

Analyzing the Limitations of African Institutions of higher Education in Enhancing Creativity, Research and Innovation in Agriculture for Food Security as a Sustainable Development Goal

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Abstract:- The role of a university is key for sustainable development of any society in the world. Graduates from all disciplines must have knowledge and skills on sustainability as universities are regarded as key institutions for behavior modeling in the process of social change and development. This is a desk research purposed to analyze the role universities as institutions of higher learning should undertake in mitigating the challenges the society face even in such a time of climate change. The greatest role of a university is the production of highly skilled manpower and research output for meeting perceived targets in the global society. Universities are instruments that should provide new knowledge and skills that is needed to meet the contemporary challenges for sustainable development, creation of awareness and provision of necessary preconditions that will lead to informed decision-making for consumer's choice by understanding what exists through brain, knowing how to do it-vocational training by hands, and recognizing why we do it, ones' place in society the heart. This is the core role of the university. Through this paper, we re-examine the origin, development, and roles of university in the modern world. A few years ago there has been an exponential and unprecedented growth in the world of technology and artificial intelligence capabilities affecting all arenas of life and challenges in the current working practices. This study helps us to understand how a society that is digitally enabled can match the daily demands placed upon it. The paper also discusses the ways universities can become relevant agents of change through modifying their roles in response to challenges facing the global society. Thus, for the society to understand the impact of university's education, it has to perform its unique function as an enabler of change which can be achieved by embracing and walking the path of technology. Therefore, the discussion and debates around teaching activities and professional training for high level jobs and education that is necessary for development of the personality is brought out here.

Keywords:- Technology, 3D printing, AI, IOT.

I. INTRODUCTION

Food security is one of the biggest hindrance in achieving Sustainable Development Goals (SDGs) especially in developing countries more so in Sub-Sahara African countries. This challenge will most likely affect the achievement of SDGs Agenda 2030 eighty years down the line. There can be no development of any kind unless the issue of food security is tackled since most of the development goals rely heavily on this. According to Bishop and Potts (2016) argue that in the world of research where models of prediction on climate change indicates that due to increased temperatures and patterns of rainfall fluctuation food production is becoming a challenge. Moreover, 75% of staple food crops rely on insect pollination which are being phased out by climate change, talk of high temperatures which also damage flowering plants affecting seed development. Therefore, with extinction of insects pollinators, the production of food is likely to fall¹. Human activities are the highest contributor to global warming, burning and use of fossils leads to rising of surface temperatures. Fossil fuels emits greenhouse gases like carbon dioxide and methane, natural heat in the atmosphere is trapped by the emitted greenhouse gases which leads to effects of ecosystem such as drought, rising sea levels, and flooding (Bajracharya et al., 2016). Here is where the role of Institutions of Higher Education ought to come in catalyzing agricultural innovation systems. Higher education institutions in today's world need to produce knowledge and skills that effectively engage and empower communities to achieve sustainable livelihoods within their rural contexts. Higher learning education have a critical role of agricultural education and training as a creator of capacity and supplier of the human resources that populate key segments of the agricultural innovation system (AIS) and enable it to function more effectively (WB, 2012).

II. BACKGROUND

The most persistent challenge for achieving food security lie in agricultural value chain in the context of innovation system. Hence, a great need in identifying some ways for enhancing competence throughout agricultural production which calls for capacity building especially in rural women who happen to be the most performers' in agricultural tasks in rural Africa. Competence building will

¹<https://www.nature.com/articles/nplants201692#citeas>

be the key advancing social justice as a sustained development goal. To achieve the strategies needed in strengthening the technical competence of farmers in Africa, a lot of reforms need be done in higher learning institutions like universities and research institutions. Agriculture being at crossroad in Africa has led to persistent food shortage compounded with threats arising from climate change (Juma, 2015). As a matter fact, it is an obligation of man to revise the global agenda on food security. This calls for investment and advancement of science and emerging technology, use of indigenous knowledge and acquisition of new tools to promote agricultural sustainability in Africa. Hence, through technology and innovation, institutions of higher learning must work towards producing crops which depends less on insect pollination or embrace an environment that conserve the pollinators². Degani et al (2018) indicates that there was a huge annual loss of beekeepers in a study done in U.S.A and Europe. The study suggested that in 2006 beekeepers had lost about 30%-42% of the colonies while other population declined change of insect pollinator which include; flies, beetle, and other bee species.

