# Challenges for agricultural education and training (AET) institutions in preparing growing student populations for productive careers in the agri-food system

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# Challenges for agricultural education and training (AET) institutions in preparing growing student populations for productive careers in the agri-food system

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## Abstract

**Purpose** – Agricultural education and training (AET) institutions will play a strategic role in helping to prepare Africa's rapidly growing youth populations for productive careers in agriculture and related agri-businesses. The purpose of this paper is to examine the magnitude of skills and youth employment needs emanating from high-population growth rates. It then explores how agricultural education institutions are responding to these challenges in four different countries at different levels of food system development: South Africa tier 1, Tanzania in tier 2 and Malawi and Uganda in tier 3.

**Design/methodology/approach** – Demographic and school enrollment data provide information on the magnitude of job market entrants at different levels of education while Living Standards Measurement Studies in the respective countries provide a snapshot of current skill requirements in different segments of the agri-food system. In order to evaluate AET responses, the authors have conducted country-level reviews of AET systems as well as in-depth assessments at key tertiary AET institutions in each of the four case study countries.

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**Findings** – Growth rates in primary school enrollments are high in sub-Saharan Africa. At the same time, because of budgetary constraints, transition rates decline rapidly – about 40 percent from primary to secondary and 7 percent from secondary to tertiary. As a result, substantial numbers of primary and secondary school graduates seek jobs.

**Research limitations/implications** – The case study countries are limited to four. Had more financial resources and time been available, researchers could have spread further afield and in so doing increasing the precision of the results.

**Originality/value** – Estimation of the number of primary and secondary school leavers seeking employment because of failure to proceed to the next level of education. Estimation of the level of education shares in the various components of the agri-food system.

**Keywords** Africa, Youth employment, Agricultural education and training,
Agriculture in primary and secondary education

**Paper type** Research paper

## 1. Introduction

Demographic pressure in sub-Saharan Africa will unleash an unprecedented wave of youth into the school system and into the job market over the coming decades. In the 15 years between 2010 and 2025, roughly 317 million African youth will enter the job market (Kaneene *et al.*, 2015). As a result, by 2025, 45 percent of the labor force will be under 30 years of age.

Agriculture, currently the continent's largest employer, will play a significant role in absorbing these new job market entrants. Given rapid growth in food marketing, processing and distribution, the post-farm segments of the agri-food system will grow even more rapidly, accounting for one-third of new agri-food system jobs over the period from 2010 to 2025 (Tschirley *et al.*, 2015).

Agricultural education and training (AET) institutions will play a strategic role in helping to prepare Africa's rapidly growing youth populations for productive careers in the growing segments of the agri-food system. This paper examines the twin challenges facing AET institutions as they strive to simultaneously accommodate growing enrollments and shifting skill needs by agri-food system employers.

In doing so, this paper first aims to quantify the magnitude of youth job demand and skill needs resulting from current high-population growth rates and simultaneously rapid food system transition. The paper then explores how agricultural education institutions are responding to these challenges in countries at different levels of food system development: South Africa (tier 1), Tanzania (tier 2) and Malawi and Uganda (tier 3).

## 2. Methods

Demographic and school enrollment data provide information on the magnitude of job market entrants at different levels of education. We start with sub-Saharan wide aggregate numbers and then we zero in on four case countries – Republic of South Africa, Tanzania, Malawi and Uganda. For both sub-Saharan Arica and the four case study countries, we take the demographic age cohort populations and their growth rates and we then estimate school enrollment data and transition rates from primary to secondary and from secondary to tertiary levels. The number of graduates at different educational levels – primary, secondary and tertiary – then provides information on the magnitude of job market entrants at different levels of education.

To provide a snapshot of current skill requirements in different segments of the agri-food system, the paper analyzes primary data from Living Standards Measurement Studies (LSMS) in the selected case study countries.

