African Journal of Rural Development, Vol. 1(2): 2016: pp. 205 - 217 ISSN 2415-2838

Date received: 14 January, 2016 Date accepted: 02 February, 2016

Developing Higher Education systems in Africa - Selected country views

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ABSTRACT

Knowledge, science, technology and innovations have emerged as predominant factors of production in the 21st century. As such, global economies have joined the race to produce knowledge through investments, regulatory frameworks and macro-economic policies that favour research and innovation. Higher education stands out as a key antecedent of knowledge. Within Africa, from issues of limitations and restrictions to access, higher education service provision has been diversified; the number of Universities increased and enrolments have soared amidst funding and quality challenges. This study of six countries shows how African higher education system are striving to cope with the new context of knowledge production, over and above the traditional role of producing skilled labour. National governments have come up with initiatives and policy documentation that will ensure that Africa can fit within the knowledge economy dispensation. The study affirms that beyond the policy documents, African governments have to fully engage in the business of knowledge production if they are to remain relevant in this competitive global space.

Key words: Africa, higher education, knowledge economy, science, technology & innovations

RÉSUMÉ

Les connaissances, la science, la technologie et les innovations ont émergé comme facteurs prédominants de production au cours de ce 21ème siècle. En tant que tel, les économies au niveau global se sont engagées dans la production de connaissances à travers des investissements, des cadres réglementaires et des politiques macro-économiques qui favorisent la recherche et l'innovation. L'enseignement supérieur se démarque comme un antécédent clé des connaissances. En Afrique, des questions relatives aux limitations et restrictions d'accès, la fourniture de services d'enseignement supérieur a été diversifiée; le nombre d'universités a augmenté, et les inscriptions ont grimpé en flèche au milieu des défis de financement et de qualité. Cette étude de six pays montre comment les systèmes d'enseignements supérieurs africains s'efforcent de composer avec le nouveau contexte de la production de connaissances, au-delà du rôle traditionnel de produire de la main-d'œuvre qualifiée. Les gouvernements nationaux ont surgi avec des initiatives et la documentation des politiques qui assureront que l'Afrique peut s'insérer dans l'enseignement de l'économie de la connaissance. L'étude affirme qu'au-delà des documents de politique, les gouvernements africains doivent s'engager pleinement dans l'entreprise de production des connaissances si elles restent pertinentes dans cet espace global concurrentiel.

Mots clés: Afrique, Enseignement supérieur, Economie du savoir, Science, Technologie & innovations

INTRODUCTION

Participation in higher education in Africa has expanded considerably since the 1970s. From 200,000 in 1970 enrolment had expanded to more than 4.5 million by 2008 and to 9.54 million by 2012 of which 6.34 million are in sub-Saharan Africa (African Union, 2015; Friesenhahn, 2015). Where most countries had a single public institution, the number of institutions had grown to more than 600 by this period; and the private sector's role has developed considerably (World Bank, 2009; UNESCO, 2010).These strides notwithstanding, gross enrolment ratios remains at 9% compared to 44% in Latin America and 95% in North America (UNDP, 2014)[1]. Overall, in Africa investment in higher education, knowledge production and research remain low and the continent is yet to 'catch up' with other developed and emerging economies within the knowledge economy that has gained prominence as the defining standard for economic development.

The challenges associated with the current expansion in both public and private higher education system in Africa without strategic reform have been illuminated by different scholars. Hayward and Ncayiyana (2014) contend that first, increased student enrolments are neither balanced with requisite staff increases, infrastructure and facilities, nor funding; second, inadequate opportunities exist to undertake research and for training at MSc and PhD level; third, there is low funding and investments in higher education institutions; and fourth, weak monitoring and evaluation frameworks that do not adequately link performance of universities to funding frameworks. All these are occurring within a framework of a move towards knowledge economies and an increasing global gross expenditure for research and development from US$1,132 billion in 2007 to US$1,478 billion by 2013, an increase of more than 30%(World Bank and Elsevier, 2014). Yet Africa's contribution remains low representing only 1% of the world research output share. At the same time, increased enrolments have resulted in decreasing unit expenditure and quality.

The reported shift from basic to applied sciences demonstrates the need to make science have immediate relevance to the day to day needs of communities. Yet basic science cannot be over looked since it provides the foundation upon which applied science is constructed. For the agricultural sector applied science is the cornerstone for uptake of technologies and practices that will improve yields and benefits across the value chain. Additionally, it is higher education systems that complement research processes as proxies for knowledge production and development irrespective of the applied or basic nature of the research undertaken.

The UNESCO 2015 Science Report puts into context the emerging trends for research, science and technology at the global level. These trends with particular relevance to Africa are likely to define the focus of higher education systems, universities and research institutions. The report notes a decline in the research Science, Technology and Innovation (STI) divide between north and south. Indeed, the national expenditure trends on research and development are still skewed towards the northern countries; with the developing and emerging economies reporting more commitment via policy documentation and grand visions. In line with the African Agenda 2063 which articulates a strong knowledge management system; experiential learning, cutting edge research and innovation, all countries in this study have grand visions, ranging from Ghana and Malawi's vision 2020 to Benin's vision 2025, Kenya's vision 2030 and Uganda's vision 2040. The visions are designed not only to address the global goals but to act as benchmarks for wealth creation and sustainable development.

