The Changing Role of Higher Education Institutions on Research and Innovation in Africa: A Systematic Review

Shallon Atuhaire
Cavendish University
Uganda

Frankline Higenyi
Uganda Management Institute

Elizabeth Bacwayo
Makerere University

Annet Mugisha
Nkumba University

Christine Mwebesa
Ndejje University

Rachel Nambuya

Abstract

Research and innovation are crucial in the process of achieving sustainable development goals. Given the significant role Higher Education Institutions (HEIs) play in research. Africa is still grappling with both the changing higher education global landscape and fostering of a research culture that addresses its own societal needs. This study explored the changing role of HEIs on research and innovation and the bottlenecks to its' realisation in Africa. E-literature was searched from online databases mainly Google Scholar, PubMed, ScienceDirect, Embase and African Journals Online. The search strategy considered relevant content on the subject by use of keywords, purpose of the study and year of publication (2010 to 2021). Overall, the search yielded 889,264 results. From Google Scholar, 805,000 were found, ScienceDirect; 9196, PubMed; 1168, Embase; 63100, and African Journals Online; 10800. The Cochrane review protocol and the PRISMA flowchart were used to assess the relevance of these articles. Eventually, 107 full articles were critically analysed for legibility resulting in 16 studies, which were included. Research and innovation as well as the role of HEIs to the two are keywords of the time. This role has been changing to meet up with globalization demands and increase in population. While their indigenous role was co-creation of knowledge and transfer, they have of recent past surged to create innovation ecosystems, transfer technologies, promotion innovation and research and its' management. They have gained an ascendancy in sustainability debates as engines of innovation most especially in science, technology, and human progress. This

changing role has been compounded by shortcomings such as inadequate competences in the use of emerging ICTs, inadequate funding, curriculum content that does not clearly spell out practical life skills, innovation opportunities, and corporate social responsibility that is still very low. The changing role of HEIs in research in Africa is evidently clear and has been from creation of new knowledge and its transfer to one that is need-driven, entrepreneurial, transformational, and able to reconfigure the status of innovation systems for regional socio-economic transformation. The limitations to its realization could be mitigated through institutional collaboration, funding and customization of research.

Keywords: Africa, Innovation, Higher institutions of learning, Research and Innovation, Systematic review

Introduction

Higher Education Institutions (HEIs) world over are responsible for research, and innovation. They also serve to generate knowledge, its adaption and transfer. They are also expected to guarantee the utilization of research results in the most efficient way, respond to the changing needs of society and cater for trends towards a knowledge-based economy, (Mutula, 2010).

Innovation refers to a recombinant process that benchmarks on the existing knowledge and absorbs it to create novel products, processes, services, and markets. Innovation has the potential to generate new raw materials as well as organisational forms for companies and nations, (Nicolaides, 2014, Juma, 2016). As such, an innovative person is capable of exploring and extending existing boundaries of knowledge, giving a nation a leading edge especially in the scientific and technological realms. Thus, it is critical in bolstering a nation's competitive advantage at the global level, (Nicolaides, 2014).

Research on the other hand, refers to the process of making diligent systematic inquiry, gathering information, analysing the data and making sense of it to provide feasible solutions, (Naidoo, 2011). According to Naidoo, "life without inquiry is not worth living", hence there are various ways of inquiring and acquiring knowledge including the traditional ways, logical reasoning, intuition, and the scientific methods.

Research and innovation have grown tremendously globally in the past two decades (Elrehail, 2018). Whereas this growth might be well researched and documented in the global north, it is different in the south specifically in Africa where research and innovation systems are still less-developed (Blass, et al. 2014). Given the significant role HEIs play in research, Africa is still grappling with both the changing Higher Education (HE) global landscape and fostering of a research culture that addresses its own societal needs.

Africa has the highest population of children, adolescents and youth whereby 41% of the population is below 18years, (Juma, 2016). Again, a greater proportion of this population are the youths who face challenges of unemployment. Research and innovation is a means through which such a juvenile group could be brought on board as economic agents. In that way, they would be supported to acquire the necessary knowledge and skills to engage in and benefit from socio-economic development, (Osakwe,

et al. 2017). In this regard, African Union has designed a Science, Technology and Innovation Strategy 2024 (STIS-2024) and is working with HEIs to realign research and innovation for socioeconomic transformation with focus on the youth. Some of the strategies to strengthen research and innovation have been setting up innovation centres or universities meant for this purpose, strengthening the research culture in higher institutions of learning, rendering community services, commercialisation, and development of agencies. Another avenue for strengthening research and innovation, has been Public-Private Cooperation (PPC), (Juma, 2016).