High learning institutions such as universities have a great obligation in creating environment where learners should critically examine in a new way, discover, preserve and transmit skills, knowledge and experience, and value through research, learning and teaching, providing leadership, civic education and service to the society. This ensures sustainability and quality life across generations. Most of the current challenges facing agricultural production in Sub-Sahara African countries heavily lie in education system. The learning, and teaching focus on training learners on seeking employment in form of white collar jobs in heavily populous urban areas as opposed to creating human capacity and competence building. Most of the research work is carried out by these institutions as solutions to existing challenges to societal needs yet many universities have limited access to research support by the existing governments (Strachan, et al, 2020).

According to the report by UNESCO, (2017) the Sustainable Development Goal (SDG) 4 stipulates through its aspiration 4.7 that all learners by the year 2030, should acquire skills and knowledge necessary for promotion of sustainability. Thus the university as an institution that handles societal challenges is tasked in generating and transmitting knowledge leading to transformation of the society (Pee and Vululleh, 2020). This calls for redesigning the curricula to address the contemporary dichotomy between acquisition of knowledge and skills through embedding essential competencies that imparts; knowledge, skills, and attitude that is complex enabling successful performance of tasks geared towards addressing real issues in the world for sustainability and opportunities (Wiek et al., 2011).

A study by Strachan, et al (2020) indicates that the role played by universities towards development of society is very significant, from the study, there has been exponential and unprecedented growth of technology and artificial intelligence (AI) capabilities challenging modern working practices hence, playing a prominent role in the way the society develops as its labeled as the fourth industrial revolution (industry 4). Therefore, for Africa to move towards attaining SDG Agenda 2030, It's learning institutions such as universities have a chance to improve innovation through embracing this technology as modified in meeting contemporary challenges and develop a proactive response to emerging issues in society.

Globally, the first university is thought to have started way back in 387 BC. as an academy formed by Plato with a purpose of producing an educated man. In Europe, the first universities date to the times of medieval where the earliest universities such as Salamanca in Spain, Bologna in Italy, Oxford and Cambridge in England were subsidized by the catholic church in Rome and tasked to train priests. This paper analyses how these roles have changed and how the changes lead to the current role of a university.

During the time of renaissance (14th-17th C.), roles of university switched from religious to specialized institutions. This was highly encouraged by leadership in different nations example under the leadership of Napoleon of France the university roles concentrated on training civil servants to run the country as needed by the leadership³. A part from just teaching, universities in Europe in conjunction with public research institute have transitioned to higher levels of conducting research. Such institutes include: (*Centre National de la Recherche Scientifique*; National Centre for Scientific Research-CNRS), (*Institut National de la Recherche Agronomique*-Institute of Agricultural Research-INRA), and (*Institut National de la Santé et de la Recherche Médicale* National Institute of Health and Medical Research-INSERM) as some of a few examples of public institutes in France that are so prestigious and leading in scientific research publications globally. Other universities in Europe with advanced technology includes; Humboldt university in German now Berlin university is the most progressive and one of the leading university in Europe. In most of these universities systems, both in execution, syllabuses and ideals the models unify teaching, research and promotion of freedom of study. Despite their being funded by the government most of these universities enjoy corporate autonomy and academic freedom's notion. In UK the influence of Newman (1801-1890) was so strong in the book "*the idea of a university*" is regarded as a major step ahead in the progressive learning. Universities such as Oxford, Cambridge, Durham, and later Newcastle, Sheffield, Reading, Bristol, Birmingham, Manchester, Leeds, and Liverpool have continually produced learners with competence and skills needed for the local community in their contribution to regional and local economic growth and development. The roles of English universities in currently is clearly indicated as Education, Research, and Knowledge exchange which is the transfer of ideas, research expertise

²<https://doi.org/10.1111/1365-2664.13153>

³<https://www.livescience.com/55230-renaissance.html>

and skills between the university and communities, the government, business and the third sector (Sweeney, 2018).

The US were influenced by the UK model in matters university as learning institutions. In 1636 Harvard College was founded to train young people for ministry, in 1701 Yale College was founded, later the New Light Presbyterians was founded in 1747, hence, Princeton, Brown university, the university of Pennsylvania and Rutgers university. Most of these universities continue to exhibit new innovations linking their work with the surrounding community thus through scientific research and innovation the society challenges are being handled at the universities.