It is anticipated that the targets as set by the Sustainable Development Goals (SDGs) highlight areas of critical importance for humanity and the planet. Within the developing world and especially sub Saharan Africa (SSA), the need to subscribe to the tenets espoused by the global agenda cannot be over emphasized; more so since the goals are in alignment with the African Development Agenda 2063. It has been documented that within the 21st century, wealth creation and /or eradication of extreme poverty as elucidated by the global goals is a function of knowledge generation and exploitation. The knowledge economy is predominated by science, technology and innovations; and it is knowledge that drives productivity and economic growth. Worthy to explore therefore, is the role of higher education and its contribution to the knowledge economy and how it impacts on appreciation, adoption and implementation of initiatives that will actualize sustainable development as articulated by the goals.

This paper assesses the status of higher education in sub Saharan Africa in general with specific reference to six African countries as case studies. The report brings together assessments made by practicing professionals in the higher education sector of these countries. Study methodologies include field work through interviews and observations; review of existing literature and extensive internet searches. The study covers the history, practices, and status as well as link

[1] http://www.uis.unesco.org/DataCentre/Pages/country-profile.aspx?regioncode=40540&code=UGA

between higher education and agricultural development. It ends with recommendations at continental, regional, country and institutional levels.

The Higher Education Systems in Africa

From the structural adjustment programmes instituted in the 1980's, the focus of education systems in sub – Saharan Africa was targeted at the lower stages especially at the primary and secondary school levels. This focus saw a liberalization of the higher education sector and a shift from wholly state financed systems to greater involvement of the private sector. As a result, commercialization, new models of private provision within public institutions as well as the establishment of privately financed institutions emerged. This coupled with the changing demographics and increased demand from both the traditional and non-traditional student populations plus the need for increased access created a fertile ground for new configurations in the higher education systems. Most importantly, enrolment levels increased and the number of both public and private institutions increased considerably compared to the immediate post independent position where each country had only one public university. However, dramatic increase in most countries was not until as recent as 2010; when the number of institutions tripled in Kenya, doubled in Ethiopia and Uganda and significantly increased in Benin.

The changes associated with this unprecedented growth present both challenges and opportunities for review. It demonstrates the need for systemic assessment especially with respect to quality and fitness for purpose. The sections below give an overview of the growth patterns in the higher education sectors of the different countries in this study. They further offer a point of reflection that would form the basis for the policy recommendations in the later section of the report.

Ethiopia

The higher education system in Ethiopia unlike other countries in this study is not modelled along any colonial system. What emerges is a home-grown system that has gone through different phases of development. University education in Ethiopia has transitioned through three distinct generations of university establishments. The initial phase begun with the establishment of Addis Ababa University (AAU) in 1950. By 2015 AAU, the largest university in Ethiopia had an enrolment of 48,673 students (33,940 undergraduate, 13,000 MSc/MA students and 1733 PhD candidates), 6043 staff (2,408 academic and 3,635 support). In its 14 campuses, the University runs 70 undergraduate and 293 post graduate programs (i.e., 72 PhD and 221 Masters Programmes), and various specializations in Health Sciences. Early developments in university education included the institution of eight Universities across the country among which was the Alemaya College (later transformed into Haramaya University) which stands out as the Agricultural education institution of Ethiopia as an agreement between the US and Ethiopian governments in 1952. These early ingenuities spawned seven universities including Awasa, Arbaminch, Gondar, Jima and Mekele Universities.

Systemic reforms were introduced in 2003 to accommodate greater autonomy and cost sharing: establishment of the Quality and Relevance Assurance Agency (HERQA) as well as institution of the Higher Education Strategy Centre (HESC). These reforms preceded the second generation comprising of 13 universities including, among others, Adama, Debrebirhan and Dire Dawa universities. The third generation of universities began in 2010 with nine new universities which included Addis Ababa Science and Technology University and Adigrat University among others. By 2015 Ethiopia had 36 public and four private universities, undergraduate enrolment had reached 755,244 students in more than 165 programs. The share of the private sector was 15%, in sharp contrast to the higher education systems of other countries in this study which have several private institutions and a predominantly private/ fee paying enrolment, even within public institutions.

Ghana

University education in Ghana has its roots in the British Colonial Asqcuith Commission that established the Gold Coast University as a constituent college of the University of London in 1948. The post independent transitions created the University of Ghana and the Kwame Nkrumah University of Science and Technology in 1961. By 2014 there were nine (9) public universities, 10 polytechnics with degree awarding status and 64 private universities in Ghana.

Between 2004 and 2014, the demand for higher education in the five main public universities had grown steadily and had far exceeded the supply. Using the University of Ghana as an example, the number of applicants had increased substantially from approximately 19,000 in 2004 to 79,000 by 2014. The admission of University of Ghana, the largest University in Ghana for example accounts for only 12% of applicants who qualify for university entry. The proportion of female admission over the period 2004-2014 ranged from 31% to 40% of the total admissions for the nine (9) public universities. The enrolment in agriculture for females ranged from 16% to 23% of the total enrolment in agriculture.

Kenya

By 2015 Kenya had 22 public universities, 9 Constituent University Colleges and 21 private universities with charters granted by the Commission for University Education (CUE), spurred by Universities Act 2012. Before 2013, there were only seven public and 15 chartered universities. The development of university education started with the establishment of the University of Nairobi in 1970 as the first public University, having been a constituent college of the University of East Africa. The number of students in tertiary institutions has doubled since the introduction of free primary and secondary education policy in the country. Out of the 400,000 students sitting for Kenya Secondary Certificate of Education (KSCE)150,000 attain minimum university entry requirement grade and of this number 62,000 (41%) got admitted to the public universities and another 20,000 (13%) to the private universities while the rest joined other colleges, (JAB-Kenya 2014).

