, solar power and other methods of energy conversion. Mechanization, the outstanding feature of agriculture has relieved the farmer much of the work. It includes irrigation systems, processing, transport and related technologies (Sims et al, 2015). Planes are used for planting, transport of perishable goods, firefighting and pest fumigation to control diseases. Packaging, processing and marketing are related activities that are impacted by mechanisation.

Mechanised methods of rapid freezing and dehydration have increased the markets for agricultural products. A well-equipped vocational training centre can empower farmers to cope with the technical demands in all these areas including ICT where radio and television transmit vital weather data and other information of interest to farmers. According to Food and Agriculture Organisation (FAO, 2019), modern agriculture depends heavily on engineering, technology and the expertise of agricultural scientists, educationist, extension experts, technologists and engineers.

In Sub-Saharan (SSA), Agricultural Mechanization still shows very low levels of adoption, adds FAO (2019). In total, only 10 percent of farm activities are done using tractor/machinery power. The rest rely on human and animal power. In Eastern and Southern Africa, the International Maize and Wheat Improvement Centre (CIMMYT) is involved in

mechanisation projects aiming to promote the adoption of two-wheel tractor technology in. By focussing on tasks which urgently need mechanisation, excess labour will be freed to be involved in other agricultural activities (Vergnani, 2013). Technical and Vocational Education and Training institutions, particularly VTCs can play crucial role to empower farmers in adoption of agricultural mechanisation but they must have the necessary institutional capacity.

According to Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) and Forum for Agricultural Research in Africa (FARA), reforming the institutional capacity of TVET is key to rural and agricultural development and would require a greater inclusion of agriculture-related courses in the curriculum. This approach according RUFORUM and FARA (2011) assumes that TVET delivery can be transformational in contributing to rural economic regeneration and should concentrate also on Agricultural Education. A publication for the year 2012 progress report of UNESCO, that is 'Initiative Education for All Youth and Skills: Putting Education to Work,' (UNESCO, 2012), reported that increased attention is being paid to TVET. World Bank Development report, 'Jobs,' also devotes a separate chapter to the issue of training or skills (WB, 2012). Two reasons may be cited for this recent shift towards TVET. First, the increase in unemployment as a result of the global financial crisis in 2008 among youths and also young adults have shifted the attention to TVET as a remedy to lack of appropriate skills in agricultural mechanisation that will make them relevant to employers especially the SHF who are the majority employers in Sub Saharan Africa.

Internationally, TVET with adequate institutional capacity is considered a force in the rapid success of many countries. In Malaysia, VTC graduates engaged in entrepreneurship upon graduating which led to low levels of unemployment and high growth of economy (Yasin, 2011). TVET has historically been a key agenda in UNESCO's mandate for education. Organizations like the WB have begun to place greater priority than has previously been the case on the skills agenda (WB, 2011). These organizations often provide overlapping but different rationales for investing in TVET. In the case of financial institutions such as the WB, policies to promote TVET are seen as investment in human capital and means for supporting economic growth, while UNESCO's interest in TVET is linked to a more human-centered view that it's a means for supporting sustainable development. The TVET is one of eight priority areas declared in the African Union (AU), 2006-2015 second decade of development in Education.

In Kenya, National Strategy for Agricultural Education was developed in 2014. With the support of German International Cooperation (GIZ), 'TVET project, reform measures of TVET in the agricultural sector,' was developed in cooperation with other stakeholders. Key results of the project is that, TVET be integrated in National Agriculture Investment Plans (NAIPs) and/or national training strategies in Kenya according to the New Partnership for Africa Development (NEPAD, 2019) report. Further, the overall goal and strategic objectives of the Kenya Government policy document known as 'Capacity Building Strategy for Agriculture Sector' (CBSAS, 2017), is to enhance institutional capacity for vocational education for practical training of agriculture value chain players by aligning the curriculum of agriculture institutions to the TVET and National Industrial Training Act (NITA) of 2013. More support that link TVET to capacity building in agriculture, farmers and agricultural mechanization is in the Kenyan constitution 6th Schedule, Section 15 (2a), which recognizes skills empowerment through training as key to development (CBSAS, 2017). The need for a structured approach to capacity building has also been underscored by the Intergovernmental Thematic Working Group (ITWG) on food Security, capacity building and extension.

1.2. Statement of the Problem

There are 23 equipped Vocational Training Centers (VTC) expected to provide skills for sustainable livelihoods and work in Kisumu County. They are intended to empower learners and farmers to acquire and adopt systems such as Agricultural Mechanization (AM) to improve their production and income. However, the level of AM is still low in Kisumu County. This could perhaps be due to lack of Institutional Capacity of the VTCs to promote agricultural mechanization among Small Holder Farmers (SHF). Even though studies that examine VTCs and promotion of AM have been conducted elsewhere, a search could not find literature that links Institutional Capacity of VTCs with promotion of AM among SHF in Kisumu County, hence reason for this study. Results from this study could fill the gap by informing the government to leverage on VTCs in promotion of AM among SHF. Factors of Institutional capacity examined in the study were curriculum, qualifications as human capital among tutors, relevance of facilities in VTCs, ownership of hand tools, equipment, machinery and facilities. Finally outreach services offered by VTCs to SHF was also examined in relation to promotion of agricultural mechanization.

1.3. Purpose of Study

Determining institutional capacity of Vocational Training Centers to promote agricultural mechanization among small holder farmers in Kisumu County, Kenya was the purpose of this study.

1.4 Objectives

This study was guided by the following objectives:

i. Assess courses in the curriculum of Vocational Training Centers that are related to promotion of Agricultural Mechanization among crop, livestock, and fishery among Small Holder Farmers in Kisumu County, Kenya.
ii. Examine the qualifications of tutors in Vocational Training Centers in relation to promotion of Agricultural Mechanization of crop, livestock and Fisheries in Kisumu County.
iii. Assess the relevance of Facilities in Vocational Training Centers in relation to promotion of Agricultural Mechanization among crop, livestock and Fish SHF in Kisumu County.
iv. Examine hand tools, equipment, machinery and facilities owned SHF in relation to agricultural mechanization in Kisumu County, Kenya.
v. Examine whether Vocational Training Centers offer outreach services that promote agricultural mechanization among crop, livestock, and fish farmers in Kisumu County, Kenya.

1.5 Research Questions

The study sought to provide answers to the following research questions:

i. Which courses in the curriculum of VTCs are related to promotion of agricultural mechanization among crop, livestock, and fish SHF?
ii. What qualifications of VTC tutors relate to promotion of agricultural mechanization among crop, livestock, and fish SHF?
iii. What facilities available in VTCs are relevant to promotion of agricultural mechanization of crop, livestock, and fish among SHF?
iv. Which hand tools, equipment, machinery and facilities owned by SHF, relate to agricultural mechanization?
v. Which outreach services are offered by Vocational Training Centers promote agricultural mechanization among crop, livestock, and fish SHF?

1.6 Significance of the Study

Small Holder Farmers can be empowered by utilizing the benefits of agricultural skills, technology, training, technical services and equipment deployed in Vocational Training Centers as informed by the findings. Results of this study may also inform deliberate, sustainable collaboration between Vocational Training Centers and Small Holder Farmers. Results can also be the basis to revamp Vocational Training Centres facilities, staff and to enroll more students. The outcomes can be used to create demand for fabrications, equipment, and consultancy once farmers become aware of the institutional capacity in VTCs and hence earn revenue for VTC income generating programs. Data about tutors' qualifications, facilities, equipment and machinery owned and required by Small Holder Farmers and training, outreach services, opportunities in Vocational Training Centres can help to address strength, weakness and the identified challenges. The National and County governments together with VTCs strategic partners may use these outcomes to promote Agricultural Mechanization through Vocational Training Centres to mitigate food shortage

1.7 Scope of the Study

Study was conducted in Kisumu County to find out Vocational Training Centres institutional capacity by identifying courses in the curriculum that promote agricultural mechanization of crop, livestock and fish farming. Human capital was also determined in terms of qualifications, numbers, competencies and experience. Scope also covered a report on adequacy of workshops, tools, equipment and machinery as well as tools, equipment, machinery and physical facilities owned by Small Holder Farmer and outreach services by Vocational Training Centres to Small Holder Farmers in promotion of agricultural mechanization.

1.8 Limitations of the Study

According to Kerlinger (1993), limitations refer to the constraints that the researcher has no control over. The study faced the following limitation: Data was collected using self-administered questionnaires which sometimes elicit answers which the respondent feel will please the researcher

1.9 Assumption of the Study

The following assumption guided the study:

That Principals, HoD's and Small Holder Farmers had ample time and provided comprehensive facts when providing information sought from them as respondents.

1.10 Definition of Terms:

Agriculture: The practice of cultivating the soil, growing crops, or raising livestock for human use, including the production of food, feed (Oxford Reference , 2024). In this study it means the use of land whether or not covered by water for forest, food production and include cultivation of crops, breeding animals and fishery

Agricultural Education: The educational process involving the study of technologies, related sciences, acquisition of practical skills, attitudes and knowledge relating to occupations in agriculture (Jones, 2013). In this study it means the scientific study of the principles and methods of teaching and learning as they pertain to agriculture.

Agricultural Mechanization: The application of mechanical technology through the use of machinery, tools and equipment to agriculture, as a means to enhance the production along crops, livestock and fisheries value chains (MoALF&C, 2021). In this study it means the technical area of study under agricultural engineering which deals with the adoption, understanding, operation and maintenance of mechanization in agriculture.

Institutional Capacity: Ability and skills that institutions have to implement and execute plans and contracts (Itzel et al., 2023). In this study it means the availability and functionality of the requisite resources in terms of personnel and facilities for appropriate transfer of skills to leaners and to perform functions effectively to achieve the set goals.

Clustering: Statistical method used for grouping individuals or objects into lots and the objects in the same lot will be similar (Blasi, 2020). In this study it means the process is to segregate groups with similar traits and assign them into clusters.

Curriculum: A planned sequence of instructions or the student's experiences in the school's instructional goals (Rao, 2021). In this study it means combination of instructional practices, learning experiences, and students' performance assessment that are designed to bring out and evaluate the target learning outcomes of a course.

Demonstrations: A teaching process that teaches learners how to complete a task using actual materials (Smith et al., 2013). In this study it means shows hosted by VTCs to demonstrate various skills, tools or machines of interest to the farmers to illustrate the value of an improved practice and possible solution.

Determining: Having the power to determine an outcome (Ayodele et al., 2023). In this study it means to find out or come to a decision about the institutional capacity of vocational training centers by investigation, reasoning, or calculation.

Equipment: Farm appliances, utilities found in workshops, laboratory, building or rooms in VTCs to carry out experiments, research and teaching practical classes.

Exhibitions: Is a public display of art or other items of interest, held at a trade fair (Dawkins, 2021). In this study it means displays of articles by VTCs meant to catch the attention of the farmers, stimulate his interest and urge him to take action to buy items like water pump or plough.

Fabrication: Is a process of assembling materials and components into a functional form (Sagnik et al., 2021). In this study it means crafting objects and parts from materials like sheet metal by way of welding, bending, punching, cutting and forging in foundry, grinding and use of lathe machine to produce components.

Facilities: Training rooms equipped with audio/visual, computers, laboratories, and electronics tailored to the needs of each training program (Hajjar et al., 2018). In this study it means buildings for training and non-training activities, equipment for academic and non-academic activities, areas for sports and games, farms, roads and paths.

Farm hand tools: The Oxford Dictionary of English (2024, edition) defines it as a device, especially one held in the hand, used for a particular function. In this study it means light equipment used manually, without machinery or animals to till land, trenching, carry fertilizer or materials.

Farm/home visit: Is face–to–face contact of the extension agent with the farmer (Yekinni, 2019). In this study it means a one-on-one contact by a VTC outreach agent with a client at their farm, home or enterprise to advice and teach skills involving agricultural mechanization.

Field days: An outreach approach where farmers meet, learn about new technology, and observe its performance mostly through demonstration by an extension agent (Emerick. et al., 2020). In this study it means, a trade and learning show by VTCs, industry and equipment especially for small holder farmers to sow case their products

Global Positioning System (GPS): Is Global Navigation Satellite System (GNSS) that provides geo location and time information to a GPS receiver anywhere on or near the Earth. (Ershad, 2020). In this study it means a utility that provides users with geo positioning, navigation and timing services.

Implements: In this study it means any equipment, engine, machine, or related attachment used in farming operations. Examples are soil reapers, cereal threshers and seed planters and chemical boom sprayers

Machinery: Machines used in processing agricultural, forestry, and livestock products and parts and accessories involved (Korea Legislation Research Institute, 2022). In this study it means machines used in agricultural activities to accomplish tasks. Example are power tools, tractors and implements that are towed or operated.

Outreach: Activities of providing services to any population that might not otherwise have access to those services and involves meeting someone in need of an outreach service at the location where they are.

Promotion: Approaches in developing and encouraging the adoption of technologies for particular farming systems like agricultural mechanization technologies that can improve efficiency of farming activities.

Physical Facilities: Buildings, properties and infrastructure including physical and material assets which administrators, teachers and students in VTCs utilize to achieve effective and purposeful teaching and learning experiences.

Qualification: Combination of quality assessment also referred to as valuation particularly in market contexts (Callon et al., 2005). In this study it means official record showing that a tutor had successfully completed a course, training or study and have the ability to teach and promote agricultural mechanization.

Registered Qualifications by CDACC: In this study they are skill sets approved by Curriculum Development Accreditation and Certification Council (CDACC) for study in VTCs many of which are related to promotion of agricultural mechanization.

Small Holder Farmer: Farmers with a low asset base and operating in less than 2 hectares of cropland. (Csaki et al., 2003). In this study it means small scale farmer of livestock, fish, and crop less than one to five acres.

Workshop: In this study it means structure for safety of the workers, repair and maintenance of tools, equipment, implements, structures, monitoring and documentation.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter reviewed literature on the critical role of Agricultural Education, Institutions offering agricultural education and TVET systems for agricultural mechanization globally and in Kenya. It discusses VTCs curriculum, qualifications as human capital, physical facilities, agricultural equipment owned by SHF and outreach engagement with SHF with regard to promotion of agricultural mechanization. The theoretical and conceptual frameworks of the study are also presented.

2.2 Agricultural Education:

According to the United States of America department of Agriculture (USDA, 2019), agricultural education is much more than teaching students about farming. The agricultural education Program relates topics such as science, nutrition, and pre-service and professional development opportunities for leaners. In Bulgaria (Zaalmink et al., 2022) agricultural education is concentrated in vocational high schools with a professional orientation in the field of plant growing, livestock breeding, agricultural machinery and veterinary medicine.

Jones (2013) defined agricultural education as the study of technologies and related sciences, acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in agriculture. It imparts skills in agricultural production, processing and occupations related to agricultural mechanization, service and maintenance of farming machinery. Karim et al. (2013) concluded that effective Agricultural Education and training programs improve the skills and knowledge of people who manufacture, market, service and use agricultural machinery and equipment. In order to achieve skills development, there are a number of institutions offering Agriculture Education and Training at Degree, diploma, craft certificate and artisan levels in Kenya. The ministry of education and ministry agriculture, livestock, fisheries and crops manage most of the A-TVET institutions. In addition, there are a few institutions that are faith-based or/and privately sponsored and managed (Economic survey, 2019). Authors and institutions often use different terms to describe the same concept, like agricultural technical and vocational education and training (ATVET), Agricultural Education (AE), Agricultural Education and Training (AET), or Vocational Training in Agriculture (VTA).

2.2.1 Institutions offering Agricultural Education

The success stories of India, Brazil, South Korea and Malaysia, shows that it is possible to build productive and financially sustainable Agricultural Education and Training (AET) systems and Agricultural Education and Skills Improvement Framework (AESIF, 2015-2025) is keen to transform agricultural Education and Training system for a better impact of African's agriculture on the development of the continent.

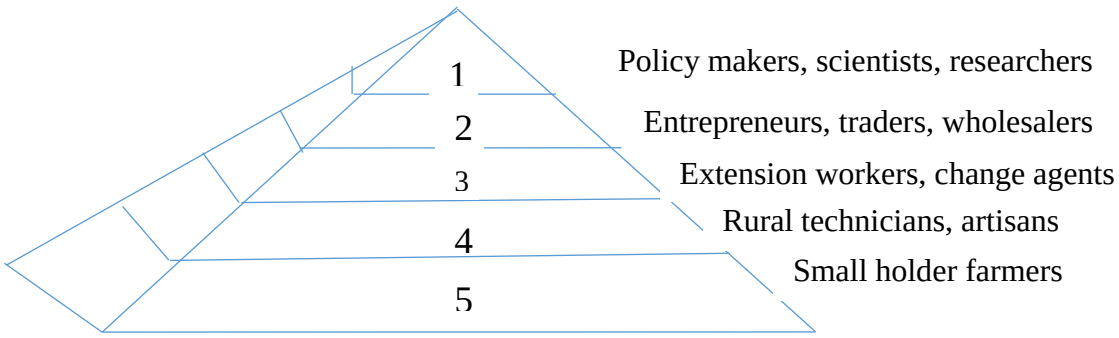
Development of skills in agricultural sector through TVET (Akpomi, 2009) institutions is receiving attention globally and locally. In Kenya such skills are offered at various levels in the education and training system. Public and private universities and middle level colleges offer degree and diplomas in agricultural education. It's also offered in Technical Vocational Education Training (TVET) institutes namely: National Polytechnics (NP), Technical Training Institutes (TTI) and Vocational Training Centers (VTC at diploma, Craft, artisan and trade test levels. Kenya National Examination Council (KNEC) and the National Industrial Technical Authority (NITA) examine students in TVETS.

Vocational Training Centers offer AM within the context of Agricultural Education defined by Jones (2013) as the study of technologies and related sciences, acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in agriculture including Agricultural Mechanization which is the technical area of study under agricultural engineering that deals with the adoption, understanding, operation and maintenance of mechanization of crops, livestock and fishery. The scope of Agricultural Mechanization includes construction and maintenance, agriculture power units from solar, wind and hydro, tractors and related equipment; soil and water management; electricity; structures and environment; materials and food processing and handling.