In Africa like any other continent most of the countries strove to establish at least a university of its own after independence. The purpose of these university was to promote learning at a higher level of education with aims of addressing the problem of underdevelopment such as; illiteracy, poverty, hunger, unemployment, low production, and social disorganization. Majority of these African nations are still faced with the problem of socio-economic, political and technological challenges that continues to threaten the progress of their society. Although in some countries governments continue to support education sector with an objective of solving the challenges arising in the society (Moshia, 1986). In conclusion, the whole idea of a university or higher learning institution should be mirrored on Plato's philosophy and concentrate on producing an 'educated' man and a better citizen. The combination used here in Plato's philosophy is; What exists, exists- that is understanding and meaning (brain), How to do it- vocational training (hands), Why we do it- recognizing ones' place in society (heart). These three should be at the core of university for acceleration of its relevancy in society as it has been experienced in European society for more than a thousand years and had a direct and prominent effect on the development of European universities.

III. STATEMENT OF PROBLEM

A country with food security is a society geared towards achievement of Agenda 2030 of sustainable development goals (SDG). Achievement of this particular goal is directly linked to a healthy population through malnutrition, sustained economic development, trade, and good environment. In Sub-Saharan African countries, most of the farmers are small scale (subsistence farmers) who live in the rural areas. Studies indicate that majority of these farmers are faced with a lot of challenges such as lack knowledge on soil fertility and its management, the issue of land degradation, and continuous cropping. Most of these farmer's agricultural activities are highly exposed to climate change and its variability. This is because the agricultural activities directly depend on climate conditions which has adverse effects on environmental sustainability compromising food security⁴. A society with food insecure

⁴<http://kmco.co.ke/wp-content/uploads/2018/08/FOOD-SECURITY-AND-ENVIRONMENTAL-SUSTAINABILITY-IN-KENYA.pdf>

and poorly equipped on agricultural production faces survival challenges with spill overs to environmental sustainability in the quest for survival. Therefore, survival of man depends entirely on environmental protection and sustainable food production and for food security to be achieved, the African countries must adopt other forms of food production such as embracing technology in our institutions, investing in research and dissemination of the information on improving agriculture production is the only solution for food security in Africa. New forms of technology is the way to go in the modern world since they are the outcome of disruptive innovation to satisfy the diversified needs of the society. Even though the public has an obligation of scrutinizing the new technology, some group tend to oppose the health implication, social norms, and social disruption. Still others are under influence of prejudice and human ignorance concerning innovation which is basically a process of creativity for economic transformation, increased entrepreneurship for available huge consumers in the modern world unlike the pre-modern world (Juma, 2016).

A. Food situation in Africa

Sub-Saharan Africa is facing acute shortage of food, over 656 million people (over half of its population) are facing food insecurity. The most hit regions are the Eastern and Southern African states like Ethiopia in the Eastern and Madagascar in the Southern where over 22.7 million and 7.8 million respectively of their population are in dire need of nutritious, adequate, and safe food.

In East Africa, 7.2 million people continue to face severe starvation since 2019, Kenya stands at 4.1 million people facing starvation as of June 2022, according to The National Drought Management Authority (NDMA) the number had increased from 3.5 million (2021) the most affected areas are Arid and semi-Arid land (ASAL) regions (Counties). The cause of this has been failed rains for long periods which has negatively affected agricultural production, global hiking prices of food resulting from devastation of climate disaster and adverse effect of COVID-19 that has threatened and claimed thousands of lives. Although the Kenyan government came up with some intervention such as cash transfer of \$25 per household, it had its own challenges reaching the most vulnerable in the target group. 23 ASAL counties were seriously hit by drought by June 2022 due to inadequate rains since 2021 this saw a huge loss of livestock in those areas⁵.

The issue of climate change is not only an African countries affair, from 2019 the world at large had experienced extreme weather, conflicts and later on COVID-19 pandemic which ended up pushing over 50 million people as additional number into serious food insecurity in Sub-Saharan Africa. Still, emerging global food prices resulting from Russia-Ukraine conflict from February 2022, leads to volatile commodity markets of such items as fertilizer, energy and disrupted markets amidst stagnant incomes has increased food insecurity. Studies have

⁵<https://www.businessdailyafrica.com/bd/data-hub/have-kenya-s-food-security-formulas-failed-to-work-3848386>

revealed that apart from hunger and famine, food shortage has also led to increased number of undernourished cases this increases the number of people with poor health conditions. An estimate of over 44 per cent of children in Ethiopia are said to be stunted due to dietary diversity⁶. The issue of food insecurity seems not to be leaving Ethiopia any time soon World Food Program report show that although attempts by the government to reduce poverty and expand investment in basic social services has improved, food insecurity and malnutrition are still a major concern in the country. Currently, an estimate of 20.4 million people including the internally displaced (IDPs) due to conflict in North and severe drought-stricken South and South-East are in dire need of food support⁷.