University management in public universities continue to complain of inadequate funding and the Government urges them to compensate through innovative activities and income generation. This has embolden the universities to vary tuition and other fees charged and encouraging module II or Parallel degree programs to increase student numbers, often at the expense of quality education. The universities have expanded by creating campuses in various towns and regions and innovatively establishing ODeL facilities under the guise of increasing access. Some departments in the universities have only one staff member who has a PhD, and most likely that is the Head (Chair) of the Department. Private universities on the other hand are run as companies or by religious organizations such as churches and have different methods of raising funds. Most private universities have lean staff and rely on academics employed by public universities to teach for them on part-time basis.

Malawi

University of Malawi the first university in Malawi was established in 1965 soon after independence with only 90 students. Two years later, the Institution of Public Administration, Hill College of Education and Bunda College were established as colleges affiliated to the University of Malawi (UNIMA). It was not until 1999 that the second university, Mzuzu University (MZUNI),was established by Act of Parliament. Within the last fifteen years there has been a rapid expansion of Malawi's national education system. Lilongwe University of Agriculture and Natural Resources (LUANAR) was officially opened as the third public university focusing on agriculture and natural resources, in 2012. This was followed by the opening of the Malawi University of Science and Technology (MUST) to focus on science and technology development. By 2009, students numbers enrolled in the country's universities had increased to 7,972, up from 3 117 in 1990 and 3 872 in 1995 (Ng'ambi, 2010). However, compared to other African education systems the system is still relatively underdeveloped. There are only a total of about 15000 students enrolled into all its five public universities and 16 accredited private universities. Out of these, about 20% are enrolled into agriculture programmes, mainly at LUANAR.

Uganda

The foundation for the modern day education sector in Uganda is rooted in the 1992 Government White Paper on Education (GWPE). Based on the Education Policy Review Commission findings, the white paper outlines the aims and objectives of education as well as the pathways for improving the Ugandan education system. The White Paper underscores that 'education is a powerful tool for transformation of society' and that, "… No education system can be better than the quality of its teachers, nor can a country be better than the quality of its education.' (Government of Uganda 1992). From one public university in 1989, Uganda had by 2014, thirty five (35) universities: (6 public and 29 chartered and other private universities)[2]. Enrolment had increased by more than 800% from 15,000 in 1992 to close to 150,000 by 2011 (NCHE, 2013). Gender composition boarded on parity at 44%.

The university system is however, still characterized by a mismatch between the student numbers and facilities. These capacity issues manifest through crowded classrooms, inadequate staff student ratios, obsolete equipment and challenges to the governance and management structures (Visitation Committee to Public Universities 2007). In addition, the system is still plagued by access and equity limitations. For example, Makerere University the largest institution takes only 28% of the students eligible for university entry. Furthermore, the sector focus is predominantly undergraduate as evidenced by the enrolment and graduation levels. PhD graduation represent 0.3% of total graduates and within Makerere University for example, graduate enrolment represented only 7% of total enrolments over a three year period (Bunting, Cloete *et al*., 2014; UNCST 2014; Makerere University, 2015).

[2] The Government intends to start /covert 7 new public universities by FY2016/17

Benin

Only one university existed in Benin until 2000 called National University of Benin (ex-University of Dahomey). In late 2001, a new university was created and called the University of Parakou (due to increase of the number of students per year in the first one). As such, these two public universities have been offering higher education in Benin until 2008. But from 2009 to 2014, two new public universities were created. By 2015 three other universities had been created raising the current number of universities to seven. All research and education activities are directly managed by the Ministries of Education (primary, secondary, and higher education) and national scientific research institutes within the country. Major advances have been made in education, especially in the areas of access and teaching/ learning conditions. Gender balance and geographic equity have shown significant improvements in gross numbers of girls and children from disadvantaged areas attaining education in general. Nonetheless, major constraints and challenges remain.

Placing African Higher Education within the Knowledge Economy Discourse

The narratives associated with higher education systems in Africa demonstrate a similar growth pattern across the region. The concomitant challenges highlighted have been experienced by other developing and emerging economic systems. What comes to light is how the players in the Higher Education systems in Africa perceive themselves and the role they are expected to play in economic and national development. Cloete and Maassen (2015) highlight social legitimisation and cohesion, training the labour force and production of scientific knowledge as core functions of Universities. For all the higher education systems in Africa, the predominant and explicit role has been the provision of labour force. Yet even this has relevance and comprehensive community needs challenges. Although enrolments have soared, unemployment remains high and the link between education and community needs is still tenuous. This has been explained as a mismatch between education and the job market primarily because the university curriculum is still rooted in traditional public sector white and blue collar preparation mode neglecting the dynamic needs of the 21st century private and other sectors.