The Forum for Agricultural Research in Africa (FARA, 2011) states that, to make Agriculture Education more effective, Small Holder Farmers require empowerment through Vocational Training Centers so that they can learn and gain information that can make them knowledgeable in Agricultural Mechanization and Value Addition. Although there is under investment at all levels of the human capacity pyramid (Figure 1), Technical Vocational Education Training (TVET) in particular, has been severely neglected, therefore the focus now has to be on restoring the essential equilibrium of the human capacity pyramid (FARA, 2011).

Figure 1:

Levels 1-5 and sectors of the human capacity pyramid



Source *: Forum for agricultural research* (2011)

Table 1

Level, Sector and Comparative advantages obtained in the human capacity pyramid

Level	Sector	Sector Comparative Advantage
1.	Policy makers, scientists, and researchers	Providing opportunities to study in the wider context of economic development, security, world trade, climate change
2.	Entrepreneurs, traders, processors, producers, wholesalers and those who interface with producers and business people	Improving agriculture business education in agri-business
3.	Extension workers and change agents	Providing training in soft skills /personal mastery skills
4.	Rural technicians and artisans	Providing non-formal Technical Vocational Education Training in Vocational Training Centres to Small Holder Farmers as part of agricultural education
5.	Small Holder Farmers	Require empowerment by learning, gaining information to make them knowledgeable in Agricultural Mechanization and Value Addition chains through Agricultural Education in Vocational Training Centres

Source *: Forum for Agricultural Research* (2011)

In Kenya, the policy article *'Capacity Building Strategy for Agriculture Sector'* (CBSAS) of 2017 establishes the roles and comparative advantages between Small Holder Farmers and VTCs as beneficiaries and providers of knowledge in Agricultural Mechanization respectively. In the CBSAS (2017) developed by the Ministry of Agriculture, Livestock and Fisheries, '*analysis of stakeholders'*, the role of farmers is to participate in training and to implement recommendations, while the farmers' comparative advantage is to provide platform for engagement, while the farmers' target area of support is to be made knowledgeable in farming inputs including Agricultural Mechanization. The role of TVET is training, outreach programs and capacity building to farmers while the comparative advantage is stated as possession of training facilities and skilled personnel. The CBSAS (2017) presents the implementation roadmap by way of a log frame which outlines intended intervention outcomes. Number 3 of the envisioned intervention outcomes is the enhancement of intuitional capacity for vocational and agricultural education centers (VTCs) at national and county levels.

2.3 Big Four Agenda, Sustainable Development and Agricultural Mechanization

The Big 4 Agenda is a plan of action intended by the Government of Kenya to transform the economy. Pillars of the agenda are stated as Manufacturing, Affordable Housing, Food Security and Nutrition as well as Universal Health Insurance Cover. Manufacturing in Kenya, mainly produces agro-processing products, textiles, leather, construction materials and machinery. All these sectors prioritized in the agenda require mechanization and particularly agricultural mechanization for food security, nutrition and manufacturing. There is great untapped potential for agricultural mechanization to support rural development initiatives in low- and middle-income countries. As technology transfer of large machinery from high income countries was ineffective during the 1980s and 90s, mechanization options were developed that are appropriate to SHF cultivating small and scattered plots (Loona et al., 2020).

Food and Agriculture Organization **(**FAO) expressed concern about gaps existing between agricultural mechanization technologies produced through research institutions and the adoption of such technologies by rural households in Sub-Saharan Africa **(**FAO, 2013). A study by Luyali et al. (2015) showed that learning, participation and partnership with industry and farmers are important for fostering relationships, and promoting adoption of modern technologies. The study noted that extension should be established to carry the results of innovations and scientific research to farmers in a practical way and to bring farmers and

industries' technical problems to the attention of service providers for solutions. Learning through practice–in –work as in VTCs, stands as the most pervasive and salient provision of learning for occupations across human history (Billett, 2010). It has largely met the capacities required for sustaining the human needs for nutrition, shelter and health care as expressed in the Big 4 Agenda and Sustainable Development objectives.

Globally, there are efforts to reorient TVET to address the sustainability of the economy, environment and society. TVET was a central theme in the Bonn Declaration in the year 2004 and there have been discussions about adding TVET to the UNESCO Education for Sustainable Development Initiative (Maclean, 2011). Sustainable Development became part of a new paradigm for TVET that was adopted at the International Conference on TVET in Seoul, Korea in April 1999 according to UNESCO (2013).

Government of Kenya budget for 2018/19 focused on setting up the foundation for skills development for the youth. To achieve this objective, the government prioritized the construction and equipping of various VTCs across the country. In addition, there was a conditional grant to Counties amounting to KES. 2 billion to support VTCs (GoK, 2019) where training of masonry, building, plumbing and electric wiring can be offered to realize the construction of 500,000 houses proposed in the Big 4 Agenda.

According to Kenya Bureau of Standards (KBS, 2018), agricultural challenges must be mitigated to address food production shortages which include pre-and post-harvest losses, inadequate extension-farmer linkages and mechanized methods of production. To realize the Big 4 Agenda initiatives, there should be increased levels of Agricultural Education, Extension, Mechanization and Skilled manpower. These factors of success can be offered to farmers in VTCs. To achieve 100% food security and nutrition, the government of Kenya intends to lower the cost of food drastically through early warning systems, subsidy to farmers, eliminating some of the taxes applied to food products in the value addition chain and contracting farmers to supply the strategic food reserve. The government also intends to enable more 700,000 acres of rice, maize and potatoes to be cultivated by irrigation to mitigate against unreliable rains and floods (GoK, 2018). These strategies proposed to realize the Big 4 Agenda require sensitization and awareness so that farmers can learn the processes to access and benefit from them. Vocational Training Centers with institutional capacity can provide consultancy to link SHF to issues in the Big 4 Agenda.

The other plan in the Big 4 agenda is to enhance maize production by 27 million bags and potatoes by 0.9 million tons by the year 2022 and also to boost the capacity of SHF by waiving importation duty of bags and cereal drying equipment (GoK, 2018). Illegal fishing will be curbed and fishermen provided with fishing vessels. To achieve these goals private partners must be involved (GoK, 2018). These tasks will require knowledgeable farmers and trained hands-on service personnel. In Kisumu County, the most appropriate sector to provide skills for these tasks are the VTCs because they have the means and are nearby to farmers. They also have personnel who can offer training and consultancy. Effort was made during the study to find out the institutional capacity of VTCs' as enablers of Kenya government Big 4 goals by promoting AM.

Another initiative associated with TVET is the Sustainable Development Goals (SDGs), introduced by United Nations Organization (UNO) in 2015 as targets for the economy, society and environment. According to the United Nations Development Program (UNDP), there are 17 SDGs (UNDP, 2020). Sustainable Development Goals and Big 4 Agenda objectives are related because SDG number nine (9) is industrialization and infrastructure (UN, 2015) which covers manufacturing as in the Big 4 agenda. Vocational Training Centres with institutional capacity are needed to offer skills and to participate in the development of infrastructure for small holder farmers to transport their farm produce and obtain equipment cheaply. More than 80 % of world merchandise trade by volume is transported by lakes, rivers and sea, making maritime transport a critical enabler of trade (UN, 2015). Lake Victoria is partly in Kisumu County where VTCs can support green economy with skills in boat and ship construction, repair, fishing gear manufacture and maintenance.

2.4 Promotion of Agricultural Mechanization by VTCs through Curriculum

Curriculum is the plan of action that is aimed at achieving desired goals and objectives (Stotsky, 2012). It is a set of learning activities meant to make the learner attain goals as prescribed by the educational system. As the focus of training for resource-intensive industries, such as agriculture, mining, forestry, construction, manufacturing and tourism gains momentum, UNESCO considers TVET to have multiple responsibilities in the area of Agricultural Mechanization and environmental sustainability which includes developing, through the TVET curriculum, a range of environmental concepts, encouraging personal values and lifestyle choices and promoting critical thinking and relevant practical skills both

in agriculture where application of farm mechanization is required among other subjects (UNESCO, 2013).

Globally, TVET with adequate institutional capacity is considered a force in the rapid success of different factors of economy in many countries including Agricultural Mechanization. Law (2010) stated that, a major factor behind Singapore's success especially in mechanization has been the ability to align TVET policy with economic development. When the institutional capacity and objective of TVET is designed to provide knowledge to respond to rural transformation and the skills that bring about rural change and the individual transformation, it provides the best opportunity of success in many areas of development (Shaw, 2011).

Compared to other western countries, TVET curriculum in German speaking countries, has foundation in their culture and social set up as a society. The dual system of training at school and on-the-job is deemed to be one reason for the relatively low youth unemployment rates in German-speaking countries and is therefore considered a best practice model internationally. There is demand to implement dual system curriculum in the developing countries. However, experience shows the limited transferability of the dual system (Barabasch et al., 2011; Maurer, 2012; Swiss Agency for Development Cooperation 2011; World Bank, 2012). The educational traditions and social environments are too different. In German-speaking countries, the curriculum for vocational training is part of a historically rooted and specific form of social organization of labour, which is based on the cooperation between Agriculture Mechanization industry, public administration, the education system, the private sector, professional associations and interest groups (Avis, 2012). The dual system is an institutional setting that exists in very few developing countries.

In the United Kingdom, TVET providers have been innovative in the Curriculum and in the ways in which they engage with the employment market and agriculture mechanization industry (British Council, 2015). In France, (World TVET data base, France, 2015) TVET is guided by 'Education and Training in Europe 2020', a ten-year European strategic framework, in which EU countries have identified a number of common objectives including Agriculture Mechanization. Specifically related to TVET. France aims to reduce school drop-outs to less than 9.5%. In the year 2012 report from UNESCO 3rd International Congress on TVET in China, emphasized that developing TVET should be top priority in the quest to tackle poverty through Agriculture Mechanization and other measures of intervention. The African Union (AU) declared development of TVET as one of the eight priority areas in the

Union's second decade of Education between 2006-2015 (AU, 2006) and it also committed to support curriculum reforms. Norwegian Agency for Development Cooperation (NORAD) noted that very few enterprises and jobs exist in Africa but agriculture has potential to provide the most opportunities if mechanized so that it can expand and be efficient to produce more produce (NORAD, 2011). In Nigeria, Bukar and Timothy (2013) observed that, VTC graduates engage in entrepreneurship which has led to low levels of unemployment and high rate of economic growth including agriculture the main stay of most SSA economies.

Curriculum defines the environment where learning activities take place, adds Stosky (2012).In Kenya, the Technical and Vocational Education and Training Act (TVETA Act, 2013), established TVETA to oversee management of TVET in Kenya. The Act also established the Curriculum Development Assessment and Certification Council (CDACC) under section 44(1) with a mandate to undertake design and development, evaluation of competency-based curriculum (CBC) and to provide support materials for TVET. The CDACC approved 87 courses for VTCs, of which 30 are related to Agricultural Mechanization from level 3 to level 6. This is an improvement from the previous system.

Ministry of Youth Affairs and Sports in 2005, developed a five-year strategic plan with thirteen course curricula (MoYA & S, 2009). Courses in the curriculum are metal processing, electronics, electrical, vehicle mechanics, carpentry, joinery, ICT, tailoring, hair care, entrepreneurship, life skills, technical drawing and agriculture (GOK/KIDDP, 2009). These courses are relevant to Agricultural Mechanization. Curriculum for VTCs is modular in approach, competency based, flexible to accommodate diverse interest groups like SHF and future aspirations of the communities hosting VTCs. It also integrates generic skills, life skills and entrepreneurship add MoYAS (2009).

The Figure 2 depicts the relationship between the inputs, process and outcomes in the agricultural education sector where course delivery is through theory and practical to generate meaningful outcomes.

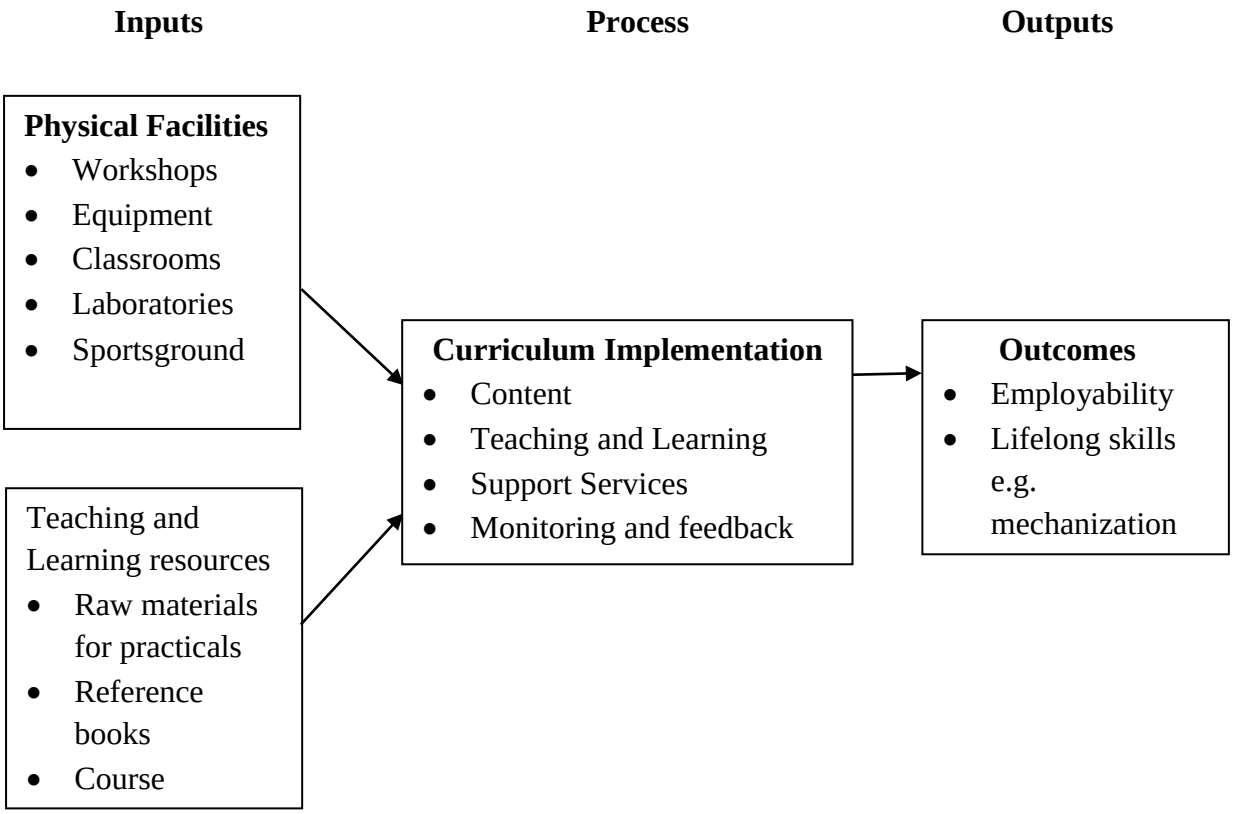


Figure 2: Resources utilization and Curriculum Implementation

Source: *Gessler et al. (2018)*

Kalemba (2013) stated that VTCs revised their curricula by integrating green skills and knowledge (UNEVOC-UNESCO, 2013). The first period of a pilot project lasted from 2008 to 2011, and was carried out in over 100 well-equipped VTCs. The pilot testing of the developed "green curriculum", includes pertinent issues of Sustainable Development. The curriculum to carry out the agribusiness course for example, comprises tree growing, tree nursery operation, pollution prevention, solid waste disposal, use of recycling paper, organization of environmental and health clubs, community clean-ups, clean energy, fish farming, bee keeping and greenhouse technology according to her After the testing phase, this curriculum was reviewed for possible modifications by end of June 2014, she adds, with the aim of national implementation in over 800 public VTCs in Kenya. All areas of the green curriculum promote use of Agricultural Mechanization. The basis behind that pilot project was to show that Curriculum interacts with resources to achieve the desired outcomes including skills in Agricultural Mechanization as illustrated in Figure 2.

2.5 Qualifications of Tutors in Vocational Training Centres

Qualification among tutors is a factor of human capital. According to the Organization for economic Cooperation and Development (OECD, 2013) indicators of qualification are

Knowledge, skills, education levels, work experience, creativity and social skills. The tutor should be able to demonstrate skills they are teaching and also be a master-craftsman (Karim, et al., 2013) because skills development is best based on supervised, hands-on practical approach in which trainees learn by doing. This requirement may seem obvious but observations in many countries show that some tutors attempt to teach skills by telling rather than doing. This is because they are inadequately trained or the institutions lack the resources to purchase practical teaching aids (Rapsomanikis, 2015).

Knowledge, skills, health or values directly influence agricultural productivity among Small Holder Farmers. These factors according to Rapsomanikis (2015), also shape the way in which inputs are applied by tutors, farmers, learners, institutions and other users. They also help in acquiring and embracing information and technology and affect tutors' and farmers' ability to adapt their practices to a particular situation or to changing needs. To achieve objectives qualifications must be applied. Qualifications of Tutors in VTCs and other stakeholders in the country are related by interaction in the process of application. The Forum for Agriculture Research in Africa (FARA) created an outline to illustrate how the five levels and sectors in the human capacity pyramid (HCP) interact to achieve objectives.

2.5.1 Agricultural Mechanization Facilities in Vocational Training Centers

According to the Netherlands Organization for International Cooperation in Higher Education (NICHE), insufficient training equipment leads to trainees overcrowding during practical demonstrations (NICHE, 2010). The International Institute for Educational Planning newsletter (IIEP) stated that the delivery of TVET requires smaller classes and expensive equipment (IIEP, 2007). A study by Dasmani (2011) revealed that inadequate instructional materials, large number of students in the class, insufficient training facilities and lack of collaboration with the local industries for hands-on-experienced trainers and trainees lead to ineffective and inefficient training of students. Umar and Ma'aji (2010) concluded that most of the TVET institutions in Nigeria have been forced to perform below standard due to non-availability, poor management or neglect of the required facilities in the workshops, therefore, there is need to provide adequate workshop tools, equipment and machines for effective implementation of TVET programs in Nigeria.