In his coverage as a photo-journalist "The closest thing to hell on earth" (Mohamed Amin, 1984) covering the northern part of Ethiopia (Koreme) was able to capture what he termed as the 'horrors' witnessed on film and photographs that made the whole world feel silent only waking up to the tragedy of modern 'Biblical famine'. From the coverage thousands of poor citizens were dying in the fields, in the freezing rain and under the searing sun, this death was not as a result of diseases or war as it seems to be today in Tigre, but due to hunger when millions of tons of grain were rotting in stores in Europe while in Ethiopia thousands of its people died for months and months or probably for years helplessly waiting to die while the government couldn't care less⁸. It was until the American singers spearheaded by Harry Belafonte and Ken Kragen and other musicians such as Michael Jackson and Lionel Richie composed a song that was a worldwide hit 'We are the World'⁹ in January, 1985 it sold in its millions and raised over \$50 million for the victims of Ethiopian famine and other African countries hit with drought.

These trends of events is a learning curve for African countries to consider seriously to avoid a replica of the same going forward towards uncertainties. In collaboration, African countries through their institutions should adopt and invest in technology in building food system resilience that will enable the region in responding to global challenges faster and more effectively. More importantly, research done by different institutions should not be shelved as it has been the trend according to Food and Agriculture Organization (FAO, 2019) programme manager, (All Port Robert). Instead the research by institutions should be harnessed to help farmers tackle their problems and improve productivity. Knowledge and solution of agriculture through technology should be disseminated widely through Mobile-Apps with the government considering to revise food prices as an enablement to access nutritious food by all the families.

B. The University and Technology

According to Darwinian theory of human development, the early man could have appeared three thousand years ago in African continent. Through more transitions, he developed different capabilities up to being able to harness and use technology. Over time, these technologies helped man to make things that could help control his environment. Such invention like clothes, fire, and building the house helped man to get rid of bad weather and cooking. Such an urge to reproduce through manufacturing became useful in establishing a learning institution hence the birth of university (Segre, 2015). Different countries exhibited tension of a kind between academic and vocational role, whether the job market should be the determinant of the university purpose and its alignment of structure such as socio-economic, and political society's demand. University's should embrace their very original role to avoid much consequences in society. Statistics Agency of Higher Education in United Kingdom indicates that there was increased deficit in the number of universities from 40 in 2016-2017 to 47 in 2017-2018. In England, data indicates that 32 out of 134 Higher Education institutes (HEIs) exhibited a deficit in 2018, from 24 HEIs in 2017 while 10 in 2015-2016. This paper examines the role of modern university and whether it is fulfilling its mandate in research and development of the society a case of universities in Africa.

At a time when there are high rates of unemployment more so in Africa there still significant potential in enhancing agricultural productivity and climate resilience in learning institutions in Africa through innovation. Learning institutions such as universities have obligations embracing, teaching, transmitting, and training the society in ways to prepare and go about in agricultural production. Agricultural productivity can increase if modern technology is adopted and enhanced careful selection of farm inputs.

Through research centers set up in the learning institutions such as to undertake soil testing activities to allow proper agricultural production. The centers can have weather stations to determine the weather charts and advise the farmers more appropriately and on kind of food to be planted in different regions.

Climate risks can be handled through digital tools that can help identify onset of climate shocks before happening and enhance responses for building resilience. Plants need water not rains, therefore, if resources such as soil and water are put in proper use and restore natural capital and ecosystem further more adapt automated irrigation system, invest in drones and soil sensor which will improve production more efficiently.