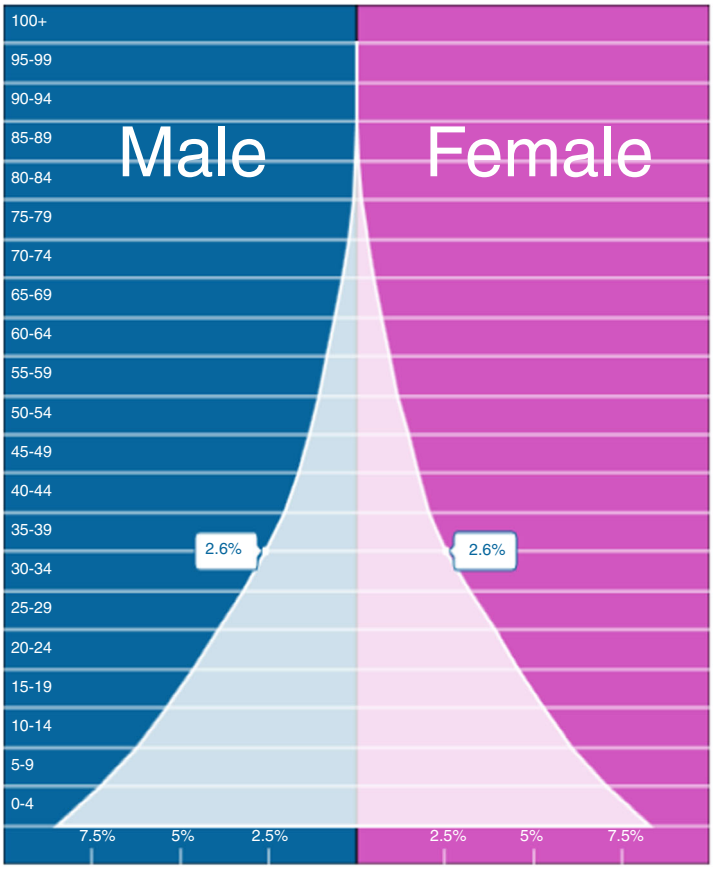
In order to evaluate AET responses, the authors have conducted country-level overviews of AET systems as well as in-depth audits at key tertiary AET institutions

in each of the case study countries. The paper draws on interviews and evidence from four countries at different levels of food system transformation: South Africa (top tier), Tanzania, (middle tier) and Malawi and Uganda (bottom tier). The authors have selected these countries using the typology of food system transformation by country developed by Kaneene *et al.* (2015) and as shown in Table AI.

## 3. Overview of student populations, enrollment dynamics and labor market changes in sub-Saharan Africa

### *3.1 Student populations*

Sub-Saharan Africa region is the fastest growing region in the world with a population growth rate of 2.5 percent. Total population of 640 million in 1999 reached 831 million by 2010. Projections suggest it will reach one billion in 2020 and 1.7 billion in 2040. The resulting demographic pyramid tapers into a tight cone at the top and becomes quite broad at the bottom. As a result, youth under 15 make about 41 percent of the population while young adults between 15 and 29 account for a further 28 percent of the population (Figure 1). The shape of the pyramid speaks volumes – it is a function of




**Source:** http: population pyramid sub-Saharan Africa

**Figure 1.**
Sub-Saharan Africa population pyramid, 2010

high-population growth rates but the fast shrinkage as one climbs the ladder is caused by multiple factors among them being low-life span caused by a series of diseases as well as, hunger and starvation. Note, in particular, how lower birth rates and the high incidence of HIV and AIDS contribute to the hollowed out adult cohorts in South Africa (Figure 2(b)).

In 2010, the total number of pupils in primary school stood at 138 million and in secondary school 45 million. Unfortunately, not all those enrolled in primary school are able to complete that level of education. Of these 138 million children, about 11 million children leave school before completing primary education. Among these drop-outs, females are always more numerous than men because of social and financial pressures coupled with unwanted pregnancies and early marriages (World Bank, 2012). There is a very high probability of these primary school drop-outs joining the group of unemployed for a number of reasons – literacy rate is likely to be very low and also they do not have the skills yet to meet the demands in the labor market. Estimates suggest that each additional year of education increases the chance of finding a job by 10 percent (World Bank, 2012).