Also, the value that individual faculty places on research, for most of faculty, the primary motivation for carrying out research is promotion. The biggest question therefore is: How does faculty motivate each other to move from beyond the 'publish or perish' syndrome, and undertake research and innovation out of the desire for new knowledge? (Kigotho, 2021). In addition, it is clear that the decline in research output in HEIs in Africa calls in to question the ability of the higher education system to meet the research and development agenda of the country. The decline in traditional or basic research, including research in humanities, is worrying, according to Lincoln & Guba, (2000). Research output has the capacity to increases institution's reputation, which result in high levels enrollment of high-quality students and lecturers. While it is important to note that higher education provides several non-economic benefits such as nation building and socialization, this section focuses on the challenges to realisation of the changing role on research and innovation by higher institutions of learning in Africa.

Researchers have suggested three fundamental reasons for the failure of research and innovation in HEIs including; lack of interdisciplinary infrastructure such as lack of researchers trained in integrated research, lack of quality journals to publish in and the lack of a college of peers to collaborate with, (Miles & Huberman, 1994). Inadequate funding has been top on the list of the factors that hinder universities to engage in serious research.

In this context, the role of the university research system is not simply to respond to local imperatives, but also to develop the capacity to take advantage of the new opportunities that globalization engendered. The value and importance of research and innovation cannot be over-emphasized; research, in all its forms and functions, is perhaps the most powerful vehicle that a country has to develop all its faculties, (Spielman et al., 2011).

Research promotes the values of inquiry, high order thinking, innovation and open-mindedness that are fundamental to engender a strong economy in society. Through research, collegiality and networks across geographic regions and disciplines are built. It makes possibility of the growth of an innovation culture in which new ideas, approaches and applications increase the adaptive and responsive capacity of our society, thereby enhancing Africa's competitiveness and ability to solve her most pressing social challenges, (Al-bader et al., 2010).

Research and innovation comprise of social sciences, natural sciences, engineering and humanities, which are critical in fuelling national development and economic growth, (Nicolaides, 2014). Higher institutions of learning are often at the centre of these innovations and research. However, their role could be changing to meet up with globalization demands, and increase in population. In spite of the proliferation of publications on the role of innovation and research to development, little information

is available on the how the role of higher institutions of learning has changed in relation to research and innovation over the past few decades more so in Africa. Against this backdrop, the study explored the emerging dynamics in the role and practices of HEIs on research and innovation in Africa. Specifically, it documents how the role of higher institutions of learning on research and innovation has changed over the past 10 years, describes the bottlenecks to research and innovation in HEIs in Africa and provides recommendations on how research and innovation could be promoted to trigger sustainable socioeconomic transformation. The study has been conceptualised as in Figure 1.

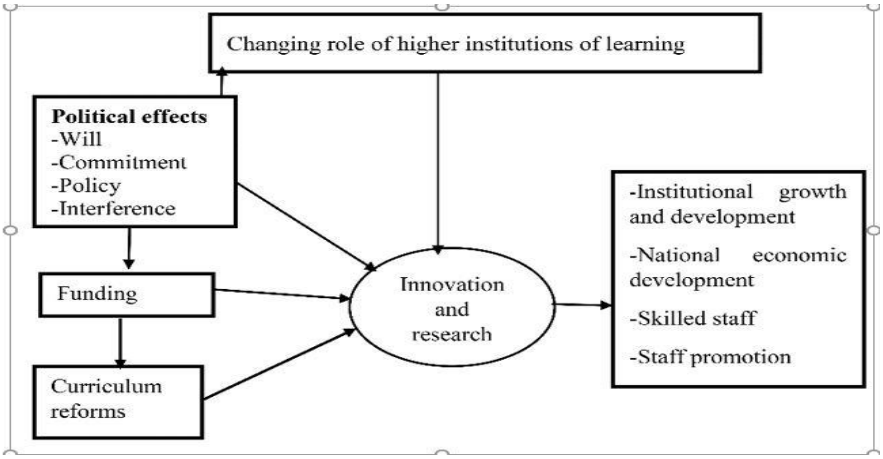

Figure1: Conceptual framework that has been adopted and modified from various studies including but not to limited to Al-bader, S. et al (2010).