In Kenya, the Kisumu County Integrated Development Plan of 2012-17 (KICD, 2012) proposed the establishment of VTC in each ward and to rehabilitate the existing ones, to construct four modern workshops in each VTC, review the curriculum, establish production

units in the VTCs, recruit more qualified staff and to subsidize VTC tuition as part of their effort to revamp the institutions. According to the KCIDP, Kisumu County government also proposes the promotion of mechanized agriculture from 10% to 100% by maintaining, equipping machinery services and establishment of agricultural technology development center. With adequate institutional capacity in VTCs, the Kisumu County Government can use VTCs in the promotion of agricultural mechanization. Results of this study may help the County government to decide whether their VTCs have the requisite institutional capacity. Luyali et al. (2015) in a survey found out that in West Pokot County, the quality of training in VTCs has been hampered by inadequate facilities, understaffing, lack of funding and negative attitude from the community about VTCs, curriculum and programs.

2.5.2 Agricultural Mechanization facilities among Small Holder Farmers

Investment in agricultural mechanization enables farmers to produce more and to improve national and local prosperity (FAO, 2012). In other jurisdictions, adoption of mechanized agriculture is not left to chance. Ministry of Agriculture in India sponsored programs known as 'Centrally Sponsored Schemes' as was the case in their ninth five-year plan of 1997-98 to 2001-02: Promotion of farm mechanization in Udaipur District, Southern Rajasthan'. Implements were provided to the farmers on subsidized rate through the 'Work plan and Promotion of Agricultural Mechanization among Small Farmers' program (Jangid et al., 2016).

The same could happen in Africa, if African farmers could be helped to intensify their farming through increased levels of agriculture mechanization. This would lead to improved land use, increased food production, enhanced rural prosperity and on the national scale, greater export potential and less reliance on imports from outside Africa.

Brian et al., (2015) observed that improving smallholders' access to agricultural mechanization inputs is faced with difficulties as the adoption of any innovation must be seen as a useful and profitable investment from the perspective of the farmer. In Kenya, this would trigger demand for the innovations leading to increased supply. However, this demand is non-existent due to low-income levels of SHF which in turn lead only to elementary mechanization input in rural areas. This situation is referred to as 'the vicious cycle of mechanization development' (Sim et al., 2015). It requires broad action among actors involved in rural development and sustainable programs from the SHF farmers' level to

VTCs (TVET) up to and including policy makers to break the cycle according to (FARA, (2011).

The livelihoods of many residents of Kisumu County depend on fisheries and rain-fed small-scale farming. Mechanically-powered technologies, such as tractors, harrows, threshers or shelling machines, seeders and irrigation equipment can contribute significantly towards increased production (Rapsomanikis, 2015). A machinery can include small equipment, like water pump, seed planter, a thresher or a hydraulic pressing machine. According to the KCIDP 2013-2017, Kisumu County has 149,983 small scale farmers engaged in production of crops, livestock and fisheries. The County government (2014) reported that increased access to tractors has increased crop yields. Farm products require agriculture mechanization to produce, preserve, transport, store, process and sell. The KCIDP report endorses the crucial role and potential institutional capacity of VTCs which can benefit the adoption of agricultural mechanization through agriculture education curriculum.

2.5.3 Outreach Services offered to Farmers by Vocational Training Centres

Collaboration between training institutions and rural communities can either be formal or non-formal or both. In Ecuador, the National Plan for good living or Plan Nacional para el Buen Vivir 2009-2013, (Delgado, 2009 (PNBV) calls explicitly for reciprocal interaction between education and the productive sector to transform the productive structure which creates economic demand for responsive TVET (Delgado, 2009). A key driver of agriculture sector is a functional Agricultural Extension service that is responsive to socio-economic conditions. Extension should be established to carry the results of innovations to farmers in a practical way and to bring farmers technical problems to the attention of service providers like TVETs for solutions (Luyali et al., 2015). This requires skilled manpower who can respond to dynamic situations.

According to Obibuaku (1983), Extension is out-of-school system designed to help rural farmers satisfy their farm needs. Obibuaku adds that, agricultural extension is an element of agricultural education but dynamic in process, non-formal in nature and directed to bring about changes in what people know, changes in how people react to situations and changes in what people can do with their resources.

However, one of the challenges identified by the Ministry of Livestock and Agriculture of Kenya (MoLA, 2017) is weak institutional capacity to deliver quality extension services. The

delivery methods of extension services in the agricultural sector include Focus Group Discussion, Agricultural Shows, Farmer Field Schools, Farm Visits, On-farm Demonstrations, Field Days, Electronic Media and Exchange Visits. Each of these approaches have components aimed at building human and institutional capacity to increase productivity (GoK, 2015). According to CBSAS (2017) the role of TVET is training, outreach programs and capacity building to farmers so that they can adopt agricultural mechanization. The demand for agriculture mechanization emerges at the point when it becomes cost effective for farmers to use it over other available options. Thus, policy interventions aimed at promoting agriculture mechanization must first confirm whether sufficient demand is indeed present (Diao et al., 2016).

Awareness is also important. Information Education and Communication (IEC) plays a vital role in changing the attitudes of SHF for adopting technologies (Ministry of Human Resource, India, 2009). Shaik et al., (2014) defines IEC as an approach that attempts to change or reinforce a set of behaviors in "target-audience" regarding a specific problem in a predefined period. By using IEC, the level of awareness among SHF farmers will increase. The Information, Education and Communication strategies involve planning, implementation, monitoring, and evaluation. Effectiveness of IEC materials depend on relevance, appeal, uniformity, simplicity of the content and language, the accuracy of the information, length of the material, cultural appropriateness, availability and modes of dissemination such as videos, brochures, posters, pamphlets, booklet, new flipbook, and interpersonal communication (Benson et al.). Vocational Training Centres can create the demand for agricultural mechanization among farmers through training and outreach program.

2.6 Theoretical Framework

This study was guided by the Human Capital Theory (HCT) postulated by Schultz T.W (1961) which states that Education as a component of HCT is an investment in man therefore its consequences should be treated as a form of capital. Since education becomes a part of the person receiving it, then it should be referred to as human capital. He defined HCT as knowledge and skills obtained by people as capital in the process of vocational and technical education. Human Capital Theory provides the dominant explanation for economic value of education and informs the provision of skills and innovations such as the promotion of Agricultural Mechanization by VTCs. This hypothesis suggest that, conditions that make farmers to adopt labour saving technology are agro-ecological, population pressure and market demand which in turn prompts Agricultural Mechanization, by adoption of existing

skills through curriculum, human resources, equipment, tools, and the development and dissemination of new technologies. Vocational Training Centers can contribute in adoption of Agricultural Mechanization technologies if their institutional capacity is established and farmers sensitized about capabilities in Vocational Training Centers.

2.7 Conceptual Framework

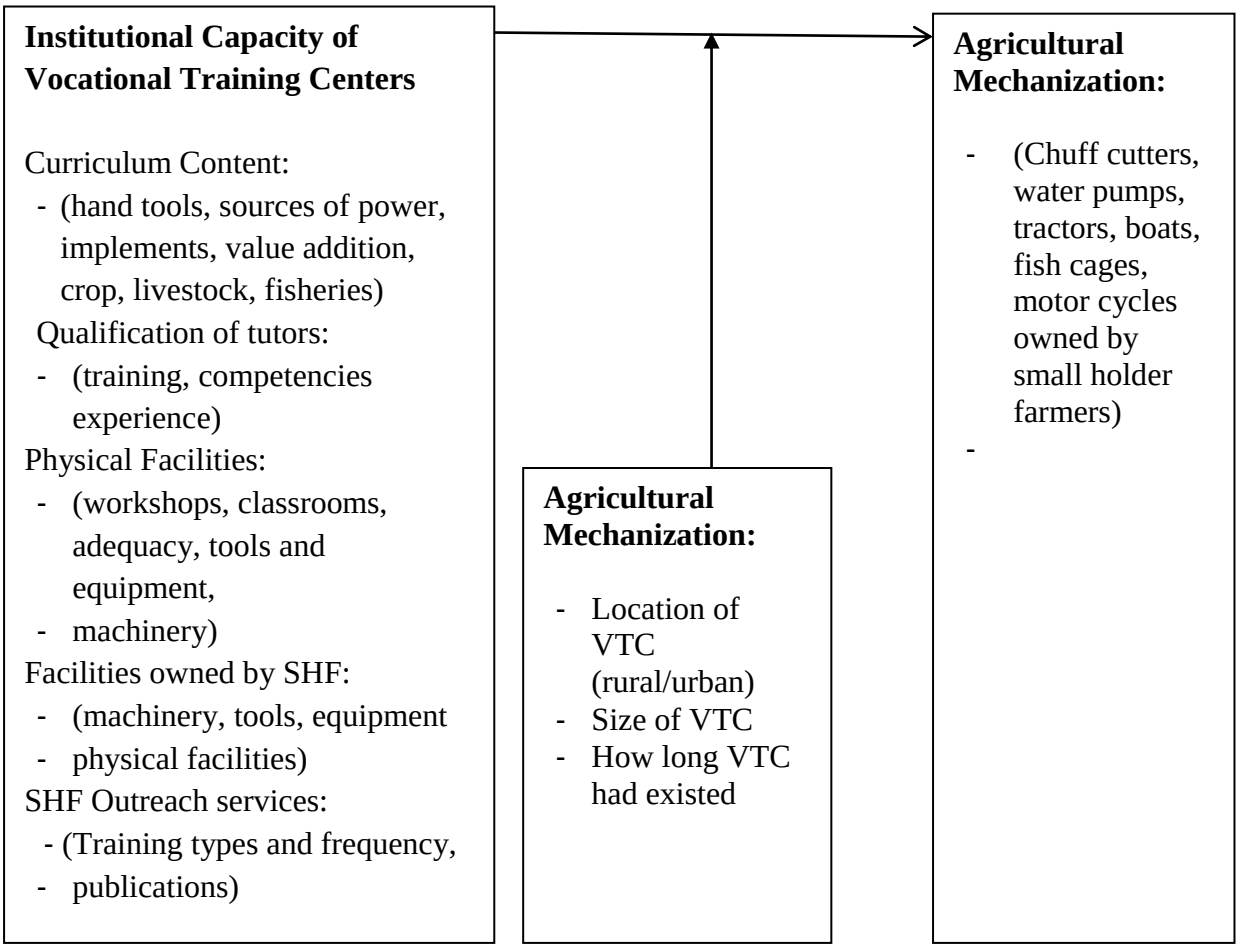


Figure 3 :

Conceptual model for the institutional capacity of VTCs to promote agricultural mechanization

The independent variable is Institutional Capacity of VTCs as determined by the Curriculum, Qualifications of Tutors, Physical Facilities, machinery owned and needed, and Training of SHF by VTCs about programs aimed at promotion of Agricultural Mechanization in Kisumu County. These independent variable indicators are for the provision of knowledge and skills to achieve objectives. The independent variable indicators interact during curriculum

implementation to achieve the learning outcomes of the dependent variables. However the ability to promote Agricultural Mechanization may be affected by location of the VTC whether rural or urban area, size of the VTC and the time it has been in existence. Intervening variables were not observed because they are mediating or intermediary variables. They are hypothetical variables. Their role is to explain causal links between other variables. Location of the VTC can determine access to the institution, adequacy of facilities and quality of staff. Size of VTC can determine funding, number and quality of staff. Duration of existence can present how resilient the VTC is, in terms of well-wishers, funding and infrastructure. The intervening variables of location was addressed by selecting VTCs from urban and rural areas as they were, while size of VTC was addressed by selecting VTCs as they were. Finally, duration was controlled by selecting all VTCs irrespective when they were built

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This Chapter outlines the methodology that was used to obtain the objectives of the study. It presents the research design, location of the study, population of the study, sampling procedures and sample size, instrumentation, reliability and validity, data collection and analysis.

3.2 Research Design

This study adopted the descriptive survey design. It was deemed suitable for this study because the research did not involve manipulation of variables (Kathuri, 2008). Through descriptive surveys, opinions, attitude, various suggestions for the improvement of education practice that leads to promotion of agricultural mechanization has been obtained. The design provided a numerical description of some part of the population and also explains events as they are, as they were or as they will be (Onen et al., 2011). It's suitable for educational fact finding because it offers accurate information.

3.3 Location of the Study

The study was carried out in Kisumu County located in western Kenya. The County covers a total area of 2,660 km^2 of which 567 km^2 is under water of Lake Victoria. Non-seasonal rivers, that is, Nyando, Sondu-Mirui, Awach and Nyamasaria also cross the County into Lake Victoria. Kisumu County is suitable as the area of study because according to the County government of Kisumu, adoption of mechanization is low in spite of 5 VTCs located in urban areas and 18 VTCs located in rural areas within in Kisumu County. Kisumu county government is promoting food crops such as sorghum, rice and arrow roots. April is the month with the most rain, with an average rainfall of 9.6 inches. January is the month with the least rain, with an average rainfall of 2.1 inches. Counties neighboring Kisumu County are Siaya to the West, Vihiga to the North, Nandi to the North East and Kericho to the East. Its neighbors on the South are Nyamira County and Homa Bay County is on the South West.

3.4 Target Population

The target population was 150,029 subjects, comprising of 149,983 SHF in Kisumu County (KICDP, 2013-2017), 23 principals who are managers of VTCs and selected 109 HoD's in charge of sections that were offering skills related to agricultural mechanization. Determined

by census, the maximum possible number of HoD's were to be 131, being the number of sections in 23 VTCs offering courses related to AM but some VTCs deployed one HoD to head two or more sections. The target population was chosen because the SHF stand to benefit from VTCs' resources and services, while Principals and HoDs are the custodians of VTC deliverables and resources.

The Accessible population is sub-set of the Target population with the most suitable representative characteristics for the study. The accessible population were 270 comprising of 138 SHF that is, 6 farmers (3 females and 3 males) purposively selected within a radius of five kilometres from each of the 23 VTCs, were engaged in crop, livestock or fishery farming for at least 8 to 14 years. Principles were 23 and 109 HoDs (Table 2). Whereas the accessible number of principals were 23, two did not respond to the researcher's request to participate in the final data collection. The balanced selection of male and female SHF was to address any bias in gender viewpoint, inclusivity and community endorsement.

Table 2

Accessible population of the study

Category	Accessible population
SHF	138
Principals	23
HoDs	109
Total	270

3.5 Sampling Procedure and Sample size

The study employed purposive sampling technique to choose the sample because it's used to select typical cases and focused information only. The sample size comprised of 21 VTC principals, 21 heads of departments (a deputy principal who is also HoD and assisted by other HoDs represented a VTC in the data collection) of agricultural mechanization related courses selected through census and 110 farmers who met the criteria for SHF who had been farming for 8 to 14 years, exhibited interest in agricultural mechanization and desired training were selected purposively from the accessible population. According to Kathuri and Pals (1993) for survey research, each major sub-group requires a minimum of 100 cases and a minor sub-group should have 20-50 cases. Therefore, a sample size comprising of 152 is adequate for a descriptive survey study (Table 3). The 110 SHF were organized into 5 clusters of 22 farmers per FGD comprising of 11 females and 11 males with track record in

farming. Clustering was employed because it brings about convenience, ease of management and variety of ideas for a wider audience (Blasi, 2020). The 21 VTCs were organized into 4 clusters. The 4th cluster had 6 VTCs. At least one VTC in a cluster was used as a venue for each of the 5 FGD meetings.

Table 3

Sample size of the Study

Category	Accessible population	Sample size
SHF	138	110
Principals	23	21
HODs	109	21
Total	270	152

3.6 Instrumentation

The four instruments that were developed by the researcher to collect data for this Study were interview guides, structured questionnaires, focus group discussion guides and observation guides. The interview guide with a section for introduction and a section with questions was used to get information from principals while structured questionnaires with a section for introduction and section A for demographic information and B for courses in the curriculum were used to collect data from 21 HoDs. Focus Group Discussion guides were deployed to obtain data from FGDs. The observation guides were used to observe and document physical facilities. The instruments were developed with the guidance and scrutiny of experts in the area of agricultural education and extension who directed that certain item in the instruments be adjusted. Some adjustments advised by the experts was that items on the same instrument must not elicit similar responses (Appendix A, B, C, and D).

3.6.1 Validity of Instruments

Experts from the Department of Agricultural Education and Extension of Egerton University reviewed the tools to address the face and content validity. Kothari (2008), defines validity as the degree to which an instrument measures what it is supposed to measure. Validity of instruments that is interview guide, questionnaires, FGD guide and observation guide was ensured by use of questions that are relevant to the objectives and research questions. Two types of validity were taken into account that is face and content validity. Face validity refers to the degree to which an assessment or test subjectively appears to measure the variable or

construct that it is supposed to measure. Content validity shows the extent a measure covers the range of meanings covered in a concept (Mugenda et al., 1999).

3.6.2 Reliability of the Instruments

A measurement is reliable if it provides consistent results of data after repeated tests (Kathuri, 2008). When used in a scientific study it means the instrument is dependable, predictable, accurate and stable. Random errors in research influence reliability. Mugenda et al., (1999) confirmed that as error increases, reliability decreases. Errors were reduced by use of non-biased questions, accurate coding of question items and clear instructions on the questionnaire. Interview guides, questionnaires, observation guide and Focus Group Discussion guide were employed as the main instruments for data collection. They were developed by the researcher in consultation with experts in the area of agricultural education and extension who are the validating supervisors. Piloting of the instruments done in Kisumu County where 40 respondents involved. To avoid contamination piloting comprised of 5 principals, 5 HoDs from non-public VTCs and 30 SHFs (6 SHF per cluster) purposively selected and were not in accessible population. Cronbach's alpha coefficient was used to calculate the data. The reliability coefficient of instrument was 0.713. The data collected was modified to improve their reliability. Items with reliability coefficients of at least 0.70 or 70% means the instrument is measuring the concept of interest and as a reliable measure of internal consistency of the items of the questions in the questionnaire (Kathuri et al., 1993), whereas below 0.70 requires that adjustment must be made on the instruments once the data is collected (Frankel et al., 2000). The main study covered seven sub-Counties in Kisumu County (Appendix F).