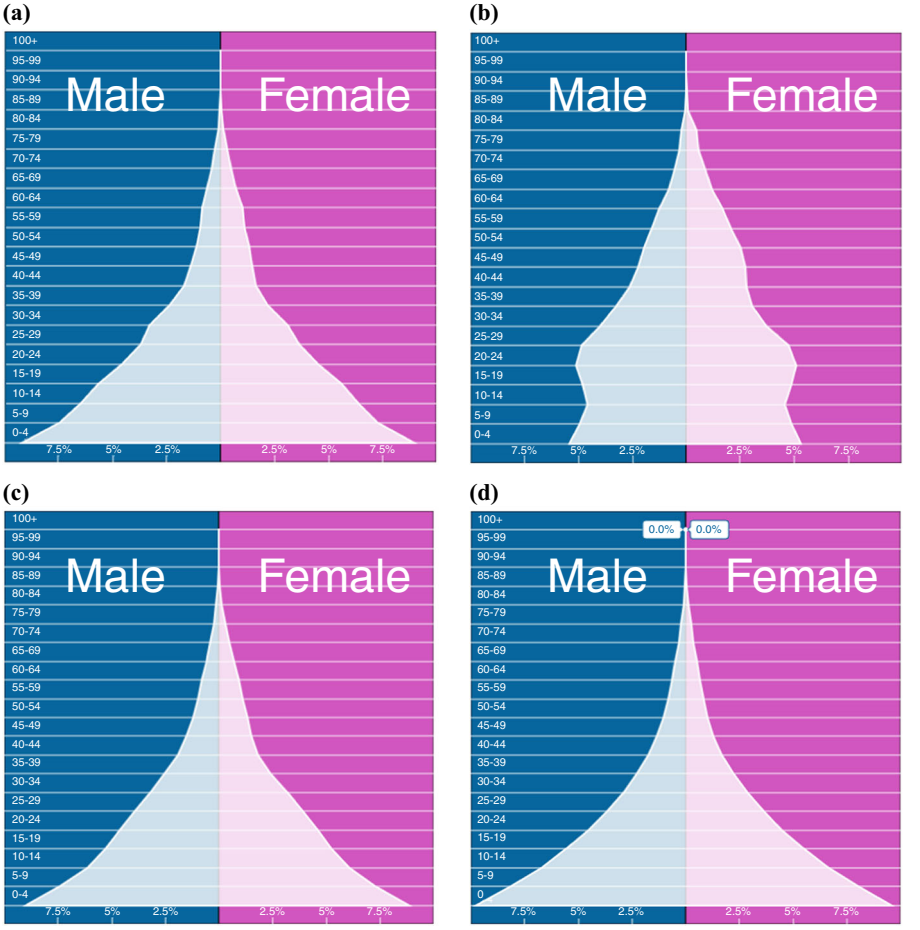



**Figure 2.**
(a) population pyramids of Malawi; (b) populaion pyramid of South Africa; (c) population pyramid of Tanzania; and (d) population pyramid of Uganda

**Source:** http: population pyramids: South Africa, Tanzania, Uganda and Malawi

*3.2 Enrollment dynamics through 2010*

School enrollment in sub-Saharan Africa increased significantly at all education levels between 1999 and 2010. Primary school enrollment increased from 59 to 77 percent in sub-Saharan Africa over the past decade. Nonetheless, sub-Saharan Africa still lags behind many other regions in meeting the goal of universal primary education. As a result of increased enrollment rates, the absolute number of children entering primary school in sub-Saharan Africa has climbed sharply since 2000. In 2010, more than 23 million of the region's children entered a classroom for the first time – an increase of some seven million over the level in 1999. Sub-Saharan Africa's gross intake rate (GIR), which registers the number of new entrants regardless of age, recorded the biggest increase in the world between 1999 and 2010. The net-enrollment ratio (NER) for primary education in sub-Saharan Africa also rose sharply, from 56 percent in 1999 to 70 percent in 2006 (UNESCO Institute of Statistics, 2012). Net-enrollment rate is the number of the school age who are enrolled in primary school to the total population of the official primary school age.