Methods

Search strategy

E-literature was searched from online databases mainly: Google Scholar, PubMed, ScienceDirect, Embase, and African Journals Online. The search strategy considered relevant content on the subject by use of keywords and specific objectives to collect data. Overall, the search yielded 889,264 results when "the changing role of higher institutions of learning on research and innovation in Africa" was used as the search strategy across all the databases. From Google Scholar, 805,000 were found, ScienceDirect; 9196, PubMed; 1168, Embase; 63100, and African Journals Online; 10800.

Selection and inclusion

Selection of these documents was based on the year of publication (2010 to 2021), research method used where by all research methods were considered and the Cochrane review protocol which looked out for the quality of study, study design, sample size, methods and the variables within the study. Accordingly, 9121 were duplicates between ScienceDirect and Google Scholar, 1142 were duplicates between PubMed and Google Scholar, 63073 were duplicates between Embase and Google Scholar, and 10718 were duplicates between African Journals Online and Google Scholar. Some papers were duplicates across more than two databases: 1102 were duplicates between PubMed and ScienceDirect, but again all these were part of Google Scholar, 1074 were duplicates between PubMed and Embase whereas 983 were duplicated between African Journals Online and PubMed. Therefore, 87,213 were

duplicates across all databases. A scan through of the relevant titles was done among the 802,051 studies, which were unique to databases, and 800,189 were excluded due to failure to answer the study objective. A total of 1862 abstracts were read resulting in exclusion of 1755 studies since there was no direct coherence with study objectives and keywords. Finally, 107 full articles were critically analysed for legibility and only 16 were included in this study. The inclusion criteria is summarised in Figure 2. The analyzed data is presented thematically under; the changing role of HEIs on research and innovation and bottlenecks involved as indicated in Table 1.

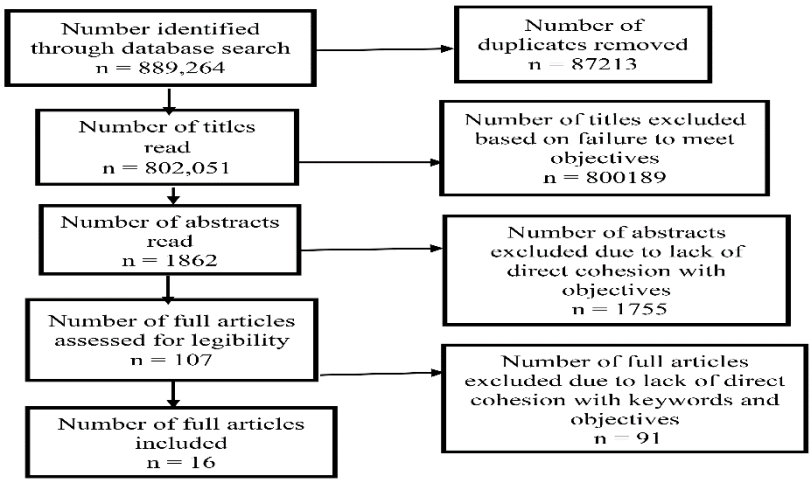

Figure 2: PRISMA flowchart indicating inclusion and exclusion criteria of the reviewed literature

Results

The changing role of HEIs on research and innovation

Whereas high and middle-income countries were able to attain the Millennium Development Goals (MDGs) especially halving poverty levels, countries in sub-Saharan Africa did not achieve this target. With the current Sustainable Development Goals (SDGs) whose key principle is "leaving no one behind", (Osakwe, et al. 2017), the global community is working collaboratively to increase income distribution through poverty eradication programs and projects and promoting sustained social progress. Accordingly, research, and innovation are crucial in this process as they have the potential to address the challenges that present with low structural transformation and enhance equity.

Higher institutions of learning have gained an ascendancy in sustainability debates as engines of innovation most especially in science, technology, and human progress. Debates on the role of HEIs in economic development have always taken place to explain the demand-pull theory and the science-push theory. The demand-pull theory emphasizes market forces as a core determinant of technological innovations whereas the science-push theory recognizes that industrial innovations are determined by science, (Nicolaides, 2014). Therefore, the role of higher institutions of learning in the innovation process is natural since it involves basic and applied research, and the reservoir of knowledge. These provide an adequate foundation for the emerging knowledge economy, policies, and industrialization, which developing countries could utilise for sustainable developments. It has been realized that the global economy has become more interdependent, witnessed by an ever-increasing exchange of goods, ideas, values, services, and expertise in various stadia, (Nicolaides, 2014).