⁶<https://blogs.worldbank.org/african/three-challenges-and-three-opportunities-food-security-eastern-and-southern-africa#:~:text=Eastern%20and%20Southern%20Africa%E2%80%9494%20home,food%20systems%20in%20the%20world>

⁷<https://www.wfp.org/countries/ethiopia>

⁸<https://artsandculture.google.com/story/xwUxTsVZRpdvIA>

⁹<https://www.youtube.com/watch?v=s3wNuru4U0I>

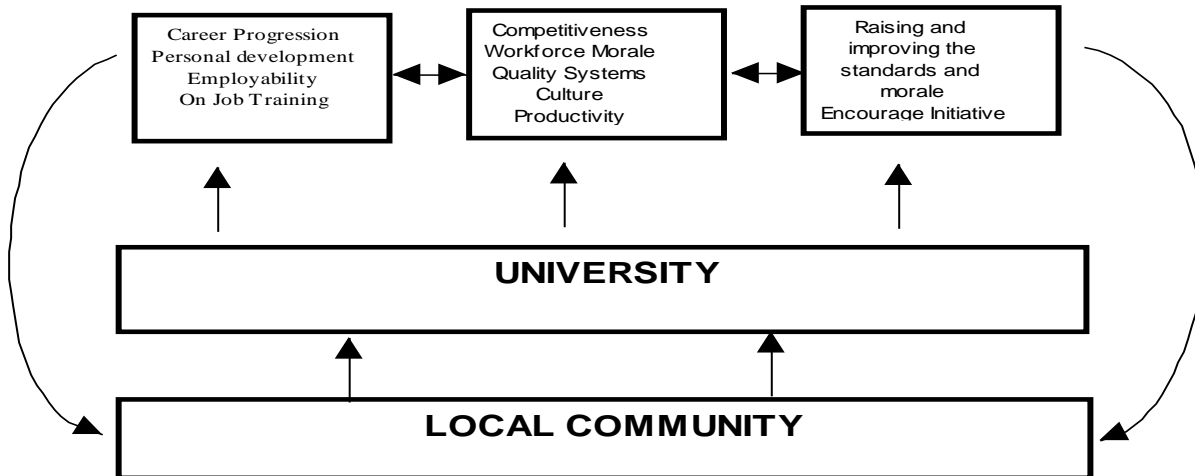


Fig. 1: Source:Role of University inrelations to the local community

IV. LITERATURE REVIEW

A. Hypothesis I(Industry 4.0 will affect the type and number of jobs for humans);

The paper adopts a hypothesis which states that “the increased efficiency and innovation developing in industry 4.0 will affect the type and number of jobs for humans”. Industrial revolution a term coined in 2015 by a member of World Economic forum (Klaus Schwab) in his work on the main areas that would be transformed by Industrial Revolution (IR). The concept is at its early stage having developed from third industrial revolution that started in 1980s marking the transformation from computerized technologies. IR blurs the gap between society and technology to create a more efficient human life. The invention is to embed into human beings mental and physical day to day activities. The exponential growth of robotics and Artificial Intelligence (AI) is considered to affect the work of many people going forward. With 4th IR came advancement of technology like robotics, 3D printing, distributed digital ledgers, internet of things, Artificial Intelligence, nanotechnology and other innovations. This shows that on daily basis technologies are being implemented in our daily lives.

B. Hypothesis II (change in employment will have significant effect on lifestyle of people)

“Digital Athens” a phrase coined by Erik Brynjolfsson (2016) coined the phrase, Athenians citizens are said to have been people who loved lives of leisure as they used to learn and create this is due to the fact that they had slaves to do the work¹⁰. In this hypothesis robots are considered to be new slaves who will free up more hours of work. What will people do is the question to ask today, in answering the question the paper concentrates on understanding the opportunity for universities in their role of modifying the society (Spencer, 2017).

¹⁰https://scholar.google.com/scholar?q=erik+brynjolfsson+and+andrew+mcafee&hl=en&as_sdt=0&as_vis=1&oi=scholart

Hypothesis II argues that change in employment will have a significant effect on the lifestyle of people, their needs and aspirations. New jobs may be created even if it may not satisfy the demand the need for alternate income such as Universal Basic Income (UBI) which guarantees enough income for living. According to Zwolinski, (2015) UBI can be argued to have a reduced rent-seeking under a universal program there is less space for political exploitation and fraud, reduced bureaucracy, a reduction in the state’s paternalistic tendencies since there will be need to categorize beneficiaries as deserving poor and there is reduced cost.