On the whole, despite the increase in enrolments to close to 4.5 million by 2008, gross enrolment ratio is estimated at 18% compared to the world average of 53% in 2015. The higher education systems in Africa are characterised by inadequate inputs and infrastructure (most times run-down) while the stock of graduates have been defined as theoretical and with limited practical skills. Fewer than 50% of the academic staff hold PhDs tempered with continuous brain drain and recruitment freezes (Hayward and Ncayiyana, 2014). This has been further aggravated by inappropriate macroeconomic and regulatory frameworks, inadequate communication infrastructures; and the capacity to harness the global knowledge base and market conditions that favour innovation to spur economic development (World Bank, 2002).

In the same vein, national development frameworks have neither adequately articulated their expectations of the Higher Education systems nor have they made acceptable provision to ensure that Africa enhances its competitive edge within the knowledge economy that has dominated the global space. Salim (2009) highlights this status as underdeveloped tertiary education systems, ill prepared to capitalise on the creation and use of knowledge and thus pose a risk of further marginalisation in a highly competitive world economy. Correspondingly, it has become increasingly clear that the development of modern infrastructure, and the achievement of economic diversification and industrialization will necessitate greater investment in STI, including the constitution of a critical mass of skilled workers (UNESCO, 2015).

Several initiatives have begun to emerge to address the issues of higher education in Africa. These include, among others, international partnerships and development frameworks which provide access to resources and facilities not available in African countries. Furthermore student mobility has increased participation particularly at the graduate levels which has enabled access to more advanced education systems. UNESCO documentation reveals that SSA outbound student mobility had increased from 204,900 in 2003 to 288,200 by 2012. This however, represented a declined percentage share of total participation from 6 per cent to 4.5 per cent in the same period, an indication of the expansion of domestic higher education systems.

At the policy level, governments have formulated visions as a framework for sector development. They however, largely remain policy documents with limited practical and implementation structures. Figure 1 shows the vision extracts relevant to higher education as articulated by the different countries included in the current study. These visions have documented transformation statements including movement towards middle income countries by the vision dates and validate national commitment to higher education as a key facilitator for development.

From another perspective, knowledge production proxies have been identified as research output, graduate student enrol and enrolments in science and

Kenya Vision 2030	Malawi Vision 2020	Ghana Vision 2020	Benin Vision 2025	Uganda Vision 2040
Provide Globally competitive quality education, training and research	Building an educated and highly skilled population and promoting scientific and technological developments and innovations	The use of science and technology to rapidly address Ghana's development to improve the quality of life for all, at the same time maintaining the integrity of the environment	Building human capital, this is through improvement in human resources will be achieved through promotion of development education	Uganda will build a modern world class education system that provides students with first rate education, compared to that offered by developed and emerging economies

Figure 1: National Commitment/Visions and Focus on Higher Education

technology (Cloete and Bailey, 2011). These have been used as a basis for the evaluation of the performance of higher education systems in Africa. While initiatives such as the African Science and Technology Indicators Initiative (ASTI) have emerged, it is clear that there is need for reliable data to enable monitoring of national science and innovation systems that should ultimately inform policy. The continent is yet to evolve a comprehensive information system to capture the knowledge development and production indicators. This implies reliance on foreign based databases generated by institutions such as UNESCO and the World Bank which in many cases lag behind up-to-date values and therefore have bias. This limits parameters of comparisons, may influence the emphasis of assessments made, and skew the designed frameworks from local contexts and home-grown solutions, as experienced with the World University Ranking systems.

RESEARCH AND DEVELOPMENT

Although the output of African scientific publications has increased over the past 10 years[3], this remains the lowest in the world at less than 1% of the world share (World Bank and Elsevier, 2014). Enrolments in science and technology programmes remain low and, research and knowledge production are still categorised as nascent with evidence of a lag between the African continent and other developed and emerging economies, (UNESCO, 2015). Only one African country, South Africa, makes it to the global top 50 in terms of research output (35th), and less than ten African countries are in the top 100, according to the *Scopus* based global SciMago Country Ranking.

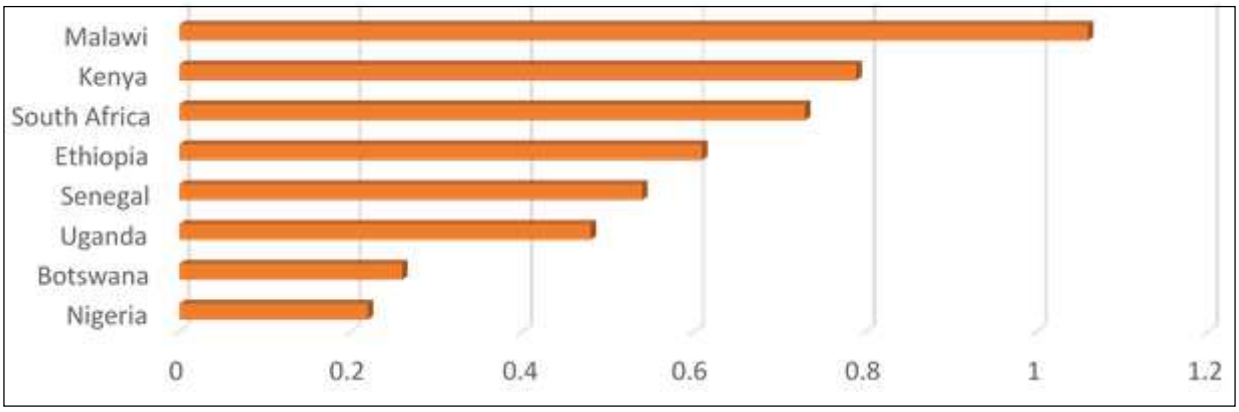
Furthermore, despite international commitment, expenditure on research and development remains low compared to other countries. Figure 2 shows the Gross Domestic Expenditure on R&D (GERD) in selected African countries. The bulk of this however, comes from external development partners. In Uganda for example, the Science Technology and Innovation Status Report 2012/13 puts government expenditure for R&D at 0.19% of GDP which represents only 10% of total expenditure on R&D in the country (UNCST, 2014). Foreign contribution represents 47% in Kenya and 57% in Uganda compared to 40% in Burundi and 42% in Tanzania (UNESCO, 2015). This notwithstanding, the 2015 UNESCO Science Report has acknowledged the growing commitment of African governments towards research and development, citing Ethiopia, Malawi and Uganda as examples. The report notes that GERD in Ethiopia rose from 0.24% (2009) to 0.61% (2013) of GDP. Figure 2 shows that Malawi had raised its ratio to 1.06% and Uganda to 0.48% (2010), up from 0.33%