Developing regions including Africa have registered gradual progress and are emerging scientifically notwithstanding, ascending from a very low base (Nicolaides, 2014). Given its' fast growing population and the projected outrageous increase by 2040, and the various challenges that deter sustainable development, the African Union is striving to achieve its' vision; "The Africa We Want" by 2063. The Africa's agenda 2063 according to Juma, (2016), provides a framework for embarking on long-term institutional reforms needed to reposition the continent as a strategic player in research, innovations, and global economy, with long-term socio economic objectives. In this regard, consented efforts have been made towards tapping into the unexploited potentials of the Africans and investing in research and innovation in higher institutions of learning, (Chuks & Sam, 2018).

According to Sanga, (2012), globalization has traditionally been associated with commercial and political interests, but in the modern age, its manifestation is more evident in the development of borderless higher education markets, scholarships, research and innovation. Therefore, there are numerous opportunities if the new knowledge produced is widely disseminated and utilized. However, transformations especially in curriculum and the general ways of doing things ought to take place, (Spielman et al., 2011). Further research avenues are required in order to empower higher education institutions to enable them enhance economic growth, and Africa to benefit. Some of the ways research intention can be achieved include; the cost of HEIs expansion, and curricula reforms which are necessary for improvement. Research on the existing curriculum, its suitability for fulfilling the community needs should highlight on the new and useful directions on the curricula, (Cloete, 2012).

According to Juma, (2016) there is a need for a clear vision and a comprehensive roadmap to extend research from the laboratories to the market places. He further asserts that this will give students more opportunities to gain work experience outside the classroom. He points out that this will facilitate the transfer of knowledge from universities to local communities and vice versa, consolidate on internships and offer a richer experience application. Similarly, a reverse -out –reach approach under which entrepreneurs can selectively participate in "open classroom" programs would help strengthen innovation. Institutions of higher learning have to create avenues of exponential research development to leapfrog in the global network of knowledge.

HEIs are considered as national leaders in research however, most projects in African HEIs are at the basic research level, and not yet at the level of intellectual property to take new solutions to scale. For example, in health research where capacity is directed towards product development, it requires rigorous clinical trials and funding which may be inadequate. It also requires a wide range of ideas, prototypes, and health-focused technologies, (Al-bader et al., 2010).

Due to this, the education system needs to change particularly in research and innovation approaches. According to Mafenya, (2013), in the realm of educational planning, many things are always changing for example; the structure of the education system, curriculum and textbooks, modes of teaching and methods of teacher training. He also argues that these changes may lead to an improvement, or a worsening in the quality of an education system. Therefore, it is important for an educationalist to have knowledge of research because it is involved in the process of policymaking. The various policies that are used cannot be meaningful unless they are based on factually correct data. According to Apotheker, et al. (2017), research and innovation should allow the initiators and all stakeholders to

obtain relevant knowledge and be able to evaluate the outcomes of research effectively.

Companies and higher institutions of learning in developing nations need to conceive, and develop revolutionary as well as invent progressive products and processes to retain a competitive advantage on the global scene, (Nicolaides, 2014). For example, teaching institutions have introduced innovations by incorporating a blended learning which stimulates critical thinking skills and generation of more innovative ideas, (Mulaudzi & Chyun, 2015).

Research and innovation should harness and apply a wide range of technological opportunities including biotechnology, Information and Communication Technologies (ICTs), nanotechnology and more institutional diversity to advance Africa's regional economic integration agenda. This could be through increased food production, production of drugs and medicines to fight diseases such as malaria, and tuberculosis, and generally increase economic competitiveness of the continent, (Mugabe & ACODE (Organization), 2011).

In the same regard, research output is of great benefit to societies and has seen a lot of contributions and scientific advancements to different industries in various countries in Africa especially in the agricultural sector, food and nutrition, health construction, motor vehicle assembling, engineering and robotics, (Ddungu & Edopu, 2017).

Bottlenecks to research and innovation in HEIs in Africa

The bottlenecks to research and innovation mitigate higher institutions of learning and their commitment to maximize the potential of realizing the outcomes of such innovations, (Al-bader et al., 2010).