A ten-year comparison of some basic education indicators shows substantive progress but deep rooted problems still remain (Table I):

- The proportion of private primary school enrollment reached 16 percent in 2010 and is even higher now. Since governments cannot do it alone, increased involvement of the private sector in providing education is a good sign.
- The ratio of female to male tertiary enrollment is about 60 percent, suggesting that women are still disadvantaged.
- School enrollment: at secondary was about 40 percent in 2010 as compared with 25 percent ten years before. This 40 percent drops drastically to about 7 percent at tertiary level. This means only 7 percent of those that completed secondary school are able to get a place in tertiary institutions.

| School ratio enrollment | 2000 | 2010 |
|---|---|---|
| Ratio of female to male primary enrollment (%) in sub-Saharan Africa | 85.4 | 92.8 |
| Ratio of female to male secondary enrollment (%) in sub-Saharan Africa | 81.6 | 82.0 |
| Ratio of female to male tertiary enrollment (%) in sub-Saharan Africa | 66.1 | 63.2 |
| Primary education; pupils in sub-Saharan Africa | 89,570,176 | 138,101,117 |
| School enrollment; primary (% gross) in sub-Saharan Africa[a] | 81.3 | 99.6 |
| School enrollment; primary; male (% gross) in sub-Saharan Africa | 87.6 | 103.2 |
| School enrollment; primary; private (% of total primary) in sub-Saharan Africa | 11.3 | 16.6 |
| Secondary education; pupils in sub-Saharan Africa | 22,858,011 | 45,623,637 |
| Secondary education; pupils (% female) in sub-Saharan Africa | 44.7 | 44.7 |
| Secondary education; general pupils in sub-Saharan Africa | 21,306,009 | 42,080,289 |
| School enrollment; secondary (% gross) in sub-Saharan Africa | 25.1 | 39.6 |
| School enrollment; secondary; female (% gross) in sub-Saharan Africa | 22.6 | 35.7 |
| School enrollment; secondary; male (% gross) in sub-Saharan Africa | 27.7 | 43.5 |
| School enrollment; tertiary (% gross) in sub-Saharan Africa | 4.4 | 6.8 |
| School enrollment; tertiary; female (% gross) in sub-Saharan Africa | 3.5 | 5.2 |
| School enrollment; tertiary; male (% gross) in sub-Saharan Africa | 5.2 | 8.3 |

**Note:** [a]Gross enrollment ratio is defined as the number of children enrolled in a level (primary or secondary), regards of age, divided by the population of the age group that officially corresponds to the same level

**Source:** Adapted from World Bank (2012)

**Table I.** Sub-Saharan Africa: some selected education indicators, 2000-2010

*3.3 Enrollment projections through 2040*

Using the 2010 sub-Saharan population pyramid and enrollments in primary, secondary and tertiary, we estimate the human population and the population in primary, secondary and tertiary levels in years 2025 and 2040 (Table II). In doing so we make the following assumptions: primary school enrollment will grow at the rate 2.5 percent (World Bank, 2012). The transition rates from primary to secondary and from secondary to tertiary of 40 and 7 percent, respectively, are used to compute the enrollments of students in the respective levels for the corresponding years.

Under this scenario, between 2010 through 2040 more than half of the primary level graduates will fail to enter secondary school and will instead enter the job market.

By 2040, the population of youth in sub-Saharan Africa that will fail to get into secondary school will have ballooned to 173 million (Table II). Very often we never think seriously about the unemployment of primary and secondary school leavers and the need to craft the curricula in such a way as to begin preparing them from primary school and also in secondary school because the probability is high that many of them will not get a place in the next level of education.

Primary education drop-outs represent those out-of-school youth with incomplete primary education. Several SSA countries have a significant percentage of out-of-school youth who have dropped out of school. The primary dropout population refers to students who have been enrolled in school but never finished their primary education. This group is distinct from out-of-school youth who never enrolled in schools. According to some Ministry of Education data for Uganda it is shown that for a specific chosen period of time, unpacking the total number of students in that time period revealed the following percentages: in school 40 percent; out of school (no education) 7.8 percent; out of school (incomplete primary) or "drop-outs" 29.6; and 22.8 percent out of school (have completed primary and beyond). What is striking and many times passing unnoticed is the almost 30 percent of drop-outs. These have to join the labor force with almost no skills at all.

*3.4 Youth labor market supply projections*

Between 2010 and 2040, estimates suggest approximately 712 million youth will enter the labor market in sub-Saharan Africa. Since exits due to retirement will total only 14 million, this estimation suggests that about 568 million people will be seeking over the 30-year period ending in 2040 (Kaneene *et al.*, 2015). This is a population which is more than 50 percent of today's overall Africa's population.