3.7 Data Collection Procedure

Data collection started upon approval by Egerton University Board of Post Graduate Studies and the National Commission for Science Technology and Innovation (NACOSTI) had granted the Research Permit. Data collection from 270 respondents was by administering structured questionnaires to 21 HoDs, deploying interview guides during face-to-face interviews with 21 VTC principals, using interview guide during FGDs and observation guide to collect data about facilities in the VTCs with regard relevance, availability, quantity, functionality and sector of agriculture where they apply for promotion of agricultural mechanization (Appendix A B C and D). Purpose of the study was explained to the respondents and their responses were handled with confidentiality.

3.8 Data Analysis

Data was organized, coded and Statistical Package for the Social Sciences (SPSS) used to process it. Descriptive statistics was applied to describe the data. Questionnaires collect massive quantitative data which must be grouped into meaningful patterns to reveal the essence of the data. Table 4 is a summary of how the data was analyzed. It presents the research questions, the independent variables, the dependent variables and the method of analysis.

Table 4

Summary of data analysis Use the recommended line spacing

Research Questions	Independent Variable	Dependent Variable	Method of analysis
Which courses in the curriculum of VTCs that relate to Agricultural Mechanization?	Courses in VTCs Curriculum	Promotion of agricultural mechanization	Mean, frequency, Standard deviation and percentage
What qualifications of tutors in VTCs relate to Agricultural Mechanization?	Tutor qualifications with regard to AM	Promotion of agricultural mechanization	Mean, frequency, Standard deviation and percentage
Which training facilities in VTCs are related to Agricultural Mechanization?	Training facilities with regard to AM	Promotion of agricultural mechanization	Mean, frequency, Standard deviation and percentage
What agricultural facilities are owned by SHF?	Tools, Equipment, machinery	Promotion of agricultural mechanization	Mean, frequency, Standard deviation and percentage
Which outreach services are offered to SHF by VTCs?	Outreach services offered to SHF	Promotion of agricultural mechanization	Mean, frequency, Standard deviation and percentage

3.9 Ethical Consideration

Ethical considerations are asset of principles that guide research design and practices. The most important consideration is that participants should not be subjected to harm in any way. The participants freely and voluntarily agreed to take part in the study, and no incentive was offered. During this study risk was minimized by ensuring that Focus Discussion Group meetings were held in safe surroundings devoid of pollution, harsh weather or conflicts. Meetings with Principals and HoDs were within VTCs where they are generally safe and in

charge. The researcher also took care to obtain informed consent from participants by introducing self and the topic of research. Participants were also assured of anonymity and confidentiality of their responses.

CHAPTER FOUR
RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results and discussions of the study. The study investigated the Institutional capacity of Vocational Training Centers (VTCs) to promote agricultural mechanization among Small Holder Farmers in Kisumu County, Kenya. Results cover: the curriculum, human capital in terms of qualifications of tutors, training physical facilities in VTCs as well as the facilities (tools, equipment and machinery) owned by SHF in the County. Study also investigated outreach programs by VTCs that relate to promotion of agricultural mechanization among SHF in Kisumu County.

4.2 Courses that Relate to promotion of Agricultural Mechanization

The first objective of this study was to identify courses in the curriculum of VTCs that relate to promotion of Agricultural Mechanization among Small Holder Farmers in Kisumu County. Sixteen courses were offered in the 21 VTCs. Except for Hospitality and Tiling the other fourteen are related and can promote agricultural mechanization. Analyzed data (Table 5) show that fourteen out of sixteen courses offered in VTCs are related to promotion of agricultural mechanization. The distribution of VTCs offering courses in terms of percentage (table 5) are fashion and garment making 90.5, building technology 71.4, electrical and electronics 66.7, hairdressing and beauty therapy 61.9, information technology 61.9, motor vehicle technology 57.1, food and beverages 28.8, agriculture/agribusiness 19.1, and plumbing 14.3, masonry 14.3, welding and fabrication 9.5, driving and machine operation 9.5, carpentry and joinery 9.5, metal processing 4.8 percent. Courses that are not related to agricultural mechanization are hospitality and tiling were offered in only two institutions. The fourteen courses can be categorized into the following clusters: Mechanical Engineering, Civil Engineering, Agriculture, Textile and Personal Care then Communication and Energy.

Table 5

Courses related to promotion of AM, VTCs offering and percentages

Courses Related to AM	Frequency	Percentage
Fashion Design	19	90.5
Building technology	15	71.4
Electrical and electronics	14	66.7
Hairdressing and beauty	13	61.9
Information technology	13	61.9
Motor vehicle technology	12	57.1
Food and beverages	6	28.8
Agribusiness: Farm Machinery	4	19.1
Plumbing	3	14.3
Masonry	3	14.3
Welding and fabrication	2	9.5
Driving and operation	2	9.5
Carpentry and joinery	2	9.5
Metal processing	1	4.8

4.2.1 Mechanical Engineering

Mechanical Engineering cluster comprises (Table 6) of four courses namely motor Vehicle technology which was offered by 57.1 percent of the VTCs, as in table 5, is the knowledge base of agricultural mechanization. It imparts knowledge of repair and maintenance of mechanical machines including water pumps, tractors, motor cycles, power generators, chuff cutters, flour mills and feed mixers. Welding and fabrication was offered by 9.5 percent VTCs. It involves gas welding (oxy acetylene), cutting, brazing, arc welding, soldering and fabrication of products. These skills are used in repair of broken and loose parts of

agricultural facilities and components (GOK, 2009) to ensure that agricultural mechanization succeeds.

Table 6:

Clusters of Courses

Mechanical Engineering	Civil Engineering	Agriculture	Textile-Body Care	Communication and Energy
Motor Vehicle Technology	Building-Technology	Agribusiness Farm-Machinery	Fashion Design-Garment making	Information-Technology
Welding-Fabrication	Masonry	Food-Beverages	Hairdressing-Beauty Therapy	Electrical-Electronics
Metal-Processing	Plumbing			
Driving-Operation	Carpentry-Joinery			

Metal processing was taught by 4.8 percent of the VTCs. It imparts skills on forging of tools, spare parts of machines, heat treatment and sand casting of metals. The area also covers fabrication of products using mild steel and other engineering materials in design and fabrication of trailers, chuff cutters and other machines used in agricultural mechanization.

The efficient use of agricultural farm machines require good knowledge of equipment capable of increasing work efficiency, safety and safeguarding the comfort of those using the machines (Onuoha et al., 2013). The percentage offering driving skills is low, 9.5 percent of VTCs, because according to one VTC manager, 'establishing a driving school is complicated due to rules and funds which majority of VTCs cannot afford'. According to Bulletin *#2310, Maine Farm Safety Program, 'Driving Farm Machinery Safely: before Driving Farm Machinery on Public Roads,*' safety is important. Brakes must be functional and capable of safely stopping the vehicle and its load. Agricultural mechanization can be hazardous if not handled carefully. During a Focus Group Discussion, a farmer in Muhoroni Sub County described agricultural machines as 'necessary risk'.

4.2.2 Civil Engineering Cluster

Building technology is offered by 71.4 percent of the VTCs. According to the specific objectives in the VTCs syllabus (2009), the trainee should be able to state main sources of water supply, sketch pipe work for a given method of water distribution from rivers, lakes, water treatment works, boreholes and understand various methods of storing water. Trainees are also taught relevant Kenya Building code Bye-laws covering cold water distribution, distribution to kitchen sink, size of storage cisterns, distribution to waste appliances, distribution to soil appliances and farms. They also acquire skills for Agricultural processing plants which are housed to protect them from weather vagaries and burglary. Masonry skills offered by 14.3% percent of the VTCs is used in precast cement pipes and cemented channels. The basic unit of commercial agricultural operation worldwide, is the farm. Farming systems differ widely and so there are variations in the nature and arrangements of farm facilities. Masonry deals with farmhouses and service buildings that can be classified as livestock barns and shelters; machinery and supply storage; facilities for crop storage, including fodder and special-purpose structures (Dawna et al., 2020). Masonry promote mechanization by association through the various concrete structures built for the foundation and mounting of farm machines like vacuum milking machines in the parlor.

Plumbing is offered by 14.3 percent of the VTCs. It's applicable in irrigation which is the artificial application of water to the soil through various systems of tubes, pumps, and sprays according to the Centre for Disease Control and Prevention (CDCP, 2016). The Division of Foodborne, Waterborne, and Environmental Diseases (DFWED, 2016) reported that irrigation water can come from groundwater, through springs or wells, surface water, through rivers, lakes, or reservoirs, or even other sources. Plumbing skills from VTCs enable trainees to handle all mechanized water distribution systems. Carpentry and joinery (9.5 percent) course is expected to provide the knowledge, skills and attitudes in preparing timber, use of tools and equipment, identifying and fixing ironmongery in furniture and roof construction, timber seasoning and timber preservation competencies. Skills in use of machines and timber preservation can enable the farmer to harvest his trees using power saw or deploy any other agricultural mechanization means to harvest and to preserve timber to speculate for higher prices. Farmers can use carpentry and joinery to make hand carts and trolleys to be used as mechanized means of transport of farm produce.

4.2.3 Communication and Energy cluster

Information technology was taught in 11.7 percent of the VTCs. Mechanical units using electronics (mechatronics), provide information services from the internet that are useful for the management of agricultural production. These include precision farming and livestock management which could enable more efficient decision making for managers of enterprises related to agriculture and policy makers (Kaaya, 1999; Phougat, 2006). Contributions of ICT to agricultural mechanization are Global Positioning Service (GPS) gadgets to survey sizes of land and to examine and locate other parameters of the topology, enhanced efficiency and improved productivity by sending information from field meteorological stations on current temperature of air and soil, rainfall, moisture of leaf, moisture of soil and speed of wind. ICT influences on reduction of gap between agricultural mechanization researchers and farmers. In order for small holder farmers to benefit from information technology and communication, elementary computing literacy is required. This literacy can be offered in VTCs.

Electrical and electronics course is taught by 66.7 percent VTCs. Agriculture uses energy directly as fuel or electricity to operate machinery and indirectly on inputs produced off the farm (Scolari et al., 2020). The number of sensors, actuators and Electrical Circuit Units (ECU) in agricultural machines has increased. Some advantages of electronics in agricultural machination are higher precision and productivity, comfort, lower costs and the digitalization of agricultural operations. (Scolari et al., 2020). The VTC syllabus (2009) requires the trainees to acquire skills to dismantle, assemble, inspect and examine alternating (ac) and direct current (dc) motors. These skills are necessary in promotion of agricultural mechanization because motors are used in water pumping, flour mills and animal feed mixers among other machinery.

4.2.4 Agriculture Cluster

According to the National Vocational Certificate of Education and Training (NVCET) syllabus and regulations (GOK, 2009), one objective of Agri-Business course offered by 19.1 percent of the VTCs is to impart communication, entrepreneurship and skills in repair and maintenance of farm tool, machinery and equipment. Some of the farm machines are tractors for land preparation and centrifuges where the rotary motion in the extractor forces honey out of the combs. Food and beverage offered by 28.8 percent of the VTCs, are skills on how to prepare edibles to be healthy and palatable. Sweet potatoes are mechanically chopped to make chips, bakeries use ovens, cereals are ground to flour using flour mills, extractors are used to produce juice, cooking oil is produced using oil press and deep freezers are used to

store fish. Threshers are used on sorghum, millet and sim sim separation processes. All these applications promote agricultural mechanization.

4.2.5 Textile and Body Care cluster

Fashion design and Garment marking was offered by 90.5 percent of VTCs. It is a significant outcome of Industrial Revolution because it mechanized textile manufacture, precursor of fashion design and garment marking. The power loom and the mechanized management of cotton increases mass production. Clothes are essential with regard to human civilization and mode of showcasing one's social status, religion, culture and professional status. Hair dressing and beauty therapy was taught by 61.9 percent of the institutions. Normally natural elements from agricultural produce are mechanically extracted and processed to yield by-products used in the formulations which enhance appealing, attractive, gorgeous nail, hair and skin appearance. Some of the VTCs have this institutional capacity though, it's limited because of quality concerns. A Kenyan firm, Inter Beauty Products of L'OREAL (E. A) on one of their package states that, 'Nice & Lovely Aloe Vera Body lotion is enriched with Aloe Vera Extracts and Natural Oils'. The company also invests in products with avocado, sweet almond oil, sunflower seed oil, cocoa butter and shear butter as key constituents. This is a clear statement that hair dressing and beauty skill sets promote agricultural mechanization

4.3 Qualifications of Tutors and promotion of Agricultural Mechanization

The second objective of this study was: To examine qualifications of tutors relative to the ability of a VTC to promote agricultural mechanization among SHF in Kisumu County, Kenya. Qualifications of tutors is examined under the following sub headings: Number and Level of professional training attained, trade area and years of experience. Quality training is to a large extent determined by the capacity of tutors to interpret and implement the curriculum according to the Ministry of Education, Science and Technology (MoEST, 2015).

4.3.1 Vocational Training Centres, Tutors, Courses and Students

The number of tutors in each VTC were ranging from 3 to 14 depending on the number of courses offered. The total number of courses offered in the 21 VTCs were 16 while the staff were 156 in total. Fourteen courses (98.1%) were directly related to agricultural mechanization while two (1.8%) hospitality and tiling are not. Most of the courses had one tutor while a few had two depending on the number of students and other factors. Analyzed data (Table 7), show that the overall ratio of tutors to trainees is 1:23 (156:3471) but individually VTCs show varying ratios.

Table 7

Vocational Training Centres, courses, Tutors and Number of Students

VTC	Courses	Tutors	Number of students
Achego	9	9	145
Ahero	15	14	1451
ACK Kigoche	7	6	72
Akado	10	8	147
Alara	5	5	40
Bar Mathonye	5	5	100
Chwa	3	3	20
Bishop Okoth	10	7	129
Kadongo	4	4	55
Karaten'g	3	6	42
Kandaria	6	5	63
Katito	15	17	319
Kitambo	7	7	167
Lun'ga	6	6	161
Mariwa	8	8	119
Nyabera	5	6	54
Obange	8	8	158
Sabako	9	9	87
Sianda	8	8	60
Wachara	8	8	64
Withur	4	4	33
Total		156	3472

The National Industrial Training Authority (NITA) and Technical Industrial Vocational Education Training Authority (TIVETA) recommends that a class should have 26 to 35 students. Majority of the tutors are in trades that can promote agricultural mechanization, hence it's possible that VTCs can promote mechanization through tutors. Thirty tutors i.e., 19.2 percent in the VTCs had pedagogical skills from Kenya Technical Teachers College (KTTC) in addition to qualifications in their areas of specialization (Table 8), 34.6 percent had trade test, 14.1 percent had craft certificate, 43.6 percent have diploma while 7.7 percent

had degrees in their areas of specialization. By virtue of training, tutors with pedagogical skills possess methods of subject delivery that can be useful in outreach programs to promote agricultural mechanization among farmers which explains why the Teachers' Service Commission encourage their tutors, however competent, to attend KTTC for pedagogical skills. This percentage means a reasonable number of VTCs in Kisumu County have the institutional capacity to promote agricultural mechanization. However, instructors without KTTC diplomas reported having attended pedagogical short courses to enhance their knowledge in subject delivery.

Table 8

Tutors' level of Qualifications and tutors with pedagogical skills from KTTC

Qualifications	Instructors	Percent
Trade test	54	34.6
Craft	22	14.1
Diploma	68	43.6
Degree	12	7.7
Total	156	100
KTTC Diploma	30	19.2

The distribution of tutors in terms of experience (Table 9) show that 39.1 percent of the instructors had below 5 years of experience, 44.2 percent had between 6.0 – 10.0 years of experience, 8.8 percent had between 11.0 – 15.0 years, and 9 percent had 16.0 – 20.0 years, while 2.6 percent had above 20.0 years. Experience as stated by OECD (2013) is necessary in promotion of agricultural mechanization because it determines competence and confidence. Table 9 show that 60.9 percent of the tutors had more than 5 years of experience. The capacity of 60.9 percent of experienced staff can influence promotion of mechanization due to confidence in communication and handling of promotion materials as well as mature approach to matters agricultural mechanization

Table 9

Tutors' Years of Experience

Experience	Instructors	Percent
Below 5 yrs.	61	39.1
6.0 yrs. -10 yrs.	69	44.2
11.0 yrs. -15.0 yrs.	14	8.8
16.0 yrs. - 20.0 yrs.	10	9.0
Above 20.0 yrs.	4	2.6
Total	156	100

4.3.2 Training of Vocational Training Centres' Tutors

In Kenya there are two types of TVET tutors' training. The first one is where trainee tutors are recruited after secondary education and put through an integrated curriculum featuring, subject matter specialization, pedagogical courses and industrial attachment before one is certified as a diploma or degree holder TVET tutor. The second model is where the tutors initially obtained subject matter specialization and industrial work experience before undertaking pedagogical training to become a TVET tutors. In this Study, 19.2 percent (Table 8) of the teachers had undertaken their tutor training after acquiring their subject specialization.

Analysis show that 19.2 percent trained as tutors after subject specialization. Due to knowledge as trained tutors, the 19.2 percent staff were qualified to promote agricultural mechanization. According to ADEA, 84 percent of the tutors would prefer undertaking pedagogical training after acquiring subject matter expertise as it's the most effective model for training TVET tutors. In this model, trainees complete their technical training, undertake a prescribed period of industrial experience before committing to a career in TVET teaching. At this point the trainee is more mature and presumably in a better position to identify teaching as a career of their choice unlike the integrated model where the learner is usually a school leaver with little knowledge of careers (ADEA-2012).