Although funding of this kind of income could be a challenge however stopping all other forms of benefits could offset such expenditure yet not involving a lot of changes in taxation. Labor savings out of automation would pay for UBI, one-part wealth tax and other part ownership restructuring. A small tax levied on share from every initial public offering and put in a common capital depository which in effect will grant citizens property rights over new technologies that would yield financial returns (Varoufakis (2017).

➤ *Artificial Intelligence (AI)*

This is a higher machinery intelligence that forms more independent and user-oriented device. As a machine presented intelligence, though not only a basic result of algorithms. It collects data, examines it, understands it, and thereby takes actions. The innovation is most discussed with many believing that it could outpace people and hence replace blue-collar jobs as its rapidly entering the market with its recognition as a vital part in the development of the society.

➤ *Internet of Things (IoT)*

Internet of Things (IoT) is able to connect different devices allowing a flow of communication between those devices. For instance, a phone can be connected to your car, fitness tracker, and the sensors in the bedroom of your baby. IoT technology enables exchange of information quickly and personalized service. It becomes easier to navigate the daily

activities by use of a few devices as it internet becomes more wireless. This technology is linked to Artificial Intelligence (AI) for best outcome in fields like smart house, self-driven cars, and retail sector.

➤ *Digital Distributed Ledger or Block chain*

Block chain technology changed the way we share and store data. It has a complex system that encrypts information and forms blocks where the information is saved. With the high levels of transparency and immutable nature, it brought a safer and more private way of data distribution. Block chain is changing our daily activities such as banking, online shopping, authorizing assets. One of the excellent examples is LuxTag. We are proud to implement one of the most life-changing technologies to drive our business. But we aren't the only market innovators. For many years' companies like IBM, Walmart, Virgin Atlantic benefit from using block chain.

➤ *3D Printing*

3D printing process involves layering small parts as liquid molecules resulting in forming a new three-dimensional shape (additive manufacturing/process of making three dimensional solid objects from a digital file)¹¹. A similar technology was used for a few decades. In the coming generation 3D printing becomes so advanced and can form precise and tiny shapes. The technology has been embedded in industries where it is used daily in such fields as engineering, aviation, healthcare, architecture. For example, F1 prints vehicle parts for its racing cars or Nike designs product prototypes using this printing technology¹².

V. METHODOLOGY

A. *Manufacturing Industries*

According to Behun, et al, (2018) any country that what to grow its economy must adopt manufacturing industries, this sector can quickly spur the growth and development of economy for sustainability. Adapting robotics in our industries has direct effect on employment of young talented people in society in addition to giving rise of 3-D printing that enhances impressive developments such as is being experienced in Chinese economy where 3-D printing 6-storey office blocks. This technology is predicted to control all productions by 2027 by 10 per cent, such products like smart phones will possibly get 3-D printing. At the same time, pharmaceutical companies have adopted 3-D printing from (cellular material) human kidneys and liver in order to test their drugs with no harm to recipients.

A. *Agriculture sector*

Food production industries employs over 44 million people in Europe, agricultural sector on the other hand has over 20 million regular employments although some of these jobs are under threat. The future prediction has it that in developing countries will have over \$100 agricultural robots this will allow farmers to be managers and not workers in the field. Aeroponics (process of growing plants in the air/mist environment without soil or 'geoponics'

which is the aggregate medium). will be employed¹³. Aeroponics is a process conducted without a growing medium unlike aquaponics which uses water and fish waste or hydroponics which uses a liquid nutrient solution as a growing medium and mineral that sustain plant growth¹⁴. Through aeroponics, water is produced from cheap electricity and desalination which helps to cut down CO₂ hence, reducing global warming.

Robotic world affects all areas of man's life including and not limited to transport sector where speed has been increased, electric driverless cars have been manufactured moreover the electric cars have profound impact on environment unlike fuel engine cars¹⁵. According to Kim and Heo (2016) health sector has improved so much as creation of devices such as tri-recorder by Japanese has improved diagnoses illness. Inserting one's hand in the device leads to diagnosis of 80 per cent of known diseases (Riek, 2017). Non-invasive surgery is now headed towards cellular surgery¹⁶. Medical researchers and geneticists are working on altering DNA sequences in enabling to edit part of genome in genetic manipulation¹⁷.