The coming wave of youth entrants into the job market include drop-outs from primary, secondary and tertiary levels, primary and secondary school leavers and

**Table II.**
Sub-Saharan Africa: primary and secondary level job seeking population from 2010 through 2040 assuming a population growth rate of 2.5 percent

| | 2010 | 2025 | 2040 |
|---|---|---|---|
| Sub-Saharan Africa | 831,463,000 | 1,216,991,000 | 1,704,670,000 |
| Primary enrollment | 138,101,117 | 199,970,417 | 289,676,426 |
| Secondary enrollment | 45,623,637 | 79,988,167 | 115,870,570 |
| Ex-primary-level job seekers | 92,477,480 | 119,982,250 | 173,805,855 |
| Tertiary enrollment | 3,193,954 | 6,399,053 | 8,110,940 |
| Ex-secondary-level job seekers | 42,429,683 | 73,589,114 | 107,759,630 |
| Ex-primary and ex-secondary job seekers | 134,907,163 | 193,571,364 | 281,565,486 |

**Source:** Computed by authors from various sources

tertiary level leavers. In Table II, where we estimate the current enrollments and those that fail to cross from primary to secondary and from secondary to tertiary we find that approximately a total of 281 million youth mostly under 18 years will be seeking jobs by 2040.

*3.5 Employer demands*

Looking now at the demand-side of the labor market, through the use of LSMS, we estimate the proportion of jobs available for different educational levels of agri-food systems workers by level of food system development (Table III). As Table III shows, more education is needed as one goes up the agri-food system transformation ladder. At least two-thirds of the jobs in the top tier agri-food systems such as South Africa require workers that have finished middle and secondary school. For the middle tier at least 50 percent of the jobs require that one must have completed primary school, while in the bottom tier over two-thirds have no education or some primary school (Table III).

It is interesting to note that even for the top tier, demand for university graduates accounts for only 6 percent of the agri-food system labor force. This means that building career skills in the early stages of the educational system is of paramount importance.

Agricultural jobs, in general, require less education than the post-farm segments of the agri-food system, such as food processing, packaging and distribution. Only in South Africa, with its highly skewed landholding and large, modern farms, have over three-fourths of farm owners completed either secondary or tertiary education. Among agricultural workers, however, only 12 percent have completed secondary school or higher, with the vast bulk of jobs requiring middle or primary school. In the bottom tier about two-thirds of the jobs for those working on their own farms have "no primary" or "some primary" education, a similar educational profile to their hired workers (Table III).

| | No primary | Some primary | Finished primary | Finished middle | Finished secondary | Finished tertiary | Total workforce |
|---|---|---|---|---|---|---|---|
| *All agri-food system (AFS) jobs* | | | | | | | |
| Top tier (RSA) | 0.06 | 0.07 | 0.16 | 0.41 | 0.24 | 0.06 | 1.00 |
| Middle tier (Tanzania, Zambia) | 0.20 | 0.12 | 0.53 | 0.14 | 0.01 | 0.00 | 1.00 |
| Bottom tier (Malawi, Mozambique, Uganda) | 0.37 | 0.31 | 0.19 | 0.12 | 0.01 | 0.01 | 1.00 |
| *Agriculture – own farms* | | | | | | | |
| Top tier | 0.05 | 0.04 | 0.07 | 0.17 | 0.40 | 0.26 | 1.00 |
| Middle tier | 0.20 | 0.12 | 0.52 | 0.14 | 0.01 | 0.00 | 1.00 |
| Bottom tier | 0.39 | 0.30 | 0.18 | 0.11 | 0.01 | 0.01 | 1.00 |
| *Agriculture – workers on other farms* | | | | | | | |
| Top tier | 0.10 | 0.11 | 0.23 | 0.44 | 0.11 | 0.01 | 1.00 |
| Middle tier | 0.23 | 0.17 | 0.51 | 0.08 | 0.01 | 0.00 | 1.00 |
| Bottom tier | 0.35 | 0.33 | 0.19 | 0.11 | 0.01 | 0.00 | 1.00 |
| *Post-farm AFS jobs* | | | | | | | |
| Top tier | 0.03 | 0.03 | 0.10 | 0.40 | 0.35 | 0.10 | 1.00 |
| Middle tier | 0.13 | 0.10 | 0.54 | 0.18 | 0.03 | 0.02 | 1.00 |
| Bottom tier | 0.15 | 0.31 | 0.27 | 0.22 | 0.04 | 0.01 | 1.00 |