4.4 Facilities in Vocational Training Centers

Facilities for training in a VTC enable tutors to achieve objectives of the course. The third objective of the study was: To describe the training facilities in VTCs that are related to the promotion of agricultural mechanization among crop, livestock and fish SHF in Kisumu County, Kenya. The facilities are described under the following categories: Equipment,

machinery, tools and physical facilities. The respondents in VTCs were asked to state the quantity, status (condition), sector of application, to the promotion of agricultural mechanization. A checklist and inventories were also used to observe and record the status as it were. Respondents were asked to state which equipment on the list were available and any other. The results (Table 10) are presented below.

Table 10

Equipments in Vocational Training Centres

Equipment	Sector of relevance	VTCS	Percent
Incubator	Poultry	2	9.5
Hatchery	Poultry	2	9.5
Brooders	Poultry	1	4.8
Planters	Crop	1	4.8
Generator	livestock, fishery, crop	5	23.8
Pump (petrol)	livestock, fishery, crop	1	4.8
Pump (solar)	livestock, fishery, crop	2	9.5
Freezers	livestock, fishery, crop	1	4.8
Sprinklers	Crop	1	4.8
Welding	livestock, fishery, crop	3	14.3
Lathe	livestock, fishery, crop	1	4.8
Wheelbarrows	livestock, fishery, crop	21	100
Food blenders	crop, livestock	3	14.3
Concrete mixer	livestock, fishery, crop	1	4.8
Porker vibrator	livestock, fishery, crop	1	4.8
Block mould	livestock, fishery, crop	1	4.8
Carwash machine	livestock, fishery, crop	1	4.8

Table 10 shows that out of 21 VTCs surveyed 100 percent owned wheelbarrows. Electric generators were in 23.8 percent while arc welding machines and food blenders were each in 14.3 percent of the VTCs. Incubators, hatchery and solar pumps were each present in 9.5 percent of the institutions. Brooders, planters, petrol pump, freezers, sprinklers, carwash machines, building block molds, concrete mixer and porker vibrator were each 4.8 percent in the VTCs surveyed. This means VTCs operating in the county have varied capacities in terms

of equipment. Availability of equipment influence delivery of specific skills to learners while their shortage can affect institutional capacity to promote agricultural mechanization by most of the vocational training centers. Analyzed data shows that sewing machines are owned by 57.7 percent of the VTCs. Table 11 gives a summary of machinery available in the institutions.

Table 11

Machinery in Vocational Training Centres

Machinery	Sector of relevance	VTCs	Percent
Flour mill	Crop, livestock, fishery	1	4.8
Tractor	Crop, livestock, fishery	Nil	Nil
Motor Vehicles	Crop, livestock, fishery	7	33.3
Feed mixer	Crop, livestock, fishery	1	4.8
Chuff cutters	Crop, livestock, fishery	1	4.8
Motor boats	Fishery	Nil	Nil
Motor cycles	Crop, livestock, fishery	1	4.8
Millet thresher	Crop	Nil	Nil
Oil press	Crop	1	4.8
Harvesters	Crop	Nil	Nil
Bread oven	Crop	1	4.8
Juice press	Crop	1	4.8
Sewing machines	Crop	12	57.5
Driers (solar or power)	Crop	2	9.5
Wood lathe	Crop, livestock	1	4.8
Knapsack	Crop, fish	2	9.5
Air compressor	Livestock	1	4.8
Cabro mould	Livestock, crop, fishery	1	4.8

Sewing machines are used on textiles, garments and fabrics that are derived from crops like cotton. Motor vehicles are owned by 33.3 percent of the VTCs offering motor vehicle mechanics. Hair blow driers and knapsacks are each found in 9.5 percent of the institutions. Air compressors, cabro and block molds, flour mills, feed mixers, chuff cutters, motorcycles, oil press, bread oven, juice press and wood lathe are each owned by 4.8 percent of VTCs. The percentage of ownership was low but they present institutional capacity to promote

mechanisation. The results in Table 12 indicate that 19 different types of facilities were in the VTCs.Variation was found to exist in the relevance to promotion of agricultural mechanization.

Table 12

Physical Facilities in Vocational Training Centres

Facilities	Sector of relevance	VTCs	Percentage
Electricity	Crop, livestock, fishery	7	33.3
Workshops	Crop, livestock, fishery	8	38.1
Classrooms	all-purpose	10	47.6
Class/workshop	all-purpose	11	52.4
Library	all-purpose	7	33.3
Resource centers	all-purpose	4	19.0
Demo farm	Crop	3	14.3
Poultry house	Livestock/poultry	1	4.8
Greenhouses	Crop, livestock, fishery	2	9.5
Sanitation	Purpose built	21	100
Solar panels	Crop, livestock, fishery	2	9.5
Catering	Crop, livestock, fishery	1	4.8
Hostels	Accommodation	2	4.8
Water tanks	Crop, livestock, fishery	4	19.0
Taped water	Crop, livestock, fishery	1	4.8
Irrigation (farm)	Crop	1	4.8
Machine shop	Crop, livestock, fishery	1	4.8
Borehole	Crop, livestock, fishery	5	23.8
Driving school	Farm produce transport	2	9.5

mechanization. Facilities which present capacity to promote agricultural mechanization on average were in some of the institutions. The facilities include electricity, workshops, library, resource centers, demonstration farms, poultry houses, greenhouses, solar panels, catering, water tanks, taped water, irrigation system, machine shop, borehole and driving lessons.

Most VTCs are well stocked with hand tools as shown in Table 13. They are for maintenance of compounds, school farms and training of leaners. Jembes, slashers and machetes were owned by 100 percent of the VTCs.

Table 13

Hand Tools in Vocational Training Centres

Hand tools	Sector of relevance	Status	VTCs	Percent
Jembe (Hoes)	Multipurpose	in use	21	100
Rakes	Multipurpose	in use	15	71.4
Water can	Multipurpose	in use	17	81
Workshop tools	Multipurpose	in use	21	100
Forks	Multipurpose	in use	8	38.1
Slasher	Multipurpose	in use	21	100
Machete	Multipurpose	in use	21	100
Secateurs	Multipurpose	in use	2	9.5

Water cans and rakes were owned by 81 and 71.4 percent respectively. Forks were in 38.1 percent while secateurs were owned by 9.5 percent of the farmers. Secateurs are mostly owned by rice workers and farmers.

4.5 Agricultural Facilities owned by Small Holder Farmers

The fourth objective was to: examine agricultural facilities owned by small holder farmers in Kisumu County. In this study the term agricultural mechanization was used to mean utilities namely hand tools, machinery and equipment for the purpose of achieving objectives and outcomes in crop, livestock and fish farming. Prior to determining the facilities owned, the farming sectors the SHF were engaged in was established as summarized in Table 14.

Table 14

Farmers who participated in the survey

Category	Number	Percent
Crop Farmers	40	36.4
Livestock Farmers	33	30.0
Fishery	37	33.6
Total	110	100

Results from the Focus Group Discussions (Table 15) show that 31.8 percent of farmers used wheelbarrows in their activities. Drinkers and knapsacks were each used by 22.7 percent of farmers. The others were below 2.7 percent. In other jurisdictions, adoption of mechanized agriculture is not left to chance. Results (Table 15) obtained during the FGD indicate that

farmers own very few agricultural mechanization equipment and machinery. Data on equipment owned by SHFs was also gathered and analyzed. Table 15 shows the summary of results.

Table 15

Equipment owned by the SHFs

Equipment	Sector	Owned	Percent
Incubator	Poultry	2	1.8
Donkey carts	Multipurpose	2	1.8
Drinkers for poultry	Poultry	25	22.7
Knapsack	Crop, Livestock	25	22.7
Juice extractor	Crop	2	1.8
Bee hives	Livestock(apiary)	3	2.7
Hive smoker	Livestock(apiary)	3	2.7
Centrifuges	Livestock(apiary)	3	2.7
Petrol water pump	Multipurpose	35	31.8
wheelbarrows	Multipurpose	94	85.5
Solar water pump	Multipurpose	10	9.1

Results in (Table 16) show that 28.2 percent of the farmers owned motor cycles followed by irrigation water lifting and application devices which were owned by 22.7 percent. Transport plays a key role in any given society at any given time. The high occurrence of motor cycles among farmers is because, its gearbox unit can drive externally attached implements like water pumps. The demand for transport is a derived one in that, it originates from the needs of people to travel to places of work, schools, markets and moving industrial raw materials and manufactured products (Jangid et al., 2010). Transport therefore plays the role of providing satisfaction of some other needs (Bamford, 1998). Water pumps powered by petrol fuel and solar energy were used by 18.2 and 4.5 percent of SHF. They were common because they are deployed in irrigation for efficient conveyance and application of water to crops ((Jangid et al., 2010). Results about skill attributes among tutors and utilities owned by VTCs indicate that they have the capacity to maintain, repair, service and train farmers and VTCs can promote mechanization among SHF.

Table 16

Machinery

Machinery	Sector of relevance	Owned by farmers	Percent
Groundnut processor	Crop	1	0.9
Feed mixer	Livestock	20	18.2
Chuff cutters	Livestock	5	4.5
Tractors	Multipurpose	3	2.7
Motor boats	Fishery	17	15.5
Motor cycles	Multipurpose	31	28.2
Flour mills	Crop	21	19.0
Rice mills	Crop	1	0.9
Rotavators	Crop	10	9.1
Rice harvester	Crop	1	0.9

The enhanced level of mechanization for irrigation is due to droughts experienced following perennial floods in the Kano plains region. Significant mechanization was also seen as 19.0% and 15.5% respondents' possessed flour mills and motor boats respectively. Agricultural mechanization will not be successful if the economy of SHF is unable to pay for servicing, fuel and spare parts (Sims, 2006). Flour is the main ingredient of 'ugali' which is a well-cooked dough kind of cuisine which is a staple food in Kenya. Flour mills grind grains into flour and hence their popularity at 17.0 percent ownership among small holder farmers.

Analyzed results (Table 17) show that farmers owned assorted hand tools. The most owned were Jembes (hoes) and machetes at 100 percent. Farmers explained that jembes and machetes are affordable, handy, do not require skilled people and are used by all members of a family. Slashers are used by 92.7 percent of the farmers. They come in different shapes. Farmers use slashers to clear bushes and to trim fences from farms and homes. Pupils are also 'occasionally asked to carry slashers to school' according to some farmers in Nyando sub county. Water cans, rakes and forks were used by 56.4, 48.2 and 42.7 percent respectively. The three were used on crops, livestock and fishery. Secateurs were used by 9.1 percent. They are used to harvest rice and fodder for cattle among other applications.

Table 17

Hand Tools owned by Farmers

Hand tools	Sector of relevance	Status	Farmers	Percent
Jembe (Hoes)	Multipurpose	in use	110	100
Rakes	Multipurpose	in use	53	48.2
Water can	Multipurpose	in use	62	56.4
Forks	Multipurpose	in use	47	42.7
Slasher	Multipurpose	in use	102	92.7
Machete	Multipurpose	in use	110	100
Secateurs	Crops	in use	10	9.1

Analysis of the physical facilities (Table 18) owned by farmers show that Electricity was very common at 89.1 percent. This could be the impact of promotion by the government which encourages citizens to adopt electricity. The same could happen with machinery if VTCs focused on promotion of farm machinery. Cattle barns was at 20.1 percent while fish ponds were at 17.3 percent. Poultry houses were 13.6 and fish cages were 9.1 percent. Sectors targeted by government for promotion show enhanced adoption.

Table 18

Physical facilities owned by Small Holder Farmers

Physical facilities	Relevant sector	Status	Farmers	Percentage
Electricity	Multipurpose	in use	98	89.1
Cattle barns	Livestock	in use	23	20.1
Poultry houses	Poultry	in use	15	13.6
Fish cages	Fishery	in use	10	9.1
Fish ponds	Fishery	in use	18	17.3

4.6 Outreach Services offered by VTCs with regard Agricultural Mechanisation

The fifth objective of this study was: To establish whether there was outreach service to Small Holder Farmers by Vocational Training Centres to promote agricultural mechanisation in Kisumu County, Kenya. In this study the term outreach between VTCs and SHF was used

to mean an arrangement whereby farmers were encouraged and sensitized through formal or informal or deliberate educational methods to adopt mechanized means and utilities to improve performances and procedures in farming activities. Discussion about the gender of farmers, a distinguishing factor considered important to this study is presented in this section. Farmers who attended Focus Group Discussions were asked to state their gender. The distribution in frequency and percentage of the gender is presented in Table 19. The results indicate that 50.9 percent were women and 49.1 percent were men. This outcome shows that women are more responsive to mechanization issues than men. Gender of the farmer is important in African societies because it determines how farming operations are undertaken and how resources are owned and managed. According to Chambers et al. (1989), it also affects how information is disseminated and how new ideas and are perceived. Extension officers and researchers use this cultural structure to develop and promote technologies that are acceptable to the intended audience. With respect to this study the factors of women being more responsive could be used to promote agricultural mechanization.

Table 19

Distribution of female and male respondents in terms of numbers and percentage

Cluster	Female (%)	Male (%)
Katito	12(10.9)	11(10.0)
Ahero	10(9.1)	10(9.1)
Sianda	14(12.7)	10(9.1)
Kitambo	12(10.9)	10(9.1)
Kigoche	8(7.3)	13(11.8)
Total	56(50.9)	54(49.1)

During focus group discussions, participants were asked to state whether they were aware of programs being offered by VTCs. The results are presented in Table 20. Findings show that exhibitions had the highest-level awareness of 18.2 percent among the respondents while seminars had the lowest awareness of 3.6 percent. Field days and workshops level of awareness was 10.9 percent each. Farm/home visits and demonstrations were 9.1 percent and 6.4 percent respectively. According to the Higher Education Ministry of India (2009) technologies developed by research institutions could not be adopted by SHF since the process of transfer of technologies was not undertaken in a planned manner. These results

show low levels of awareness. Exhibitions at 18.2 percent, was the highest due to fashion design, hair dressing, beauty therapy services and shows in the VTCs. The level of non-awareness was above 80 percent for all methods. This is consistent with Binde (2010) assertion that techniques of communication used to promote knowledge determines the level of awareness and rate of adoption of the innovation. These result are also consistent with studies which have shown that communities are not informed of VTCs' activities and potential benefits.

Provision of technical and consultancy services to farmers, businesses and industries through outreach programmes are among functions of VTCs as stated in the County Government of Lamu, Kenya vocational training centers (previously referred to as Youth Polytechnics) bill of 2014. However, not many respondents were aware of these functions of VTCs. Table 20 shows the results from FGD sessions when the participants were asked about trainings.

Table 20

Level of SHF awareness about extension methods used by VTCs to reach farmers

Extension Methods	SHF Aware (%)	SHF Not Aware
Farm/home visits	10 (9.1)	100 (90.9)
Exhibitions	20 (18.2)	90 (81.8)
Seminars	4 (3.6)	105 (96.4)
Field days	12 (10.9)	98 (89.1)
Workshops	12 (10.9)	98 (89.1)
Demonstrations	7 (6.4)	103 (93.6)

Table 20 shows the results from FGD sessions when the participants were asked about trainings. A total 59.1 percent of the respondents confirmed having attended skill improvement training about poultry in the VTCs. The other 37.7 percent attended innovation training on solar pump application, hiring, collaboration, and funding and for mechanical and electric pump for irrigation and other farming requirements. Another 29.9 percent attended training about drip, overhead, surface irrigation. Most of these courses were conducted in Ahero, Katito and Arch Bishop Okoth. Vocational Training Centres in Kisumu County. VTCs are at a different level of competence to promote agricultural mechanization. Ahero, Arch Bishop Okoth and Katito VTCs are fairly equipped. Katito has a fully-fledged school of agriculture with irrigation facilities including a borehole, solar pump and a training farm.

They also offer poultry activities. Ahero has poultry undertakings, both mechanical and solar pump to irrigate crops in the green house and the farm. Arch Bishop Okoth has built a poultry house used for training farmers in poultry production. Farmers expressed the need to 'sensitize

Table 21

Trainings offered by Vocational Trainings Centres to farmers

Training	Topic	Farmers in attendance	Percent
Skill improvement	Irrigation	32	29.1
Sensitization	Hatchery	65	59.1
Innovation	Solar pump	41	37.7

Table 22 shows that computer packages, hair dressing and fashion were the outreach services offered most at 14.3 percent of the VTCs. This is in line with Chauhan (2008) assertion that numerous digital educational tools have been innovated and used in promoting collaboration with community, and facilitating communication between students, tutors and the public. Building technology and electrical and electronics was each offered by 4.8 percent VTCs. Heads of department explained that building services included architectural plans and actual construction of structures as requested by individuals and county government. Electrical and electronics was required by the community for electrical installations and repair of appliances.

Table 22

Outreach Services that promote AM offered by Vocational Training Centres

Outreach Service	Component	VTCs	Percent
Computer packages/services	Cyber	3	14.3
Fashion show	Design	3	14.3
Hair dressing	Beauty	3	14.3
Electrical and Electronics	Wiring	1	4.8
Buildings	Construction	1	4.8

Reports and data from the interview with principals and corroborated by SHF in the Focus Group Discussions, only 11 (52.4) VTCs offered outreach services. The services were on and off and not deliberate or formally scheduled. According to one principal, 'services were offered on request from the SHF and other clients'. He added that 'outreach works well when

awareness is created among the target groups about agricultural mechanization'. Information Education and Communication (IEC) plays a vital role in changing the attitudes of people (Ministry of Human Resource, India, 2009). The low uptake of services shown on Table 22 is because IEC has not been applied by VTCs to create awareness about their potential. A Principal of one VTC noted they had been successful because of 'collaboration with experienced partners who offered valuable knowledge about outreach to poultry farmers'.

The VTCs which offer outreach services (Table) are few compared to the total number of VTCs in the county.

Table 23

Outreach services to SHF and VTCs offering the services

Service to SHF	Vocational training Centres Offering the services
Computer packages/services	Ahero, Kitambo,BishopOkoth
Hair dressing	Kitambo,Kadongo, Nyabera Wachara, Bishop Okoth
Electrical	Ahero
Buildings	Ahero
Fashion Show	Mariwa,Kadong,BishOkoth

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the study, conclusions and recommendations of the study. The first section of the chapter presents summary of the study, followed by the conclusions of the study which are organized according to objectives of the study. Recommendations of the study are both for further research and policy considerations.