Research activities entirely depend on funding to facilitate logistics such as computers, internet, libraries, laboratories, and consultancies. Although HEIs have internet-connectivity, the reliability and access is daunting, (Sanga, 2012). Research and innovations are expensive, yet there is still a challenge of inadequate funding for staff in HEIs to carry out outstanding research. Funding is mainly by governments, nongovernmental and international bodies, although commitment by governments to invest in research at higher institution level of learning is still low, (Spielman et al., 2011, Al-bader et al., 2010). In this regard, Africa needs to seize the grand opportunities offered by regional and international institutions such as the African Union (AU), the African Development Bank (AfDB), United Nations Educational, Scientific and Cultural Organization (UNESCO), the New Partnership for Africa's Development (NEPAD), and the World Bank, (Mugabe & ACODE (Organization), 2011).

Adequate investment in research enables researchers to conduct research, publish findings, subscribe to scholarly academic journals, and access professional bodies and networks, (Kyaligonza et al., 2015). Concerning publications, Kigotho (2021), considers the publishing industry in Africa to be ineffective as academics may "perish" even after they have published. HEIs lack research hubs, visibility, intra-Africa book trade, produce mediocre content, and curricula content that does not address research and innovation issues. As far as innovation networks are concerned, they are critical in research and call for interuniversity collaborations. These support effective reform efforts through engagement of different actors to defend, advocate, and mediate conflict situations common to research and innovations, (Klerkx et al., 2010).

Other factors that affect capacity for research and innovation include; low levels of research skills, low investment in supportive infrastructure for research and development, weak ties between research-focused public sector and industry, little incentives for firms to innovate, lack of policy coherence and inadequate capacity in innovation policy development, (Al-bader et al., 2010, Mugabe & ACODE (Organization), 2011). Generally, there is still inadequacy in regional innovation policy dialogue, innovation strategies and alliances for funding regional innovation activities in science and technology, (Mugabe & ACODE (Organization), 2011).

The other challenge is that the curriculum content overlooks the creation of opportunities for both staff and students in building practical life skills and yet they are very critical for a more dynamic and innovative situation. Formal curriculum-development and review of programmes is not uniform across all HEIs thus, most new courses, and programs may be ad hoc and rarely based on solid market research, and consultations, (Spielman et al., 2011).

Language barriers and communication could be a problem in conducting research and innovation for instance, it is rare for a scientist to go and read documents on philosophy just to add knowledge. According to (Mafenya, 2013), this lack of intellectual curiosity hampers personal relationship in projects oriented across disciplines and a few researchers even barely understand the terminologies used in these researches and studies.

Massification of the education system has seen increased student enrolment in higher education institutions, which has had a bearing on recruitment and contract renewal of the faculty, university budget and spending, (Sanga, 2012). The paradigm shift and philosophies in African research indicate that research findings are not customized. Therefore, research done in the Africa should be able to solve local challenges, (Mulaudzi & Chyun, 2015).

The common themes identified as far as the changing role of HEIs in research and innovation and shortcomings involved are summarised Table 1.

Table 1: A summary of the changing role of HEIs on research and Innovations and bottlenecks encountered

Changing role of HEIs on research and innovations	Bottlenecks to the changing role of HEIs on research and innovation
-Globalization, borderless higher education markets. -Growing recognition of the role of higher education in national development. -International research activities. -Improvement in local publishing infrastructure. -Creation of opportunities. -Promotion of innovations. -Diversified modes of research delivery. -Creation of an enabling environment. -Policy frameworks that are supportive to research.	-Institutional autonomy. -Emerging ICTs and inadequate competences. -Massification of education that has affected quality -Educational approaches that are still traditional. -Curriculum content that tends to overlook the importance of creating opportunities for students to build practical life skills -Decision-making abilities. -CSR is still low.

-Boosting quality assurance. -Optimizing use of all institution's resources. -Enhancing university's infrastructure. - Increased academic support. - Corporate Social Responsibility (CSR). -Dynamism and new ways of conducting university research. -Enhancement of societal technological scientific advancement. -Knowledge-based economy.	- Inefficient utilization of research results. -Inadequate application of research findings to economic life. - Challenges in the digital environment. -Inadequate contextualized research methods. -Inadequate funding for research. - Lack of intellectual curiosity -Inadequate research hubs

The changing role of higher institutions of learning on research and innovation

The changing role of higher institutions of learning on research and innovation

Reviewed studies clearly describe the changing role of higher education institutions in research and innovation and contend that there are multiple sources and users of innovation both within and out the teaching institutions, (Mulaudzi & Chyun, 2015, Al-bader et al., 2010).

In the past few decades, higher institutions of learning in Africa have witnessed renewed interest in innovations, (Al-bader et al., 2010). This orientation has been from external development agencies aimed at creating partnership. They have been able to sponsor a number of activities within African higher education including but not limited to organizing brainstorming symposia, sponsoring research and institutional development, (香西 & 石田, 2003). Therefore, following decades of challenges especially in territorial innovations, low and middle-income regions including Africa, have been acknowledged as indispensable components of global development.