**Note:** Shading indicates majority of labor force in each tier

**Table III.** Sub-Saharan Africa: educational level of agri-system workers by level of food systems

Post-farm work typically requires more education. In a modern food system like South Africa, 45 percent of post-farm AFS job holders have completed secondary or higher compared to 30 percent for the Agricultural Food System overall (Table III). Even in the top tier, 75 percent of post-farm workers rely on either middle or secondary school education. For the bottom tier, the educational requirement is almost equally spread among three categories – some primary, finished primary and finished middle educational levels.

In sum, skill requirement change along with food systems transformation in the following ways:

(1) Education requirements increase with food system development.

(2) Post-farm segments of the food system, in general, require higher levels of education than farming. Since this part of the food system is growing significantly faster than employment on the farm (Tschirley *et al.*, 2015), educational requirements in the AFS will likely increase gradually over time.

(3) Even in the most advanced, top tier food systems, over 90 percent of all workers require at most a secondary education, and fully 70 percent require at most middle school training. Elsewhere, in middle and bottom tier food systems, primary school leavers and drop-outs account for 85 percent of the AFS workforce. As a result, teaching of agriculture skills needs to happen at primary and secondary level because most of these school leavers will not be able to continue to tertiary and if they will already have some agricultural skills, they will enable them to be employed more easily.

### *3.6 Institutional responses and drivers of change in education and training institutions in sub-Saharan Africa*

In order to comprehend the dynamics and the reasons for the rapid changes taking place in the education and training institutions particularly in the last 20 years, it is important to highlight the following trends:

(1) Rapid expansion of primary and secondary school enrollment: this has meant that universities have to provide education to a growing number of students. The rapid expansion of secondary enrollment has exerted pressure on the university to admit more and more students with the same facilities. The challenge is then how to use more innovative teaching-learning approaches and to deal with large classes. This will also demand new pedagogical and didactic skills from academic and technical staff (Sokoine University of Agriculture (SUA), 2013). In Nigeria the pressure of secondary school students aspiring to get into tertiary is arguably the highest in Africa given the population – 80-90 percent of the secondary school finalists would like to get into college of some sort (Okebukola, 2002).

(2) Expansion in the number of higher learning institutions: during the last ten to 15 years, the number of universities in many countries has increased several folds. In this expansion, the rate of increase of private universities has been several times more than the public. As far back as 1982, for example, Nigeria had already instituted a legislation of private higher education and many private institutions were established in 1990s (Jibril, 2003). Uganda followed suit in 1990s with similar cases emerging in Cameroon, Mozambique and Zimbabwe. Kenya in Eastern Africa was also in the lead in this race during this same time. In fact

between 1991 and 1999 nearly 65 universities were established in sub-Saharan Africa (World Bank, 2002). By 2003 the number of private universities in selected countries had ballooned to almost 150 universities. New universities have been created in almost all African countries. In some cases the increase has been dramatic over a short period. For example, from 2005 to 2013, the number of universities in Nigeria increased from 51 to 128 and in Ethiopia from eight to 21 (Mohamedbhai, 2014). In Tanzania, for example, they increased from two public universities in 1990 to more than 30 public and private universities in 2013 (Tanzania Commission for Universities, 2013). This does not include other technical training institutions. In Zimbabwe, in the last 20 years, there has been on average one additional tertiary institution every year. All these have to compete for the same pool of applicants, the same sources of funding and the same sources of teaching staff. As a consequence, this has a potential, direct and negative impact on lowering the quality of the product.

(3) Liberalization of admission to institutions of higher learning: the current policies in many countries are to offer opportunity to as many people as possible to join institutions of higher learning, which has meant that universities now have to admit students from varied backgrounds. Furthermore, because of the many challenges associated with expansion of primary and secondary school enrollment many students admitted to the university are inadequately prepared in the basic skills of communication, language, writing and reading. Universities have to address these inadequacies of incoming students so that they may cope with university studies. In South Africa, drawing mostly on audited data for the period 1996-2011 for the public higher education system, and stratified by race given South Africa's history, a 60 percent increase in student enrollments between 1996 and 2011, from 590,000 to 938,000 was recorded (Republic of South Africa, 2013).