[3]The number of publications with African Authors grew by 60.1% from 2008 to 2014 – UNESCO Science Report 2015

in 2008; and in a futuristic perspective Kenya, has created a National Research Fund and made provisions for the fund to receive 2% of Kenya's GDP each financial year.

Apart from research expenditure, African participation in research and innovation manifests through the density of researchers per national population. These have been computed at 91.4 per million inhabitants for sub Saharan Africa by 2013 representing 1.1 percent of the global share of researchers. Yet according to NEPAD (2010), the average ratio between Full time equivalent and Head Count is around 50%, with South Africa as a case in point. Malawi and Senegal are in the same range, with Ghana following with a slightly higher ratio. Nigeria and Uganda are both considerably below the average.

The knowledge output productivity in Africa has also been evaluated by the Higher Education Research and Advocacy Network (HERANA) basing on eight flagship university project by the Centre for Higher Education Transformation. The HERANA study shows that average annual high level publications output per permanent academic with doctoral qualification was 0.73 ranging from 2.39 in University of Cape Town to 0.25 in Eduardo Mondlane and 0.26 in University of Botswana within the 2009-2011 period. Comparatively, average doctoral graduate output productivity was 0.1 ranging from 0.01 for Eduardo Mondlane to 0.28 for University of Cape Town. The flagships for the countries in the current study had (0.66 & 0.09) for Makerere University, (0.30 and 0.07) for University of Nairobi and (0.30 & 0.05) for University of Ghana, as research article productivity and doctoral graduates respectively (Bunting and Cloete, 2014). While these may not be representative of the African region, as flagships they give an indication of the productivity levels of the higher education institutions in Africa. Table 1 shows the head count graduate output for the eight flagships in the Higher Education Research and Advocacy Network (HERANA) database. The table shows that apart from University of Cape Town, Universities in Africa predominantly produce first



Source: UNESCO Science Report 2015

Figure 2: GERD as a Percentage of GDP in selected African Countries 2013

Table 1: Graduation rates in 8 African Flagships 2011

	Graduate/ Outputs						Staff with Doctorates %
	Under-Graduate	Postgraduate below masters	Masters	Doctors	Total	% Post Graduate	
Univ. of Botswana	2329	68	206	10	**2613**	11%	65%
Univ. of Cape Town	3408	1874	1085	163	**6530**	48%	63%
Dar Es Salaam	4179	129	566	24	**4898**	15%	45%
Eduardo Mondlane	1450	0	109	2	**1561**	7%	17%
Univ. of Ghana	6370	0	1591	36	**7997**	20%	50%
Makerere Univ.	7855	16	670	55	**8596**	9%	43%
Mauritius Univ.	2251	23	396	15	**2685**	16%	42%
Nairobi Univ.	7774	54	2533	61	**10422**	25%	45%
Nelson Mandela	4161	667	390	59	**5277**	21%	37%

Source: CHET/HERANA Open data source accessed 31st December 2015

degree holders, which may be an indicator to the inadequate research strength of the higher education systems in these countries.

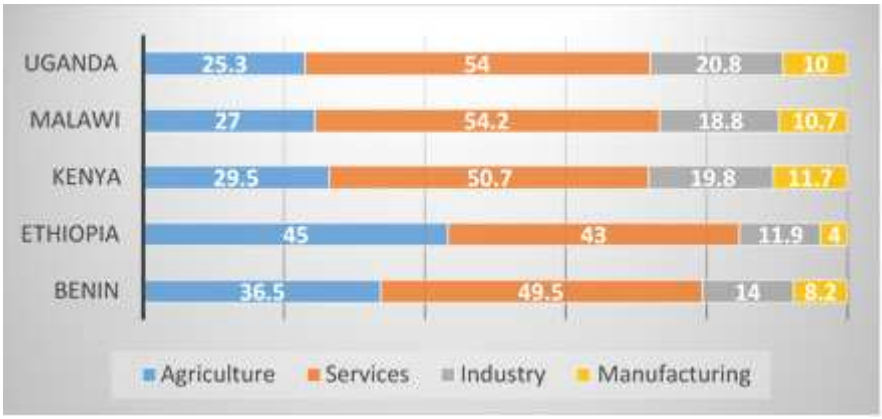
Agricultural Higher Education-Emerging Trends