VI. CONCLUSION

In general, technology right from the time of Industrial Revolution has undeniable impacted heavily on human lives. The benefits of this technology cascades into society enhancing it through digital connection. The ages of industrial revolution contributed immensely in food production, and preservation of lives through modernizing health facilities this revolutionized human lives therefore, its benefits should be highly embraced. Thus, if the agricultural sector is technological enhanced for food production, job creation and economic growth will spur accounting for increased GDP of most African countries. According to the World Bank (2020) over 59 per cent of the African population is employed in agriculture this as sampled out in countries such as Burundi whose 86% of population work in agriculture, with 80% of the population in Somalia, 76% of population in Malawi, 70% of population in Mozambique, and 66% of population in Zimbabwe and Ethiopia working in agriculture. This is an indicator that when agricultural sector is improved there will be enormous potential of improving income opportunities for majority population across African region and other parts of the world of similar experience. Hence, due to increasing population and urbanization in most African countries, embracing

¹³<https://www.google.com/search?q=aeroponics+advantages+and+disadvantages&oq=aeroponics&aqs=chrome.3.69i57j0i51219.9722j1j7&sourceid=chrome&ie=UTF-8>

¹⁴<https://www.trees.com/gardening-and-landscaping/aeroponic>

¹⁵<https://www.roboticstomorrow.com/story/2021/08/robots-continue-to-drive-innovation-in-modern-transportation/17335/>

¹⁶<https://www.google.com/search?q=robotics+in+healthcare&oq=robotics+&aqs=chrome.6.69i57j0i51214j0i457i512j0i51214.8921j0j7&sourceid=chrome&ie=UTF-8>

¹⁷https://scholar.google.com/scholar?q=robotics+in+healthcare&hl=en&as_sdt=0&as_vis=1&oi=scholar

¹¹<https://3dprinting.com/what-is-3d-printing/>

¹²<https://3dprinting.com/automotive/>

technology, invention and innovation becomes key at a level such as a learning institution which is a life equalizer for most population in modern society as most meet in learning institutions. This will result into heavy investment in food manufacturing industries spurring increased production as a result improving food security through trade business opportunity expansion and food stability experienced in the region. In any case of drought or famine hitting one country other neighbouring countries will boost their exports filling the gap but at a subsidized price unlike from far western countries. This improves regional interaction among countries.

VII. RECOMMENDATION

According to the World Bank, agricultural education and training is critical since it creates capacity and supplies human resource which plays a crucial role in agricultural innovation system enabling effective performance. Traditional, learning institutions as stakeholders focused on provision of technical knowledge¹⁸. Agriculture in Sub-Saharan Africa is currently undergoing complex challenges such as migration, conflicts, climate change, urbanization and globalization (WB, 2012). This calls for a more responsive and global catalyst in the form of agricultural practitioners to improve production system amidst degradation prone natural resource base. In addition to this, institutions of higher learning ought to produce knowledge and skills that creates capacity and empowering communities in rural areas for sustainable livelihoods. Private sectors are in admiration of better and improved services and products by through innovations by learners from institutions of higher learning (Mloza, 2011). These requires a new and revitalized dimension in the name of soft skills like facilitation, communication, leadership and networking through projects. Higher learning institutions has to partner with different stakeholders through innovation system for the betterment of African society's inclusive growth and sustained development.

Universities and institutions of higher learning have a moral duty of sensitizing the small holder and rural agricultural farmers on the symbiotic relationship between plants and animals such as insect pollinators. This helps to guide the farmers on what to produce basing on the climate change especially in unpredictable weather conditions.

There has to be increased research in plant breeding taking cognizant of soil types and right varieties of livestock and crops that is best for locality. Promotion of sustainable crop production and increased yield per hectare, the government has to target significant capital investment such as high rate of mechanization either in private or public sector¹⁹.

¹⁸<https://ruforum.wordpress.com/2017/12/05/the-role-of-higher-education-institutions-in-catalysing-agricultural-innovation-systems/>

¹⁹<https://www.kenyacic.org/2018/01/agricultural-technologies-lessons-from-israel/>

Since climate change and global warming is real its effect on weather patterns keeps fluctuating therefore, there's need to invest heavily in irrigation rather than depending on rain-fed farms. Knowledge about soil types helps determine the use of right fertilizer at the right time with affordable prices by farmers and not only this, organic fertilizers presents a strong case in increased yields and responsiveness to environment. Education and training on usage of fertilizer and its impact is a requirement for significant in boosting income²⁰. Creation of new institutional arrangements that aims at using existing technology for improved agricultural productivity such as the Green Revolution in Latin America and Asia which helped overcome chronic food shortages.

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