The role of education as the gateway to sustainable development cannot be overemphasized. Moreover, Africa needs quality higher education that does not only provide citizens with the desired skills and knowledge but also support research and innovation for it to effectively, and efficiently benefit from its human and natural resources, (Chuks & Sam, 2018). In Russia where the economy is knowledge driven, there is intensive innovation, high technology, and production. These intensive innovations require transformation of the higher education system to the one that responds to global educational trends, social and economic priorities, (Pogodaeva et al., 2015).

Similarly, a study done in the Netherland by Klerkx et al., (2010), examined the relative effects of transformational leadership dimensions on school organizational conditions, teacher motivation, and professional learning in schools. Its findings indicate that schools' capacities model changes and growth, subsequently affect teaching practices and research study can address this. Therefore, this calls for repositioning the role of education systems to focus more on research and be able to provide solutions to societal issues.

Although the indigenous and central role of higher institutions of learning has been teaching, knowledge creation and transfer, human-capita development, technological innovation, and capital investment, (Cheah, 2016), these roles have recently stretched to include regional leadership, its' influence on regional milieu, and knowledge infrastructure production and markets, (Cheah, 2016).

Accordingly, the academia is expected to embark on cutting-edge research to provide solutions to developmental challenges. Given the surging complexity of technological development, companies are adopting a new model of open innovation, which calls for collaboration. This approach is diversified and allows dense interactions and discussions with external partners, (Reichert, 2019). Therefore, higher institutions of learning are mandated to build broader and strong research institutional capacity as well as inter-organizational relationships required for innovation and smart specialization, (Vallance, et al. 2018).

Higher institutions of learning contribute greatly to the discovery of new materials, technological applications, and testing of equipment and protocols that could be applied to industrial processes aimed to enhance productivity. In biomedical sciences for example, the discovery of new diagnostics and treatment protocols improve the quality of care, and growth of the healthcare system and markets, (Cheah, 2016). Given this indispensable role, HEIs should create synergies with industries especially those in traditional manufacturing and any other involved in engineering where learning is by doing; also responding to customer needs other than participating in a scientific-based research. Such is strongly influential in the main knowledge base and modes of innovation in an economy.

Higher institutions of learning contribute to upgrading of public research infrastructure and capabilities through 'one size fits all' policy model. Meaning, research and innovation should accommodate qualitatively different innovation patterns while reflecting on the varying needs of different regions, (Vallance, et al., 2018). This desire to have a strong synergy between the academia and research industry was also reported in a study by Nicolaides (2014). Thus, for a research to produce practical and desirable fruits, the results should mould socio-economic policies and be able to meet societal needs. According to Blass & Hayward, (2014), institutions should engage with stakeholders, take ownership and exploit research for innovation hence address the missing links of and within social innovation development. Social innovation development yields a scientific community that is socially responsible and that strives to improve the living conditions of the entire population other than a segment of people, (Vessuri, 2008).

In an innovation-driven economy, technology is often at the heart; nonetheless, innovation begins with an idea, to its implementation, and then to creation of new value or products all of which require engagement of higher institutions of learning. Therefore, further innovative ideas, and research are relied upon to fine-tune the product, (Nicolaides, 2014). However, a number of university students are not measuring to the standard. They rather focus on simple research problems that will permit them to graduate faster other than one that addresses societal problems. These practices have an impact on academia-industry collaborated research as has been witnessed in Africa, (Chuks & Sam, 2018, Kigotho, 2021). Again, fears surround dependence on industry-funded research, which is driven by curiosity, and in a way biases study results, (Reichert, 2019).

HEIs have conventional tripartite functions including: teaching, research, and consultancy, thus, they are a hub to the knowledge base economy, (Mutula, 2010). Global knowledge is a backbone to economic growth and development of a nation. Accordingly, the research intention should be clear to yield good results for the staff and society. Innovations facilitate staff capacity to absorb new

technological output, knowledge, promote entrepreneurship and removes barriers on socio-cultural interactions, (Sanga, 2012).

Bottlenecks to research and innovation in HEIs in Africa

In the last five decades, research has changed dramatically to become more multidisciplinary, global, collaborative, and dependent through advanced networks, broader databases, new opportunities and challenges for professionals in HEIs, (Mutula, 2010). Research and innovations are contingent upon changes in the behaviors, culture and characterized by institution's incentives. These characteristics differ significantly from country to country partly due to the differences in policies, strategic planning and programmes, (Sanga, 2012).