5.2 Summary of the Study

This study examined the institutional capacity of vocational training centers to promote agricultural mechanization among small holder farmers in Kisumu County, Kenya. Factors that were investigated were courses in the curriculum, qualifications as human capital, facilities for training in VTCs, level ownership hand tools, equipment, machinery among farmers in Kisumu County and outreach services offered by VTCs to SHF that promote agricultural mechanization in Kisumu County.

Descriptive survey design was used in this study. Census was used to select 21 VTC principals and purposive sampling to select 21 HoDs of agricultural mechanization related courses and 110 small holder farmers from the accessible population of Small Holder Farmers. Data was analyzed using the SPSS version 20.0. Descriptive statistics such as frequencies, percentages and means were presented in tables to enable analysis. Qualitative data was evaluated, classified and categorized into appropriate themes guided by the objectives then presented in narratives.

Summary of findings of the study

The study identified courses in the Vocational Training Centres' Curriculum with topics which promote agricultural mechanization. Study found that because VTCs deliver courses that relate to agricultural mechanization, they possess institutional capacity to promote mechanization.

The other finding was that tutors in VTCs possess the necessary qualifications in terms of skills and experience to enable the promotion of agricultural mechanization. The qualifications are Government Trade test, Craft, Diploma, KTTC Diploma and Degree in their respective fields of specialization. Their experience range between 5 to slightly above 20 years. The study revealed that all tutors were hands-on facilitators and their experience compensated for the differences in levels of qualifications in handling tasks. The more

experienced are regarded to be as capable as the more qualified. The teaching and training competencies and qualifications bestow on the VTCs institutional capacity to promote agricultural mechanization.

The study also established that Vocational Training Centres had facilities for training, categorized as equipment, machinery, hand tools and physical facilities which were appropriate to teach courses and to promote agricultural mechanization among small holder farmers. They had necessary training facilities but not adequate and some were not contemporary although they were relevant for the promotion of agricultural mechanization. Some principals expressed concern about the insecurity of facilities which had impacted negatively on improvements intended by the Board of Governors.

Another finding was that farmers owned hand tools due to the history of traditional forms of farming. The most owned equipment were wheel barrows because they are affordable and can be used as means of transport in markets and towns followed by drinkers for poultry stock and Knapsacks which were popular because they can be used commercially to raise income. Ownership of machinery was also established that motor cycles, motor boats, petrol water pumps and flour mills were preferred by small holder farmers. Physical facilities were also owned fairly well by farmers. Electricity, sources of water (ponds, piped, tanks), cattle sheds and poultry houses were common among small holder farmers. Generally, utilities which could be rented out or used directly to bring income were preferred by small holder farmers. But mechanization was low among farmers.

The study further established that Vocational Training Centres offered outreach to small holder farmers but only in skill improvement in mechanized irrigation, sensitization about modern poultry especially hatchery and innovations where they learnt about solar water pumps. These trainings were mostly sponsored by Non-Governmental Organizations, farm input firms and service providers. Farmers complained that 'short courses were not frequent enough and should be supported by follow ups and evaluation to assess the adoption levels of those technologies'. The outreach services to community but not specifically to promote agricultural mechanization.

5.3 Conclusions

The following Conclusions were prepared based on the findings of the study as guided by the five research questions:

i. Vocational Training Centers offer 87.5 percent of courses which relate to the promotion of agricultural mechanization of crop, livestock, and fishery.

ii. Tutors had the training, experience and relevant qualifications to promote agricultural mechanization. Some VTCs lacked adequate number of tutors.

iii. Facilities in VTCs were relevant. Workshops, classrooms, tools and equipment, machinery was not adequate. Some VTCs used classrooms as workshops and offices at the same time.

iv. Small Holder Farmers in Kisumu commonly use manual labor and hand tools to accomplish tasks. Mechanization level is low. Electricity was the most available physical facility followed by cattle barns, poultry houses, fish ponds and cages.

v. Provision of outreach services by VTCs are minimal and not scheduled but can promote agricultural mechanization to crop, livestock, and fish farmers.

5.4 Recommendations

The following are the recommendations emanating from findings of the study:

i. Specific courses should be taught by VTCs to address mechanization as a subject and to promote it among farmers

ii. Recruitment of some tutors should be informed by the need to promote mechanization. Specific tutors should undertake short courses focusing on promotion of agricultural mechanization among farmers

iii. Facilities should be relevant, adequate and contemporary to promote agricultural mechanization. The National and County governments should adopt a standard architectural and infrastructure plan to construct uniform structures like workshops and offices in all VTCs to address physical facility disparities

iv. County and National governments should deliberately promote agricultural mechanization among Farmers to improve the level of adoption. Facilities are expensive, but cooperatives are one way to solve the problem of cost.

v. Deliberate and targeted VTCs outreach programs and not casual opportunities be put in place by County of Kisumu and National governments to promote agricultural mechanization among small holder farmer.

5.4.1 Recommendations for further Research

i. How VTCs can augment content of courses, skills of tutors and training facilities being elements of Institutional Capacity to deliberately address promotion of mechanization small holder farmers in Kisumu County

ii. Which outreach method or methods can be most appropriate for VTCs to effectively convince small holder farmers to adopt agricultural mechanization in Kisumu County.

REFERENCES

Akpomi, M. E. (2009). Achieving millennium development goals (MDGs) through teaching entrepreneurship education in Nigeria higher education institutions (HEIs). *European Journal of Social Sciences, 8*(1), 152-159.

Akpomi, M. E. (2009). Entrepreneurship Education (EE) for all students in Higher Education Institutions (HEIs) in Nigeria:A means to sustainable development. *Journal of Sustain able Development in Africa, 11*(1), 164-168. https://jsd africa.com/jsda/V11NO1_Su mmer2009/PDF/Entre%20Education.pdf

Agbulu, O.N., & Wever, D. G. (2011). *Introduction to Vocational Agricultural Education.:* Selfers Press Ltd. https://scrip,org/reference/referencepapers?referenced=1857108

Ananiadou, K. (2013). *Revisiting Global Trends in TVET: Reflections on theory and practice*. UNESCO-UNEVOC International Centre for Technical and Vocational Education and Training. https://unesdoc.unesco.org/ark:/48223/pf0000222894 ISBN.978-92-95071-57

Annor-Frempong, I. (2012, September). *Prospects of agricultural development in Africa: Implications for agricultural education and training.* In Third Ruforum Biennial Meeting (pp. 24-28). https*://repository.ruforum.org/sites/default/files/Annor-Frempong.%201.pdf*

Auda-Nepad. (2015). *Agriculture, food and nutrition* security. https:// nepad-aws.assyst-uc.com/continental data/agriculture –food-and-nutrition-security

Avis, J. (2012). Global reconstructions of vocational education and training. *Globalization, Societies and Education, 10*(1), 1-11. https://doi:10.1080/14767724.2012.646876

Ayodele, G., Harrison, G., & Maghra, H. (2023). *Curriculum Reforms in Agricultural Education for Human Resource Development in Nigeria*. Paper presented during the association of vocational and technical educators of Nigeria vol. 24 No.1. 2019. *https://researchgate.net/publication/366812279_*

Bamford, C. G., (1998). *Transport Economics*. Heinemann Educational Publishers.ISBN.0435332155. https://academia,edu *and www.cambrdge.org.*

Barabasch, A., Bohlinger, S., & Wolf, S. (2021). Policy transfers in vocational education and training and adult education. *Research in Comparative and International Education, 16(4), 335-338.* https://doi: 10.1177/17454999211063250.

Beegle, K. G., Hentschel, J. S., & Rama, G. (2013). World development report 2013: jobs (English). Washington, D.C.: World Bank Group. *http://documents.worldbank.org/curated/en/263351468330025810/World-development-report-2013-jobs*

Billett, S. (2011). *Workplace curriculum: practice and propositions*. *Theories of learning for the workplace: Building blocks for training and professional development programs*. 17-36. https://tailorfrancis.com/chapters/edit/10.4324/9780203817995-7

Blasi, A. H. (2020). *Applications of Cluster Analysis.* Technical Report.Researchgate https;//doi:10.13140/RG.2.2.32713.49764

Brian, S., & Josef, K. (2015): Mechanization of Conservation Agriculture for Smallholders Issues and Options for Sustainable Intensification. *Environments* 2015, *2*(2), 139-166; https://doi.org/10.3390/environments2020139. DOI: 10.13140/RG. 2.2. 32713.49764.

British Council. (2015). *The Uk skills system: an introduction*. https://british council.org/education/skills-employability

Bukar, G. M., &Timothy, Y. A. (2013). Impact of polytechnic education on entrepreneurship development in Nigeria. *Academic Journal of Interdisciplinary Studies*, *2*(7), 113-123. https://10.18052/www.scipress.com/ilshs.15.9. copus id: 55814832

Capacity Building Strategy for Agriculture Sector (2017) Republic of Kenya Ministry of Agriculture Live stock and Fisheries. https://*faolex.fao.org/docs/pdf/ken189996.pdf*

Callon, M., & Muniesa, F. (2005). Peripheral vision: Economic markets as calculative collective devices. *Organization studies*, *26*(8), 1229-1250.https://doi:org/10.1177/0170840605056393

Centers for Disease Control and Prevention (2016). Surveillance for Foodborne disease Outbreaks 2016 annual report. Atlanta, Georgia: U.S. Department of Health and Human Services, CDC, 2018. *https://cdc.gov/gov/fdoss/pdf/2016_FoodBorneOutbreaks_508.pdf*

Chambers, R., & Thrupp, L. A. (Eds.). (1994). *Farmer first: Farmer innovation and agricultural research*. Karthala Editions. https://doi.org/10.1017/S088918930000413

Chauhan, A. (2018). *Digital Education Tools for Teachers and Students* https://elearningindustry.com/digital-education-tools-teachers-students

Csaki, C., & de Haan, C. (2003). Reaching the rural poor: a renewed strategy for Rural Devel opment. *World Bank Publications.*https://hdl.handle.net/10986/14084

Das, S., & Dhara, S. (Eds.). (2021). Chemical solution synthesis for materials design and film device applications. *Elsevier. https://doi.org/10.1016/C2019-0-00309-3''*

Dasmani, A. (2011). Challenges facing technical institute graduates in practical skills acquisition in the upper east region of Ghana. *International Journal of WorkIntegrated Learning*, *12*(2), 67-79.*https://api.sematicscholar.org/CorpusID:208129096*

Dawkins, C. (2021). The Definition of Exhibition in Art Historical Inquiry. *Academia Letters*. https://doi.org/10.20935/AL3779DOI

Dawna L. C., & Steven B. J (2020). Maine Farm Safety Program: Hand Signals Useful for Farmers. *https://Bulletin #2335. extension.umaine.edu/publications/*

Delgado, R. C (2009). The Republic of Ecuador. National Plan for Good Living 2009-2013.PNBV.*https://planificion.gob.ec/wp-content/uploads/downloads/2016/03/Plan-National-Buen-Vivir-2009-2013-Ingles.pdf*

Diao, X., Silver, J., & Takeshima, H. (2016). Agricultural mechanization and agricultural transformation. *Xin Shen*. https://ssm.com/abstract=2778723

Emerick, K., & Dar, M. H. (2021). Farmer field days and demonstrator selection for increasing technology adoption. *Review of Economics and Statistics*, *103*(4), 680-693. *hhps://doi.org//10.1162/rest_a_00917*

Ershad, M.& Ali, E. (2020). Global Positioning System (GPS): Definition, Principles, Errors, Applications & DGPS.no April. *ResearchGate. Recuperado el*, *25*.

FAO (2012). Smallholders and Family Farmers.*https://openknowledge.fao.org/handle/20.500.14283/ar588e*

Gonon, P., Maurer, M., Wieckenberg, U., Arnold, R., Michaelowa, K., & für Entwicklung, S. D. (2011). SDC's Vocational Skills Development Activities: *Evaluation 2011/2:* Philipp Gonon...[et al.]; commissioned by the Corporate Controlling Section of the Swiss Agency for Development and Cooperation SDC.

General Report. (2012: *Third International Congress on Technical and Vocational Education and Training, Shanghai, People's Republic of China, 14-16 May*. SHANGHAI CONSENSUS. *https://unesdoc.unesco.org/ark:/48223/pf0000217683.*

Gessler, M., Evans, K., Hernandez, V., Malloch, M., Stalder, B., & Zhao, Z. (2018, January,6). Yearbook 2017: *International Journal for Research in Vocational Education and Training: Volume 1 (ISSN 21978638). https://.weraonline.org/wpcontent/uploads/2023/11/Vocational-Education-2018.pdf*

Houmy, K., Clarke, L. J., Ashburner, J. E., & Kienzle, J. (2015). Agricultural mechanization in sub-Saharan Africa: guidelines for preparing a strategy. Vol. 22, pp. xiv+-93.*https://api.semanticscholar.org/CorpusID:130491486*

Kienzle, J., Ashburner, J.E., & Sims, B.G. (2013). Mechanization for rural development: a review of patterns and progress from around the world. *Integrated Crop Management* . Vol.20-2013. https://www.fao.org/4/i3259e/i3259e.pdf.

Kenya Vision 2030 (2010) The National Treasury. State Department for Economic Planning. *https:// planning.go.ke/Kenya-version-2030/*

Kenya Agricultural Development Policy (2021): 'Food: Our Health, Wealth and Security' https://*kilimo.go.ke/wp-content/uploads/2022/05/Agricultural-Policy-2021.pdf*

Kenya Agricultural Sector Development Strategy (2010): KASDS 2010-2020 *https:// faolex.fao.org/docs/pdf/ken140935.pdf*

Kenya Bureau of Statistics (2019): Kenya Population and Housing Census. Distribution of population by Socio Economic Characteristics. *https://knbs.or.ke*

FAO, (2013). Agricultural Mechanization, sub-Saharan Africa, guidelines, strategy, preparation. *https://www.fao.org/publications/card/en/c/c5f369-668f-5a7c-acc2-b82b7055934f/*

FAO (2019) Technologies and Practices for Small Agricultural Producers. https://teca.apps.fao.org/teca/en/c/1042014

FARA (2011). Transforming African agriculture through research, advisory services, education and training. CAADP Pillar IV Strategy and Operational Plan (2011–2013). Accra, Ghana https://*library.farafrica.org/storage/2019/11/CAADP-Pillar-IV-Strategy-and-Operational-Plan-2011-2013 pdf*

Fiedler, J. L., Afidra, R., Mugambi, G., Tehinse, J., Kabaghe, G., Zulu, R., & Bermudez, O. (2014). Maize flour fortification in Africa: markets, feasibility, coverage, and costs. *Annals of the NewYork Academy of Sciences*, *1312*(1), 26-39. *https://doi.10.1111/nyas.12266*

Fien, J.,Wilson, D. (2005).Promoting sustainable development in tvet: 1 the Bonn declaration . *Prospects*.35(3), 273-288.*https://eric.ed.gov/id= EJ774780*

Government of Kenya (2009): KENYA - ITALY DEBT DEVELOPMENT PROGRAMME SUPPORT . Ministry of Youth Affairs and Sports five-year strategic plan (2005—2010): Kenya vocational training sector courses in the curriculum. https://planipolis.iiep.unesco.org/sites/default/files/ressources/kenya_kessp_final_2005.pdf. *https://nairobi.aics.gov.it/en/home/countries/kenya/debt-swap-2/*

Government of Kenya (2019). *Economic survey, 2019.* Government Printers. https://www.knbs.or.ke

Hajjar, S. T., & Alkhanaizi, M. S. (2018). Exploring the factors that affect employee training effectiveness: A case study in Bahrain. *Sage Open, 8*(2), 1112158244018783033 . https://doi.org/10.1177/2158244018783033

Indoshi, F. C., Wagah, M. O., & Agak, J. O. (2010). Factors that determine students and teachers attitudes towards art and design curriculum. *International Journal of Vocational and Technical Education, 2*(1), 917. https://academicjournals.org/article/article1379329644_Indoshi%20et%20al.pdfhttps://academicjournals,org/IJVTE

Ilcan, S., & Phillips, L. (2010). Develop mentalities and calculative practices: *The Millennium Development Goals Antipode*, 42(4), 844-874.

International Livestock *Research* Institute (2014). *Livestock improvement in western Kenya.* ILRI's strategy 2013–2022 publication. https://ilri.org/2023_ILRIstrategy

International Institute for Educational Planning Newsletter (2008). *Skills for improved productivity, employment growth and development.* Vol. XXV no 4 of October 2007. International Labor Conference, 2008. https://webapps.ilo.org/public/libdoc/ilo/2008/108B09_54_engl.pdf

Jangid, B. L., Intodia, S. L., & Regar, P. L. (2010). Status of farm power and machinery and promotion of farm mechanization in Southern Rajasthan. *Agricultural Engineering Today*, 34(4), 18-23. *https://mospi.gov.in/sites/default/files/Statistical_year_book_india_chapters/ch7.pdf*

Jangid, B.L., (2016). Promotion of farm mechanization in Udaipur District, Southern Rajasthan. Work plan and Promotion of Agricultural Mechanization among Small Farmers' program*. Ministry of Agriculture in India five-year plan of 1997-8 to 2001-2*

Jones, K. (2013). *The role of agricultural technical and vocational education and training in developing countries: A review of literature, issues and recommendations for action.* (Unpublished doctoral dissertation) The Pennsylvania State University/USAID .https://agrilinks.org/sites/default/files/resource/files/ATVET+CCS+kristal jones-9-20pdf

Jones, P., Wynn, M., Hillier, D., & Comfort, D. (2017). The sustainable development goals and information and communication technologies. Indonesian *Journal of Sustainability and Management,* 1(1), 1-15. https://doi.org/10.28992/ijsam.v1i1.22

Mondo, J. M., Bagula, E. M., Bisimwa, E. B., Bushunju, P. A., Mirindi, C., Kazamwali, L. M., Chirhuza, S. B., Karume, K., & Mushagalusa, G. N. (2020). Benefits and drivers of farm mechanisation in Ruzizi Plain, Eastern Democratic Republic of Congo. 28(1), 111.