The relevance of tertiary agricultural education is grounded in the contribution of agriculture to national economies particularly in sub Saharan Africa. In the majority of cases, agriculture employs more than 60% of the population and contributes close to 30% of GDP in several countries; this could be as high as 45% in Ethiopia and 37% in Benin (see Figure 3). For Malawi, the economy remains agro-based with the agriculture sector accounting for over 38.6% of the GDP, employing about 84.5% of the labour force, and accounting for 82.5% of foreign exchange earnings (Msiska, 2006). The adoption of the Comprehensive African Agriculture Development Programme (CAADP) in 2002 by NEPAD and African Union demonstrates response to the crisis situation of African Agriculture. In addition to increase in arable land, enhancing productivity and evolving capacities that improve access to markets, the CAADP identifies agricultural research, technological dissemination and adoption as fundamental to development of agricultural systems in Africa. It has further been argued that investment in agricultural education, extension and innovation systems will be one of the key factors for improving productivity in Africa.

Despite the apparent relevance of agriculture to national development, the response of the national education systems has not moved in sync with the need to enhance agriculture and agricultural based technologies and practices. In Uganda for example, the National Council for Higher Education (NCHE) indicates that by 2011 Uganda had only three tertiary/non-degree awarding institutions focusing on agriculture, forestry and fisheries. Enrolment stood at 0.8% (1625) of the total higher education and limitations exhibited at Masters and PhD levels for the university subsector. For Ghana, Tertiary Agricultural Education is offered in some of the polytechnics, universities and training colleges. Five out of the nine (9) public universities and five (5) out of the ten (10) Polytechnics in the country offer programmes in agriculture. Only four (4) out of about sixty four (64) private universities offer agriculture or agriculture-related programmes. Beginning 2015, the agriculture content in the syllabus of Colleges of Education has been drastically reduced. This has partly been as a result of limitation in agricultural education facilities including proper College Farms suitable for practical training of teachers of agriculture. The situation is not significantly different in Malawi and Kenya.

The exception to the agricultural education trend in Ethiopia (see Figure 3) where most universities in Ethiopia have an agriculture college or integrate agriculture in their academic programmes. There are about 50 undergraduate level academic programmes related to agriculture sector in public universities. In addition, there are 74 thesis based Masters' degree and 22 Doctoral programmes run mainly in first generation universities. Focus disciplines such as plant sciences, natural resource management and animal sciences are offered across a wide spectrum of universities.

Emphasis on the argument of inappropriate and inadequate skills for the agricultural sector has been put by other development agencies; the World Bank (2014) for example, acknowledges that there is a mismatch between the human capital in agriculture, especially as it applies to the requirements of the employers compared to what the job seekers have to offer. They further contend that this cuts across a wide spectrum of professionals that include: extension agents, agronomists, veterinarians, plant breeders, food scientists, nutritionists, applied engineers, agribusiness specialists, and entrepreneurs in agricultural supply



Source: UNESCO World Science Report 2015

Figure 3: GDP Composition by Sector 2013 (%)

chains, natural resource managers, regulatory authorities and policy analysts.

It is acknowledged that there is need to move agricultural education from the classroom to the field where learners can experience real life situations that will enhance transfer of knowledge and adaptation of technologies after graduation. Experiential learning has been put forward as the key to agricultural skills development and retention which will in the long run increase productivity. It is anticipated that it is these changes in pedagogy that will promote positive attitude towards agriculture which is currently characterised by low productivity, inadequate technology transfer and adaptation as well as low self-esteem and uptake by the younger generation. When adopted these strategies will promote CAADP pronounced vision for a 6% annual growth rate in agricultural productivity (World Bank, 2014).

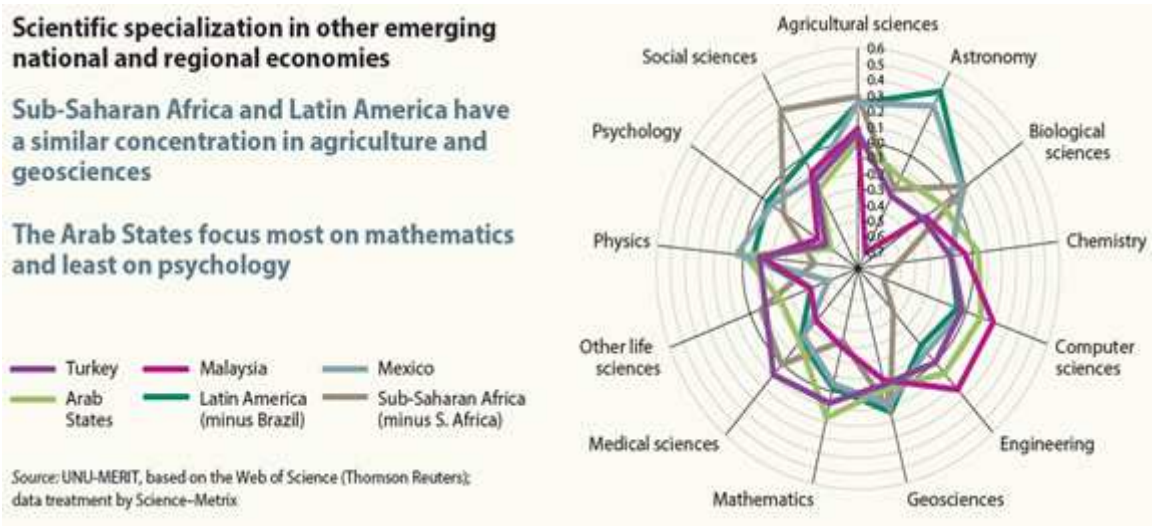
Despite these challenges, however, research hubs in agriculture have started to emerge, the RUFORUM supported Plant Breeding Centre based at Makerere University in Uganda is one such example. Other programmes include the Uganda Millennium Science Initiative funded by the World Bank to support research, education and training in science and technology with linkages to industry. Some of the funds were geared towards strengthening the Uganda Industrial Research Institute (UIRI) and the Uganda National Council for Science and Technology. In order to support agriculture as a priority sector, funding was also provided for agricultural research through the National Agricultural Research Organisation (NARO) and for the provision of extension services through the National Agricultural Advisory Services (NAADS).