In South Africa for instance, by far, the major challenge for research and innovation in the higher education institutions as seen from within the current framework, is the low participation rate, especially across racial and gender groups. Research and innovation play a key role in the production, advancement and dissemination of knowledge and the development of high-level human resources, (Department of Education, 1997, p. 82). The White Paper derives its emphasis on research from the acknowledgement that national growth is dependent on continuous technological improvement and innovations, which are driven by a well-organized, vibrant research and development systems. However, these are still wanting in the global south.

MacMillan & Schumacher, (2006) agree that a few of HEIs if any are not ready to cross the boundaries or generate new integrative knowledge. Therefore, the development and sustainability of the university research and innovative system is also dependent on its ability to respond to the opportunities and challenges provided by the global transformation in knowledge production and dissemination.

Moreover, institutional collaboration could motivate these institutions to work beyond knowledge boundaries and create solutions to societal issues. Active engagement generally strengthens partnership relevant and beneficial to institution research endeavours. Therefore, HEIs need to develop research strategies that clearly define resource needs to determine quality assurance, elaborate on ethical issues involved in research, collaborate, define peer review processes, commercialize research products, and offer mentorship, (Mutula, 2010). These will aid Africa to re-engineer and reclaim her lost glory. There is also a need to foster professional development of staff, increase input and insights, enhance large-scale reforms, reinforce accountability, and empower the HEIs for self-evaluation, (Factors & Practices, 2011).

Limitations of the study

Some of the analysed studies lacked clear methods and design and yet these were required according to the Cochrane review protocol. Again, the studies discussed did not directly address the changing role of research and innovation although they had some aspects that answered our study objective, which were excerpted and included in our study. The data about the shift in technological innovation

indicate a wide gap between African countries and developed countries, a situation that calls for further research.

Conclusions

The role of higher education institutions of learning in conducting research in Africa has been changing over the years from creation of new knowledge and its transfer to one that is need-driven, entrepreneurial, transformational, and able to reconfigure the status of innovation systems for regional socio-economic transformation and sustainable development. Common shortcomings are institutional autonomy, inadequate competences in the use of emerging ICTs, inadequate funding, curriculum content that does not clearly spell practical life skills and innovation opportunities. There is need for institutional collaboration, research policy and funding as well as customization of research to produce results that are community tailored.

Abbreviations

AfDB……African Development Bank
AU….....African Union
CSR……Corporate Social Responsibility
HE….....Higher Education
HEIs….....Higher Education Institutions
ICTs……Science Information and Communication
MDGs…….Millennium Development Goals
PPC…….Public-Private Cooperation
SDGs.....Sustainable Development Goals
STIS……Science, Technology and Innovation Strategy
UNESCO…….United Nations Educational, Scientific and Cultural Organization
NEPAD….....New Partnership for Africa's Development

REFERENCES

Al-bader, S., Masum, H., Simiyu, K., Daar, A. S., & Singer, P. A. (2010). *Science-based health innovation in sub-Saharan Africa*. *10*(Suppl 1), 1–9.

Apotheker, J., Blonder, R., Akaygun, S., Reis, P., & Kampschulte, L. (2017). Conference paper Responsible Research and Innovation in secondary school science classrooms : experiences from the project irresistible. 89(2), 211–219. https://doi.org/10.1515/pac-2016-0817

Badat, S. (2010). The Challenges of Transformation in Higher Education and Training Institutions in South Africa. Development Bank of South Africa, April, 1–37. http://www.ru.ac.za/media/rhodesuniversity/content/vc/documents/The Challenges of Transformation in Higher Eduaction and Training Institutions in South Africa.pdf

Al-bader, S., Masum, H., Simiyu, K., Daar, A. S., & Singer, P. A. (2010). *Science-based health*

innovation in sub-Saharan Africa. *10*(Suppl 1), 1–9.