Kathuri, J. N., & Pals, D.A. (1993). Introduction to Educational Research. *Journal of Science and Education (p 311-4).* https://doi.10.12691/education-311-4

Kerlinger (1993). *Introduction to Research Methodology in Psychology. (pp 5-7)* https://udc.ac.in/udc_staff/documents/downloads/RESEARCH_METHODOLOGY.pdf

Khamila, S., Ndaka, D. S., Makokha, A., Kyallo, F., Kinyanjui, P. K., Kanensi, O. J., & Mwai, J. (2019). Status of commercial maize milling industry and flour fortification in Kenya. *African Journal of Food Science*, *13*(3), 65-82. https://doi: 10.5897/AJFS2018.1782.

Kigwilu, P. C., & Akala, W. J. (2017). Resource utilization and curriculum implementation in community colleges in Kenya. *International Journal for Research in Vocational Education and Training (IJRVET)*, *4*(4), 369-381. https://doi.org/10.13152/IJRVET.4.4.4 (Techno serve 2013)

Klerkx, L., Jakku, E., & Labarthe, P. (2019). A review of social science on digital agriculture, smart farming and agriculture 4.0: New contributions and a future research agenda. *NJAS-Wageningen. Journal of Life Sciences*, *90*, 1-16. https://doi.org.10.1016/j.jas.2019.100315.

Kwon, H. J. (2009). The reform of the developmental welfare state in East Asia. *International Journal of Social Welfare, 18*, S12 S21.http://doi.org/10.1111/j.1468-2397.2009.00655.

Kelemba, K.Y. (2013). '*Youth empowerment through greening the curriculum in Kenya and youth employment through green jobs''.* Conference report: https://unevoc.unesco.org /fileadmin/up/Africa_regional_forum_meeting_report_2013online.pdf

Kenya Agricultural Sector Development Strategy (2010): https://faolex.fao.org/docs/pdf/ken 140935.pdf

KENYA, S. I. (2021). Ministry Of Agriculture, Livestock, Fisheries and Co-Operatives. https://Faolex.fao.org/docs/pdf/ken203456.pdf

Kenya Bureau of Standards (2018). *Standards for quality life. https://www.kebs.org*

Kenya Country Strategy Paper. (2013): African Development Bank Group 2014-2018.*afdb.org/fileadmin/uploads/Documents/Project-and-Operations/2014-2018_strategy paper.pdf*

Kisumu County Strategic Development Plan, (2013). *https://kpda.or.ke/documents/CIDP/Kisumu.pdf*

Kisumu County Integrated Development Plan, (2012). https://kpda.or.ke/documents/CIDP/Kisumu.pdf

Korea Legislation Research Institute (2022). *Agricultural Promotion Act number 18688.* https://faolex.fao.org>docs>pdf>korea166941

Law, S. (2010). *Case study "National policies linking TVET with economic expansion" Lessons from commission for the EFA Global monitoring Report 2012.* https://unesdoc.unesco.org/ark:/48223/pf0000217863

Leavy, J. ,& Hossain, N. (2014). *Who wants to farm? Youth aspirations, opportunities and rising food prices.* IDS Working Papers, 2014(439), 1-44. *://doi.10.1111/j.2040-0209.2014. 00439.x*

Leguizamon, I. N. C., Solano, R. A. C., Pinzón, D. E. O., Milla, B. A. G., & Moreno, M. S. N. (2023). FinTech Status in the Global Market: Challenges and the Future in Mainstreaming Cryptocurrency and the Future of Digital Finance (pp. 58-84). *IGI Global.* https://doi.10.4018/978-1-6684-8368-8.ch003

Loon V. J., Woltering, L., Krupnik, T. J.,Baudron, F., Boa, M., & Govaerts, B. (2020). Scaling agricultural mechanization services in smallholder farming systems: Case studies from sub-Saharan Africa, South Asia, and Latin. America. *Agricultural Systems.* 180, (82),1-16. 102792.*https://doi:10.1016/j.agsy.2020.102792*

Luyali, E.P., Olel, A.M., & Othuon, L. (2015). Enrolment trends in youth polytechnics in West Pokot County, Kenya. *Journal of Education and Practice.* ISSN 2222-1735 (Paper) ISSN 2222288X (Online) No.10.*https://files.eric.ed.gov/fulltext/EJ1081648.pdf*

Maclean, R., & Lai, A. (2011). The future of technical and vocational education and training: Global challenges and possibilities. *International Journal of Training Research.* 9(1-2), 2-15. *https://10.5172/ijtr.9.1-2 2*

Maguire, C. (2011). *Building the base for global food security – Agricultural education and training.* United States Agency for International Development, Washington, D.C. *https://usaid.gov/pdf_docs/pnaed457.pdf*

Makhumula, P., Dary, O., Guamuch, M., Tom, C., Afidra, R., & Rambeloson, Z. (2014). Legislative frameworks for corn flour and maize meal fortification. *Annals of the New York Academy of Sciences,* 1312(1), 91-104. *https: 10:1111/nyas.12349*

Majumdar, S (2016). *Technical Training & 21st Century Skills,* Proceedings of the Eight Saudi Technical Conference and Exhibition 2016, held in Riyadh, December 13-15.. www.tvtc.gov.sa/Arabic/Departments/

Maurer, M. (2012). *Structural elaboration of technical and vocational education and training systems in developing countries: the cases of Sri Lanka and Bangladesh*. *Comparative Education*, *48*(4), 487-503.https://doi.org/10.1080/03050068.2012.702011

Munar, B.Z., Estigoy, M.A., & Vargas, D. (2021). *Awareness level on farm Machinery among Rice Farmers.* Available at SSRN 4: 304–325.DOI:2139/ssm.3804325.

MoALF, C. R. P. (2017). *Profile for Kisumu County. Kenya County Climate (2018) :/UsersRiskProfile.Series.https://C/user/Downloads/Kisumu_Climate_Risk_Profile_Final.pdf*

Mugenda, O. M., & Mugenda, A. G. (2003). *Research methods: Quantitative & qualitative apporaches* (Vol. 2, No. 2). Nairobi: Acts press.

Ministry of Agriculture Livestock Fisheries (2015): *Achievements under the Jubilee Government's One Year*, 1–18. *https://kilimo.go.ke/wp-content/uploads/2021/02/Strategic-Plan-for-MOALF-for-2018-2022.pdf*

Ministry of Youth and Sports, (MoY&S, 2009). *National Vocational Certificate of Education and Training. Metal processing technology level I and Instructors manual. https://www.Scribd.com/document/534350409/INSTRUCTOR-S-GUIDE-LEVEL-I-AND-II-2*

Mnrique, I. I., Hermans, T., Caterina, D., Jougnot, D., Mignon, B., Masse, A.,Nguyen, F. (2024). Integrated methodology to link geochemical and geophysical-lab data in a geophysical investigation of a slag heap for resource quantification. *Journal of Environmental Management.* 349, 119-366.

Mondo, J. M., Bagula, E. M., Bisimwa, E. B., Bushunju, P. A., Mirindi, C. M., Kazamwali, L. M., & Mushagalusa, G. N. (2020). Benefits and drivers of farm mechanisation in Ruzizi plain, eastern Democratic Republic of Congo. *African Crop Science Journal*, 28(1), 111-130.

NEPAD, (2019). *Agriculture Technical Vocational Education and Training, Kenya.* African Union Development Agency.https://nepad.nepad.org/nepad-oncontinent/agriculture-tecn-and-training-atvet-kenya (2019)

NEPAD/ NPCA/ CAAD, (2013). *Review of Agricultural Technical Vocational Education and Training (ATVET) in Africa - Best Practices from Benin, Ethiopia, Namibia and Sierra Leone.* https://nepad.nepad.org/nepad-oncontinent/agriculture-tecn-*and*-training-atvet-*best-practices-benin-ethiopia-namibia-and-siera-leone/*

Netherland Organization for International Cooperation in Higher Education (NICHE, 2010): *on Technical Vocational Education and Training.https://www.nuffic.nl/en/libr*

ary/niche-strategy-on-technical-and-vocational-education-and –training-tvet.pdf. Doc no: TD/TNC.118.486

Nyberg, Y., Jonsson, M., Laszlo Ambjörnsson, E., Wetterlind, J., & Öborn, I. (2020): Smallholders' awareness of adaptation and coping measures to deal with rainfall variability in Western Kenya. *Agroecology and Sustainable Food Systems*, *44*(10), 1280-1308. *https://doi. 10.1080/21683565.2020.1782305*

Nyerere, J. (2009). Technical & Vocational Education and Training (TVET) Sector Mapping in Kenya. *For the Dutch Schokland TVET Programme Edukans Foundation. Zero Draft https://schoklandtvet. pbworks. com/f/Microsoft+ Word+-+ Mapping+ report+ final-Nyerere+ mrt+ 09+ hp+ 2. pdf.*

Nunfam, V. F., Adja Kwabena Adjei, N., & Padi, A. (2015). *Human capital development in polytechnics in Ghana: prospects of industrial attachment. Journal of Economics and Sustainable Development,* 6 (16). https://Iiste.org/journals/index.php/JEDS/article/view/25351/25951

Obibuaku, L. O. (1983). *Agricultural extension as a strategy for agricultural transformation* (p.119). https://econbiz.de/Record/agricultural.extension-extension-as-astrategy-for-agricultural- *transformation-obibuaku-lawrence/10000743849*

OECD/F AO (2016). OECD-FAO Agricultural Outlook 2016-2025, OECD Publishing, Paris. http://dx.doi.org/10.1787/agr_outlook-2016-en

Oketch, M., & Lolwana, P. (2017*). Introduction Keynotes (Vocational Education and Training in Sub Saharan Africa. (pp. 11-38). https://wbv.de/artikel/6004570w011 and docs.opendeved.net/lib/6ZRJNF95*

Onen, D. &Oso, W. Y, (2005). *A general guide to writing research proposal and report: A handbook for beginning researchers.* Kisumu, Kenya: Option Press and Publishers.

Onuoha, S. N., Ajayi, O., & Imanogor, P. A. (2013). *Hand Anthropometry of Agricultural Workers in Ebonyi State Central Zone of Nigeria*. *IJERT*, *2*(4), 500-508. https://10.17577/IJERTV21S4196

Oxfordreference.com: Agriculture – definition*. https://www.oxfordreference.com*

Paroda, R. S., & Chadha, K. (2013). 50 years of crop science research in India. *Indian Council of Agricultural Research* [Corporate Author]. https:// *lib.icimod.org/record/5047*

Rao, K. S., Rao, H. L., & Chaluvarayaswamy, R. (2021). Management of Critical Thinking Abilities of Teachers and Learners in a Dynamic Futuristic Environment.

In Handbook of Research on Future Opportunities for Technology Management Education (pp. 1-17). IGI Global. https:// 10.4018/978-1-7998-8327-2.ch001

Rapsomanikis, G. (2015). The economic lives of smallholder farmers. https://10.13140/RG 2.1. 32239440

Republic of Kenya (2010). *Agricultural Sector Development Strategy 2010-2020.* https://faolex.fao.org/docs/pdf/ken140935.pdf

Republic of Kenya (2010). *The Constitution of Kenya*. https://Faolex.fao.org/docs/pdf/ken127322.pdf

Republic of Kenya (2012). *Industrial Training Act chapter 237 revised edition*. https://Kenyalaw.org/kl/fileadmin/pdfdownloads/Acts/IndustrialTrainingActCap237.pdf

Republic of Kenya (2013). *Technical and Vocational Education and Training act no. 29 of 2013*. *https://mit.ac.ke/wp-content/uploads/2022/11/TVET-ACT.pdf*

Republic of Kenya (2017). *Capacity Building Strategy for Agriculture sector* https://sector.faolex.fao.org/docs/pdf/ken189996.pdf

Roberts, T. G. Cohen, C., Ganpat, W., Heinert, S. (2016). *Building Linkages In Agricultural Education And Training Through Systems Thinking .AGRILINKS.* https://agrilinks.org/sites/default/files/resource/files/Audio_Transcript.pdf

Shaikh, S., Memon, S., Ahmed, I., Manzoor, R., & Shaikh, S. (2014). Impact of an Information, Education and Communication intervention on key family practices of mothers related to child health in Jamshoro, Sindh. *Pakistan Journal of Medical Sciences, 30*(3), 611. *https.//ncbi.nlm.nih.gov/pmc/articles/PMC4048517/*

Schultz, T. W. (1961). Investment in human capital. *The American economic review*, 51(1), 117.*https.//links.jstor.org/sici?sici=00028282%28196103%2951%3A1%3C1%3AIIHC%3E2.0.CO%3B2-4*

Scolaro, E., M. Beligoj, M. P. Estevez, L. Alberti, M. Renzi and M. Mattetti, "Electrification of Agricultural Machinery: *A Review," in IEEE Access,* vol. 9, pp. 164520-164541, 2021, doi: 10.1109/ACCESS.2021.3135037.

Shaw, G.B. (2011). *The wit and wisdom of George Bernard Shaw.* Mineola, NY; Dover Publications. *https://urn:Icp.witwisdomofberna000unse:Icpf:b561465f-fe31-405f-b267-bb5247379d53*

Sims, B., & Kienzle, J. (2015). Mechanization of conservation agriculture for smallholders: Issues and options for sustainable intensification. *Environments, 2*(2), 139-166.ISSN 2076-3298: *https://doi.org/10.3390/enviroments2020139*

Sims, B., & Kienzle, J. (2016). Making mechanization accessible to smallholder farmers in sub-Saharan Africa. *Environments, 3*(2), 1-18. https://doi.org/10.3390/enviroments 3020011

Smith, M. K., Wenderoth, M. P., & Tyler, M. (2013). The teaching demonstration: What faculty expect and how to prepare for this aspect of the job interview. *CBE—Life Sciences Education, 12*(1), 12-18. https:// doi:10.1187/cbe.12-09-0161

Stotsky, S. (2012). Common Core Standards' Devastating Impact on Literary Study and Analytical Thinking. Issue Brief No. 3800. *Heritage Foundation*. *https://heritage.org/education/report/common-core-standards-devastating-impact-literary-study-and- analytical-thinking*

Tegemeo Institute of Agricultural Policy and Development (2019). *Capacity in agriculture.* Division of Research, Extension of Egerton University. https://tegemeo.egerton.ac.ke

Technical Vocational Education and Training Act No 29 (2013). *Published by the National Council for Law Reporting,* Kenya.

Umar, I. Y., & Ma'aji, A. S. (2010). Repositioning the facilities in technical college workshops for efficiency: a case study of North Central Nigeria. *Journal of stem teacher education, 47(3), 69-78.*

UNESCO-UNEVOC, (2013, September 17-18). *Advancing TVET for Youth Employability and Sustainable Development. Regional Forum. https://unevoc.unesco.org/fileadmin/up/africa_regional_forum_meeting_report_2013 online.pdf*

UNESCO-UNEVOC (2015). *World TVET Database, France*. International Centre for TVET. UN Campus.https://*unevoc.unesco.org/wtdb/worldtvetdatabase_fra_en.pdf*

UNESCO (2014, May). *Sub-Saharan Africa 2013 EFA report global education for all*. Meeting, Muscat, Sultanate of Oman. *https://adeanet.org/en/system/files/ssa-2013-efa-report_0.pdf*

UNESCO. (2015). *World TVET Database Uganda.* UNESCO-UNEVOC International Centre forTVET.*https://unevoc.unesco.org/home/Dynamic+TVET+Country+Profiles/country=UGA*

United States Department of Agriculture (USDA, 2019). *Agriculture in the Classroom Program.* United States Department of Agriculture. *https://perma.cc/EM59-2SUJ*.

Vergnani, L. (2013). Africa: Muscle to machines: Cutting labour drudgery in Africa. *Partners in Research for Development,(Winter2013),*16-19. http://aciar.gov.au/files/part_1306_p16-19_0.pdf

White, B. (2012). Agriculture and the generation problem: rural youth, employment and the future of farming. *IDS bulletin*, 43(6), 9-19. *https://core.ac.uk/download/pdf/43538583.pdf*

Wit, H., Deca, L., & Hunter, F. (2015). Internationalization of higher education: What can research add to the policy debate? The European higher education area: Between critical reflections and future policies, 3-12. *Overview paper*.doi:10.1007/978.3-319.20877-

World Bank (2011). World Bank Development report. *DOI: 10.1596/978-0-8213-8500-5 https://documents.worldbank.org/curated/en/806531468161369474/world-development-report-2011-conflict-security-and-development-overview.*

Yasin, M.A.S. M, & Dzulkifli, M.A. (2011). Differences in depression, anxiety and stress between low and high achieving students. *Journal of sustainability science and management.* 6, 169-1. https:///jssm.umt.edu.my/file/2012/01/19.june 11.pdf

Youth Policy, (GoK, 2012). *The youth policy,* Published by government.press.*psyg.go.ke/docs/Kenya%20National%20Youth%20Policy.pdf*

Yekinni, O. T., & Afolabi, C. O. (2019). Farmers' assessment of the effectiveness of extension communication methods used in Ogbomoso Agricultural Zone of Oyo-State, Nigeria. *Journal of Agricultural Extension, 23*(3), 126-134.*https://doi.10:4314/JAE.V2313.11.Corpus ID:202175641*

Zaalmink W. & Michelle de G. (2022). *Ministry of Agriculture, Nature and Food Quality of the Netherlands: Agricultural education in Bulgaria, Hungary, Poland and Romania.* Commissioned by the agricultural counsellors of the Netherlands to `Bulgaria, Hungary, Poland and Romania. https://www.agroberichtenbuitenland.nl/documenten/publicaties/2022/01/18/agri-education

APPENDICES

Appendix A: Questionnaire for Heads of Department

Dear Sir/Madam,

I am Kens Nyaidho-Matete from Egerton University currently conducting research titled "*Determining Institutional Capacity of Vocational Training Centers to Promote Agricultural Mechanization among Small Holder Farmers in Kisumu County, Kenya".* You have been selected to participate in this study because I believe you have information that can contribute significantly towards its success. I am therefore kindly requesting you to participate in the study by filling this questionnaire. May I assure you that any information given will be treated with utmost confidentiality and will be used only for the purposes of this study.