Regional networks have supported advanced degrees and research in agriculture in Africa. Twenty-three regional postgraduate programmes were identified in a recent study ranging from the African Centre for Crop Improvement at the University of KwaZulu-Natal in South Africa to a programme focusing on Research Methodology at Jomo Kenyatta University of Agriculture and Technology, the PhD and Masters programmes in Aquaculture and Fisheries Science, and Agriculture, Applied and Resource Economics under the Regional Universities for Forum for Capacity Building in Agriculture at LUANAR (World Bank, 2009). Such programmes generate strong graduate programmes which provide a vital link between research and teaching and expand opportunities for graduate research.

Focus on Agricultural research is evident from the publications output for sub-Saharan Africa. Figure 4 extracted from the UNESCO Science Report, 2015 shows that publications have focused on agricultural sciences, geosciences, social sciences and biological sciences compared to engineering, computer sciences and physics. These publications are further embodiment of collaborations within regional and other networks.

Financing, Returns and the Role of Higher Education in Economic Development

Higher education in Africa has been characterised by inadequate financing, generating limitations in requisite inputs and creating staff, equipment and facilities capacity gaps. In the majority of cases, institutional financing has moved from full state funding to a Public Private Partnership that has seen an increased participation by the private sector. In addition, multilateral and bilateral partners have played a key role



(UNESCO 2015, p 19)

Figure 4: Publications Focus 2014

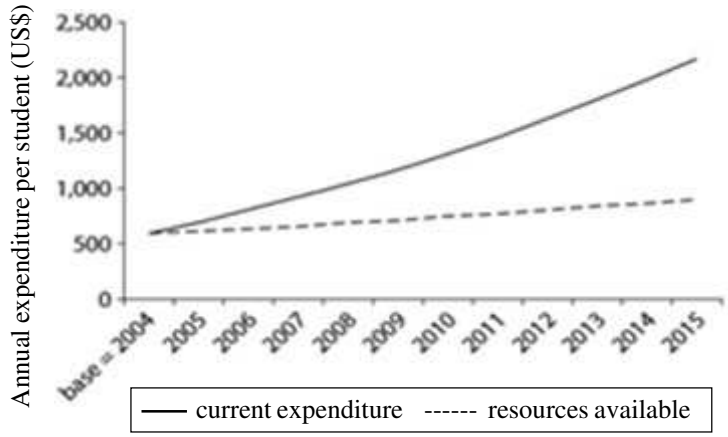
in the research as well as the governance structures of Universities in Africa. Institutions such as the World Bank, Carnegie, DAAD, IDRC, Sida/SAREC, USAID and the National Institutes of Health have provided support that has been instrumental in research output and institutional reforms. One of the key characteristics of the financing structure of African higher education systems is that the growth in enrolment has outpaced the financial capacities of several countries. Indeed it has been reported that Africa is the only region in the world where public expenditure per higher education students has reduced over the past 30 years from $6800 in 1980 to close to 981 by 2009 in 33 countries (World Bank, 2009; World Bank, 2010). Figure 5 gives an overview of the expenditure trend of higher education in Africa.

From a utility perspective, the higher education financing discourse has been dominated by the concept of social and private returns to education. While this led to the channelling of resources into the lower levels of education in sub Saharan Africa, it has emerged that four decades of support to basic and secondary education have not delivered the desired economic development. Furthermore, examples abound that demonstrate that commitment and investments in tertiary education by national governments have had a direct impact on the development processes of these countries even when they are emerging from periods of political, social or economic decline. Such examples include South Africa, Finland, South Korea, Malaysia and China.

Returns to investment in Higher Education are closer to 30% (Borland and Dawkins, 2000; Montenegro and Patrinos, 2013). Increasing enrolment by one percentage point, increases Gross Domestic Product (GDP) by between one and three per cent every year (Bloom and Canning, 2006). This is so despite the contention that the private returns are likely to be higher than the public returns in the case of higher education. The link between human capital and productivity has been given as one of the major factors that have led to the flourishing economic development that has characterized the Asian countries over the past two decades. Tertiary education directly influences national productivity which is a major determinant of living standards and a country's ability to compete in the globalization process (World Bank, 2002). This is because higher education combines both the production and service arenas of development, knowledge generation, utilization and transmission (Bloom and Canning, 2006).

However, like all other sectors, limitations to return on investment have been cited as a challenge associated with the education - skills mismatch in the agriculture sector, part of which manifests in inability to attract qualified young people; limitations in growth potential due to lack of adequate human capital; and growing level of unemployment despite having attained qualifications. The discussion concludes with the contention that Universities must support enquiry based and student-centred teaching and learning approaches that will ensure that graduates are entrepreneurial and have capacity to solve local problems.