Blass, E., & Hayward, P. (2014). Innovation in higher education; will there be a role for "the academe/university" in 2025? *European Journal of Futures Research*, *2*(1). https://doi.org/10.1007/s40309-014-0041-x

Cheah, S. (2016). Framework for measuring research and innovation impact. *Innovation: Management, Policy and Practice*, *18*(2), 212–232. https://doi.org/10.1080/14479338.2016.1219230

Cloete, N. (2012). Higher education and economic development in aFrica: The academic core. *Effects of Higher Education Reforms: Change Dynamics*, *December*, 137–152. https://doi.org/10.1007/978-94-6209-016-3

Ddungu, L., & Edopu, R. N. (2017). Social responsibility of public and private universities in Uganda. *Makerere Journal of Higher Education*, *8*(1), 73. https://doi.org/10.4314/majohe.v8i1.5

Factors, O., & Practices, L. (2011). *Educational Administration Quarterly*. https://doi.org/10.1177/0013161X11400185

Higher Education in the World 3. (2008). *Higher Education in the World 3*, *August*. https://doi.org/10.1007/978-1-349-58169-6

Items, R., Rose, W., Rose, W., If, T., & Rose, W. (2018). *Smart specialisation in regions with less-developed research and innovation systems : a changing role for universities ? Published in Environment and Planning C : Politics and Space (2017) Paul Vallance , Centre for Urban and Regional Development Studie*. https://doi.org/10.1177/2399654417705137.Reuse

Klerkx, L., Aarts, N., & Leeuwis, C. (2010). Adaptive management in agricultural innovation systems : The interactions between innovation networks and their environment. *Agricultural Systems*, *103*(6), 390–400. https://doi.org/10.1016/j.agsy.2010.03.012

Kyaligonza, R., Kimoga, J., & Nabayego, C. (2015). Funding of Academic Staff's Research in Public Universities in Uganda: Challenges and Opportunities. *Makerere Journal of Higher Education*, *7*(2), 147–162. https://doi.org/10.4314/majohe.v7i2.10

Mafenya, P. N. (2013). Investigation of the collaborative relationship between industry and academic education in open and distance learning: A South African context. *Mediterranean Journal of Social Sciences*, *4*(13), 43–45. https://doi.org/10.5901/mjss.2013.v4n13p43

Mugabe, J., & ACODE (Organization). (2011). *Science, technology and innovation in Africa's regional integration : from rhetoric to practice* (Issue 44).

Mulaudzi, F. M., & Chyun, D. A. (2015). Innovation in Nursing and Midwifery Education and Research. *Rwanda Journal*, *2*(2), 21. https://doi.org/10.4314/rj.v2i2.3f

Mutula, S. (2010). Challenges of doing research in sub-Saharan African universities: digital scholarship opportunities. *Inkanyiso: Journal of Humanities and Social Sciences*, *1*(1), 1–10. https://doi.org/10.4314/ijhss.v1i1.62101

Naidoo, N. (2011). What is research? A conceptual understanding. *African Journal of Emergency Medicine*, *1*(1), 47–48. https://doi.org/10.1016/j.afjem.2011.05.011

Nicolaides, A. (2014). Research and Innovation – the drivers of economic development. *African Journal of Hospitality, Tourism and Leisure*, *3*(2), 1–16. www.ajhtl.com

Pogodaeva, T., Zhaparova, D., & Efremova, I. (2015). Changing Role of the University in Innovation

Development: New Challenges for Russian Regions. *Procedia - Social and Behavioral Sciences*, *214*(June), 359–367. https://doi.org/10.1016/j.sbspro.2015.11.659

Reichert, S. (2019). The Role of Universities in Regional Innovation Ecosystems. *European University Association*, *March*, 102. www.eua.eu

Sanga, P. (2012). Challenges of Institutional Reform in African Higher Education: the Case of Three Public Universities in East Africa. *Makerere Journal of Higher Education*, *3*(2), 1–18. https://doi.org/10.4314/majohe.v3i2.6

Spielman, D. J., Davis, K., Zerfu, E., Ekboir, J., & Ochieng, C. M. O. (2011). An Innovation Systems Perspectives on Tertiary-Level Agricultural Education in Sub-Saharan Africa: (Evidence From Ethiopia). *Ethiopian Journal of Education and Sciences*, *7*(2), 15–32. https://doi.org/10.4314/ejesc.v7i2

香西武, & 石田啓祐. (2003). No Title四国中央部黒瀬川帯下部白亜系産の"テチス”–”テチス北方”の混在型群集. 鳴門教育大学研究紀要（自然科学編）, *18*(June), 19–28.

Vallance, P., Blažek, J., Edwards, J., & Květoň, V. (2018). Smart specialisation in regions with less-developed research and innovation systems: A changing role for universities? Environment and Planning C: Politics and Space, 36(2), 219–238. DOI: 10.1177/2399654417705137.