Instructions

- Write the name of your **Vocational training centre (VTC)** on this questionnaire.
- Indicate the selected response by placing a tick (√) in the appropriate cell/box or writing the answer in the given space.

Section A: Demographic Information

1. Gender: Male [ ] Female [ ]
2. Highest qualification: Grade 3 [ ] Grade 2 [ ] Grade 1 [ ] Module 1 [ ] Module 2 [ ] Module 3 [ ] Artisan [ ] Craft [ ] Technician Certificate [ ] Diploma [ ] Higher Diploma [ ] Bachelors [ ] Others (Specify) ……
3. Area of specialization: Automotive [ ] Farm machinery [ ] others ……..
4. Highest level of Professional training: ……
5. Experience as a trainer in years ……...

Section B: Courses in VTC Curriculum

1. Number of students in the department: Males ……..Females……
2. Number of students in the VTC: Males……Females…….

State the courses and topics which are offered by the VTC that are related to agricultural mechanisation of farms owned by smallholders engaged in crop, livestock and fish production

No	Course	Topic(s) related to agricultural mechanization
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

3. **S**uggest 3 additional courses or topics that should be offered by the VTC to enhance its institutional capacity to promote agricultural mechanization among smallholder crop, livestock and fish farmers neigbouring the institution?

a)…….. ……

b)**.....**

c)…….……

Section C: Human Resource

1.Please indicate:

- Number of staff in the department……
- Highest level of education of staff ……**.....**
- Areas of specialization ……..
- Professional training …….
- Experience in years ……...

2. In your view, do staff in your departments have the competencies (knowledge/skills) related to agricultural mechanization? ……

3. Do the department staff have the capacity to promote Agricultural Mechanization among crop, livestock and fish smallholder farmers? Yes ( ) No ( )

a) If Yes, explain……..

b) If No, state reasons……...

Section D: Facilities

1. Indicate by placing a tick against a facility listed in the below tables that are available in your department

i. Equipment

Equipment	**Available**
Incubator	
Hatchery	
Brooders	
Planters	
Generator	
Water pump	
Coolers	
Driers	
Sprinklers	
Welder gas/arc	
Lathe Machine	
Others (specify	

ii. Machineries

Machinery	**Available**
Flour mill	
Tractor	
Feed mixer	
Chuff cutters	
Motor boats	
Millet press	
Oil press	
Harvesters	
Bikes	
Motor vehicles	

Maize sheller	
Others (specify)	

iii. Hand tools

Hand tool	**Availability**
Jembe	
Rakes	
Water can	
Forks	
Slasher	
Machete	
Secateur	
Wheel barrow	
Others (specify)	

iv. Physical facilities

Facility	**Available**
Electricity supplies	
Workshops	
Class rooms	
Library	
Resource centres	
Demonstration farm	
Green houses	
Sanitation	
Others (specify)	

2. Rate adequacy of the 4 category of facilities with regard to the departments mandate to train and organise outreach programmes

i. Equipment ……..

ii. Machineries …….

iii. Hand tools ……..

iv. Physical facilities ……...

Section D: Training, Outreach Programmes and Production Units

1. Please state the number of training for non-students within the VTC which the department was engaged in the last 5 years:
   a. Number of training ……..
   b. Theme of the training ……....
   c. Participants ……
2. Give the number of shows/exhibitions/demonstrations within the VTC for non-students which the department was engaged in the last 5 years:
   a. Number of shows/exhibitions/demonstrations
   b. Theme of the shows/exhibitions/demonstrations
   c. Participants ……..
3. Indicate the number of training provided outside the VTC which the department was engaged in the last 5 years:
   a. Number of training ……..
   b. The of the training ……...
   c. Participants ……..
4. State the number of shows/exhibitions/demonstrations outside the VTC which the department was engaged in the last 5 years:
   a. Number of shows/exhibitions/demonstrations ……..
   b. Theme of the shows/exhibition/demonstration ……
   c. Participants ...……
5. Give a list of products manufactured by VTC's production unit which the department is associated with:
   a. ……
   b. ……
   c. ……
6. Has the department been engaged in the promotion of agricultural mechanization among crop, livestock and fish small holder farmers? .....……

Section E: Success, Challenges and Suggestions

1. Highlight the role that your department has played in promoting agricultural mechanization among Small Holder Farmers …….
2. Indicate the challenges faced by the department in promoting agricultural mechanization among Small Holder Farmers …….
3. Suggest ways which can be used to improve the Capacity of your department to promote agricultural mechanization among Small Holder Farmers around your VTC……..

Appendix B: Principals' Interview Guide

Date…… **Name of institution……**

1. The researcher introduces himself to the principal, explains the purpose of his visit and seeks the principal's consent to be involved in the study.
2. Researcher inquiries about number of male and female students per course
3. Researchers gathers principals bio-data (Education level, Experience, area of specialization, duration as head of the institution) …….
4. Discuss with the principal courses in the curriculum that are related to agricultural mechanization with regard to:
   - Crops (maize, sorghum, millet, rice) …….
   - Livestock (cattle, goats, sheep, chicken) ……...
   - Fish farming (pond, cage) …….
5. Engage principal in a discussion on promotion of agricultural mechanization and human resource available in the institution with respect to:
   - Number of staff available ……..
   - Level of education of staff …….
   - Professional training ……..
   - Experience …….
6. Focus the discussion on facilities in the institution and promotion of agricultural mechanization of small holder farmers. Categories of facilities:
   - Physical (classrooms, laboratories, workshops, libraries, resource centers) ……
   - Machinery ……..
   - Equipment …….
   - Tools ……..
7. Seek information on activities and outreach programs related to promotion of agricultural mechanization
   - Players in the activities/programs ……..
   - Production units …….
   - Exhibitions/shows/demonstrations ……
   - Training…….
8. Hold discussions on:

- How successful has the VTC been in promoting agricultural mechanization among Small Holder Farmers …….
- Challenges faced in promoting agricultural mechanization among SHF……...
- Recommend ways of enhancing institutional capacity of VTC to promote agricultural mechanization among Small Holder Farmers …….

Appendix C: Key Informants Focus Group Discussion Guide

1. **Introduction and organization of FGD**
   a. The researcher introduces himself to the group, explains the purpose of the discussion and seeks consent of the participants. ……..
   b. Introductions and explaining to the participants the organisation and guidelines of the discusion ……
   c. The discussion should take around 45 minutes and the proceedings be recorded on paper, and using an audio or video recorder …….

2. **Location and Details of the participants**

   a. Location of the discussion ……
   b. Date ……...
   c. Number and personal details of the participants ……..

Discussion Topics

3. **Farming activities the SHF engage in**
   a. Crops …….
   b. Livestock ……...
   c. Fisheries ……

4. **Tools, equipment, machinary and facilities owned/used by SHF**

   i. Tools ……
   ii. Machinary ……
   iii. Equipment ……
   iv. Physical facilities …….

5. **Programmes offered and community outreach services provided by VTC**

   Explore through discussions whether the SHF are aware of programmes offered by VTC and community outreach/extension services provided by such institutions.

   i. Training …….
   ii. Exhibitions/Shows/demonstrations ……...
   iii. Production-units ……
   iv. Outreach/extension-services ……..
   v. Others (list) ……

6. **SHF engagements with VTC**
    i. Training ……
    ii. Exhibitions/Shows/demonstration ……
    iii. Production units ……
    iv. Outreach programmes ……..
7. **Agricultural mechanization**

    Discuss programs/activities conducted by VTCs which can assist SHF in agricultural mechanization with regard to crop, livestock and fish farming:

    i. Training ……
    ii. Exhibitions/shows/demonstrations …….....
    iii. Extension/field visits ……
    iv. Producing farm implements/equipment/machinery ……..
8. Discuss the major challenges SHF face in their endeavor to mechanize their farming activities …….……
9. Examine with the Groups what needs to be done to enhance agricultural mechanization among SHFs …..……

Appendix D: Equipment, Machinery, Tools and Physical Facilities Checklist

Code of the Institution …… Date ….....

Concentrate on facilities related to agricultural mechanization

Section A: Equipment

Equipment	Quantity	Condition	Relevance (crop, livestock, fisheries mechanization)
Incubator			
Hatchery			
Brooders			
Planters			
Generator			
Water pump			
Coolers			
Driers			
Sprinklers			
Welder gas/arc			
Lathe Machine			
Others specify			

Section B: Machineries

Machinery	**Quantity**	**Condition**	**Relevance (crop, livestock, fisheries mechanization)**
Flour mill			
Tractor			
Feed mixer			
Chuff cutters			
Motor boats			
Millet press			
Oil press			
Harvesters			
Bikes			
Motor vehicles			

Maize sheller			
Others (specify)			

Section C: Hand tools:

Hand tool	**Quantity**	**Condition**	**Area of use (crop, livestock, fisheries mechanization)**
Jembe			
Rakes			
Water can			
Forks			
Slasher			
Machete			
Secateur			
Wheel barrow			
Others (specify)			

Section D: Physical facilities:

Facility	**Quantity**	**Condition**	**Remarks**
Electricity supplies			
Workshops			
Class rooms			
Library			
Resource centres			
Catering			
Hostels			
Sanitation			
Others (specify)			

2. Overall rating status of equipment, machinery, hand tools and physical facilities in the institution for promoting agricultural mechanization in the following farming areas:

i) Crops ……...

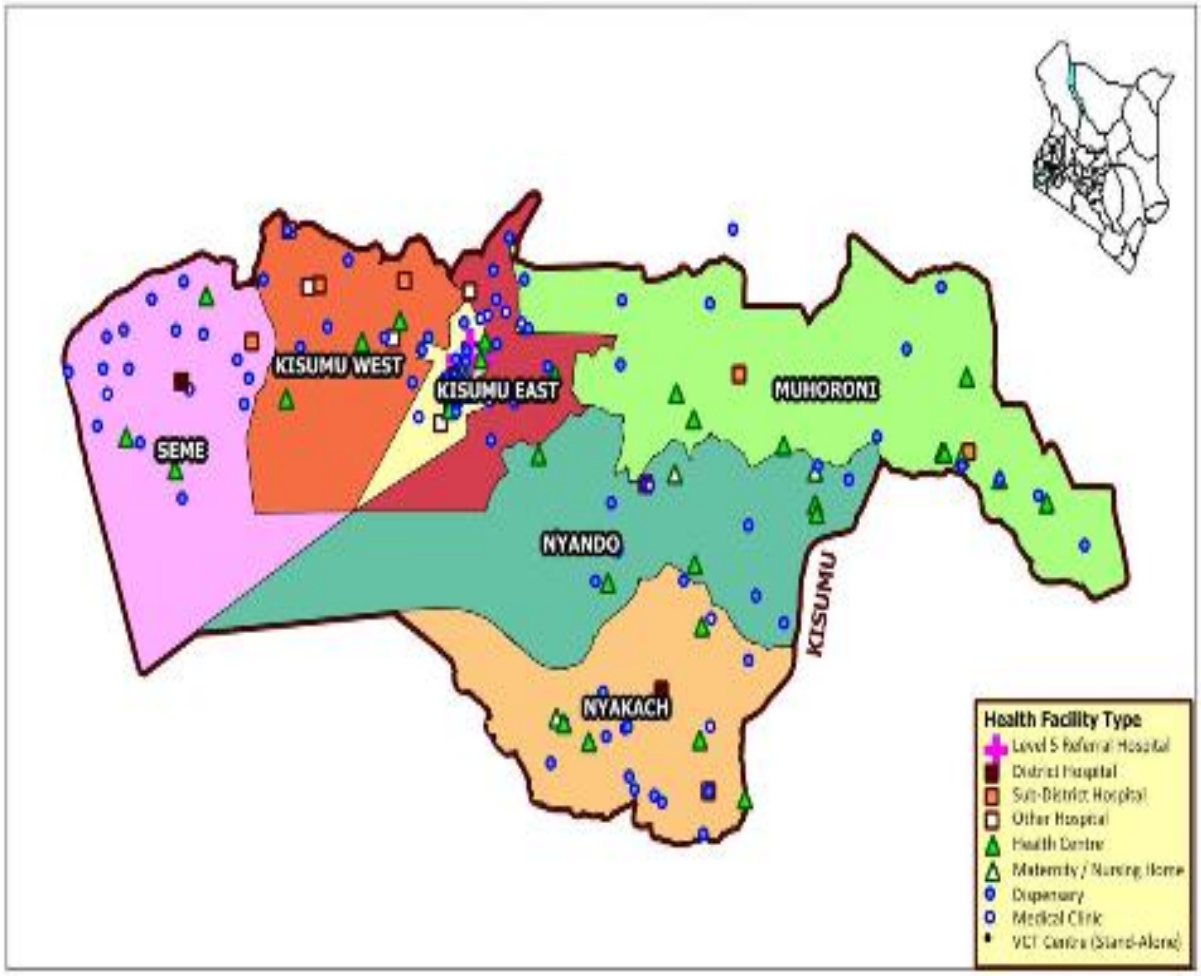
ii) Livestock…….

iii) Fisheries…….

Appendix E: Tutors in VTCs and their areas of Specialization

Vocational Training centers	Courses offered															
	Electrical and Electronics	Building Technology	Fashion and Garment	Hairdressing and Beauty	Information Technology	Tile ling	Food and Beverages	MotorVehicle Technology	Metal Processing	Welding and Fabrication	Agriculture/Agribusiness	Driving and operation	Plumbing	Masonry	Carpentry and Joinery	Hospitality
	Staff per course															
Achego	1	1	1	1	1		1	1		1	1					
Ahero	2	1	2	1	1		2	1		1	1	2	1			
ACK Kigoche	1	2	1		1									1	1	
Akado	2		1	1	2		1	1					1	1		
Alara		1	1	1									1	1		
Arc Bishop Okoth	1		2	1	2			2						1	1	
Bar Mathonye	1		1	1	1									1		
Chwa		1	1	1												
Kadongo	2		1	1												
Karaten'g		1	1					1								
Kandaria		1	1	1	1			1			1					
Katito	2	2	2	1	1		1	2		1	2	2				
Kitambo	1	1	1	1	1	1	1									
Lung'a		1	2	1	1			1								
Mariwa	1	2	2		1		1	1								
Nyabera		1	1	1					1						1	
Obange	1	1	1	1	1			1	1				1			
Sabako	1	1	1	1	1			1					1		1	1
Sianda	1	1	1	1	1		1	2								
Wachara	1	2	1	1	1			2								
Withur	1		1	1										1		
Frequency	**19**	**20**	**26**	**18**	**17**	**1**	**8**	**17**	**2**	**3**	**5**	**4**	**5**	**6**	**4**	**1**

Appendix F: Map of Study Area



Source: Map of County of Kisumu Sub-Counties (USAID, 2013*)*

Appendix G: Research License From NACOSTI

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NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **437068**

Date of Issue: **16/December/2020**

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This is to Certify that Mr.. ERASTUS KENS MATETE of Egerton University, has been licensed to conduct research in Kisumu on the topic: CAPACITY OF VOCATIONAL TRAINING CENTRES TO PROMOTE AGRICULTURAL MECHANISATION AMONG SMALL HOLDER FARMERS IN KISUMU COUNTY for the period ending : 16/December/2021.

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Appendix H: Research Authority from the County Commissioner

THE PRESIDENCY

MINISTRY OF INTERIOR AND COORDINATION OF NATIONAL GOVERNMENT

Telephone: Kisumu 2022219/Fax: 2022219
Email: ckisumucounty@gmail.com

COUNTY COMMISSIONER
KISUMU COUNTY
P.O. BOX 1912-40100
KISUMU.

Ref: CC/KC/ RES/1/3/VOL IV/72 **Date:** 4th January, 2021

All Deputy County Commissioners
KISUMU COUNTY

RESEARCH AUTHORIZATION: MR. ERASTUS KENS MATETE

Reference is made to a letter from the National Commission for Science, Technology and Innovation no. NACOSTI/P/20/8218 of 16th December, 2020 on the above underlined subject matter.

The above named is a Student of Egerton University. He has been authorized to carry out a research on "***capacity of Vocational Training Centres to promote Agricultural Mechanisation among small holder farmers in Kisumu County.***
The research period ends on 16th December, 2021.

Kindly accord him any assistance that he may need.

JOSEPHINE OUKO
COUNTY COMMISSIONER
KISUMU COUNTY.

Copy to:
Erastus Kens Matete
Egerton University

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Appendix I: Abstract of Publication

RESEARCH ARTICLE

DETERMINING INSTITUTIONAL CAPACITY OF VOCATIONAL TRAINING CENTERS TO PROMOTE AGRICULTURAL MECHANIZATION AMONG SMALL HOLDER FARMERS IN KISUMU COUNTY, KENYA

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Abstract

Despite the benefits offered by Vocational Education including skills about agricultural mechanization, Small Holder Farmers are yet to benefit from vocational training with regard to agricultural mechanization. The purpose of this study, was to determine the Institutional Capacity of Vocational Training Centres to promote agricultural mechanization among Small Holder Farmers. However the study focused on determining the Outreach Services offered by Vocational Training Centres that promote agricultural mechanization. Descriptive survey research design was employed in this study. The sample size comprised of 110 Small Holder Farmers, 21 principals and 21 Heads of Departments. The reliability coefficient of instruments was 0.713. A coefficient of 0.70 was accepted as reliable. Interview guides for principals and Focus Group Discussion, facilities observation guides, questionnaires for Heads of Department were used to collect data. Descriptive statistics of mean, frequency and percentages were applied to analyse data. This study found out that Vocational Training Centres had Institutional Capacity to promote agricultural mechanisation but requires improvement and modernisation. The study noted that Vocational Training Centres offer Outreach Services but not scheduled. This study therefore recommend that Vocational Training Centres must intentionally build adequate institutional capacity intended for the promotion of agricultural mechanisation among small holder farmers. Findings can be used by Vocational Training Centres to promote adoption of agricultural mechanisation among Small Holder Farmers through.