This may well be the justification required for additional investment in higher education. Quoted by the World Bank (2014) the Food and Agricultural Organisation



Source: Authors' calculations based on national, UIS, United Nations, and World Bank data
Note: This simulation concerns only 27 African countries

Extracted from World Bank (2010, Pg. 31)

Figure 5: Expenditure of higher education and public expenditure required to expand higher education at current rates and unit costs

asserts that it is higher education and a well-educated population that bolsters development through provision of food security and a strong agricultural base. The positive effect of education on productivity world-wide has been considered sizeable; research by Reimers and Klasen (2013) reveals that an additional year of schooling for the whole population could raise land productivity by approximately 3.2 percent. On the other hand, Borland *et al*. (2000), acknowledge that positive returns to investment in university research are largely due to substantial spill over effects that are associated with academic research.

Moreover, foreign direct investments are more likely to manifest where there is skilled human resource. The proxy for this is an effective education system, and tertiary education plays a vital role. Recent trends have discerned the effectiveness of the higher education system through the multitude of university rankings. Countries with several universities appearing on the higher education league tables are also deemed to have a more entrepreneurial and innovative work force.

CONCLUSIONS AND RECOMMENDATIONS

The discussions highlighted above demonstrate the shortcomings associated with the quest for knowledge production and development in many countries in Africa, from the inability to generate indigenous sources of information to inform policy to a reliance on external financing and policy formulation. The status of higher education systems in Africa generates opportunities for investment and reform. They further give a basis for policy direction that will enable national higher education systems to contribute to national development agenda, the African Agenda 2063 and its associate programme, the Science, Technology and Innovation Strategy for Africa (STISA 2024) and the Sustainable Development Goals as adopted by the United Nations. The growth in enrolment levels in comparison to global averages shows that although the gains made are significant, there is need to come up with alternative strategies to propel the systems towards knowledge base.

The governments in Africa need to move beyond the rhetoric outlined in the respective visions and Agenda 2063 to put in place concrete measures to develop higher education systems that enhance knowledge production and close the knowledge gap between Africa and the rest of the world. Examples of government steering of knowledge production systems can be discerned from China's *Project 985*, South Korea's *Brain K21* and Malaysia's deliberate effort to *Building a World-Class Higher Education System*. It was not until governments clearly articulated the expectations and invested in the higher education systems that significant improvements were realised. The initiative by Kenya to establish the research fund provides a welcome trail blaze; similarly, the mechanism of rewarding knowledge production in South Africa can be considered as a viable stimulant. It is anticipated that if adopted by other African countries this can form the basis for improving the level of knowledge production by African academics, boost the number of doctoral outputs and enhance productivity in general and agricultural production in particular.

Research fund has to go hand in hand with investments in other inputs, such as staff development, targeted recruitment of research students particularly at Doctoral levels as well as investment in research facilities. In addition, the relevant regulatory and market frameworks as well as incentives for innovation have to be put in place. The language of venture capital, entrepreneurship, technology parks and start-ups has to permeate a broad spectrum of national documentation, research and education activity schedules.

Key areas of focus to boost knowledge production include:

(i) Start to nurture the culture of knowledge production by establishing performance targets and indicators. Such targets may include the number of PhDs produced and number of publications per active researcher, and the number of patents and researches that transition into products adopted by the production sector. South Africa has targeted training 5000 PhDs within a period of 10 years, South Korea agreed to an annual production of 2000 PhDs, while China targeted the level of international collaborations and the number of patents granted;

(ii) Operating as a block, the African region has potential for collective definition and articulation of knowledge generation targets. The African Union can establish a research fund that will be accessed by the different national education systems and at the same task national systems should be encouraged to prioritise knowledge production in resource allocation. This will facilitate harmonization and cross national adoption of science and innovation technologies within comparable contexts. Initiatives such Erasmus Mundus programme and the Bologna process adopted by the European Union have improved mobility and national higher education systems;

(iii) Establish regional centres of excellence that will attract scientists and researchers within the region and across the globe. The centres of excellence should take into consideration the comparative advantage of different geographical locations to generate disciplinary competence. When these

centres are aggregated the research thrust of the regional block will gain momentum. Universities in the region should be obliged through policy frameworks to establish affiliation with these centres of excellence. The affiliation will create a research network that will promote access to quality facilities through enhanced academic mobility across the region;

(iv) Establishing national fora that will initiate dialogue on how higher education can be harnessed to facilitate adoption and adaptation of modern technologies to local development needs. This will keep higher education on both the national and regional agenda. It will further ensure that governments at regional, national and local levels formulate a deliberate strategy to structure higher education as the engine of development; and,

(v) There is a growing awareness of the need for reliable data to enable monitoring of national science and innovation systems and inform policy. Such data mainly collected by UNESCO and the World Bank has been used as the benchmark for measuring knowledge production in countries across the globe. The current status is that data on global indicators in Africa lags behind other regions and there is therefore need to evolve a framework for reliable data collection, mining and reporting. Governments should create information hubs to track and monitor progress by the different knowledge production centres.

ACKNOWLEDGEMENT

This review was supported by the Regional Universities Forum (RUFORUM).

STATEMENT OF NO CONFLICT OF INTEREST

We the authors of this paper hereby declare that there are no competing interests in this publication.

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