(4) Changing labor market and employment opportunities: given the trend toward private sector-driven economies, the labor market is changing as now the employers are demanding a different set of skills than before. In addition to graduates possessing up-to-date knowledge in their fields of study, employers now need graduates with skills in problem solving, team work, creative thinking, communication, ICT, leadership and ability to work independently (Purchase, 2014). In other words, employers expect university training to be skill based rather than academic based. A typical example is that a university of agriculture curriculum must adjust and accommodate courses addressing not only the farming skills – typically lower level value chain types of courses – but also accommodate value chain upstream courses such as logistics, processing, packaging, storage, quality control, financing, etc.

(5) Dwindling public funding: resources from governments have been decreasing year after year and many institutions are left to rely on student fees for their day to day operations, because the government budget has to be shared among many institutions of higher learning. This means that the universities have to look for other sources for financing their activities, including internal sources and the private sector. We hypothesize that one of the key reasons for deterioration of universities and the quality of their graduates is due to lack of sufficient financial resources.

Generally, given the afore mentioned, factors the quality of education and consequently the quality of the product has deteriorated. Summarizing the factors that contributed to this decline in Nigeria from late 1988 to 1996, and subsequent collapse from 1997 to date, Okebukola (2002) lists the following: lack of research skills in modern methods, lack of equipment for carrying out state-of-the art research, overloaded teaching and administration, overstretched schedules that leave little time for research, difficulty in accessing research funds and diminishing ability of seasoned and senior researchers to mentor junior researchers due to brain drain. Public funding in most countries is already overstretched, and alone it will not be sufficient to respond to the growing demand for access to higher education while delivering a level of quality that provides students with the skills necessary to succeed in current and future labor markets.

(6) Cost sharing: different forms of cost sharing are being implemented in most African countries. As of 2009, at least 26 countries in Africa charge either tuition fees or other types of fees such as examination fees, registration fees, identity card fees, library fees and management information system fees. Overall, higher education institutions in Africa generate about 30 percent of their income from fees. This ranges from less than 5 percent in Madagascar and Zimbabwe to 56 percent in Uganda and 75 percent in Guinea-Bissau. Some countries, like Uganda, are implementing dual-track tuition policies whereby a certain number of free (or very low cost) university places are awarded based on criteria such as academic excellence, income level or positive discrimination, while other places are available on a tuition fee – paying basis or deferred-tuition policy (Minde *et al.*, 2014). Even in some Francophone countries, such as Benin, where free higher education had long been considered a right, some public universities have chosen to charge fees for professional programs or programs of excellence. The decline in public expenditure per student is having an adverse impact on the quality and relevance of education programs. Africa is the only region in the world that has experienced a decrease in the volume of current public expenditure per student regardless of level of education – a decrease of 30 percent over the last 15 years (World Bank (2010)). This trend begs the question that many African governments have to address – to what extent is Africa getting ready to train a new generation of graduates who will be ready to face the myriad challenges that are confronting the continent? The increasing number of students completing primary school and wishing to continue their studies generates pressures on the higher education system African countries are ill-prepared to address (UNESCO Institute of Statistics, 2012).

(7) Political pressure for rapid university expansion: the higher education system, as well as individual academic institutions, is affected by politics and government. Creating university systems of the highest quality requires political will and resources, but also research and analysis (Going Global, 2014). Many new universities have been established on political grounds in almost all African countries. A typical example of rapid expansion of universities is provided in Box 1 for Kenya. The sky-rocketing numbers of universities in many countries in Africa are politically motivated. Establishment of some of these universities is promised during election campaigns. Politicians feel obligated to fight for universities to be established in their constituencies. Upon being elected they

**Box 1. University expansion in Kenya**

Over a period of 50 years, Kenya has moved from a single public university (University of Nairobi) to the current 7 universities, namely; University of Nairobi, Moi University, Kenyatta University, Egerton University, Jomo Kenyatta University of Agriculture and Technology, Masinde Muliro University of Science and Technology, and Maseno University.

The number of campuses of the tertiary institutions has increased greatly also. For instance, the University of Nairobi has 10 campuses; Moi University has 5 university colleges and 7 campuses, Jomo Kenyatta University of Agriculture and Technology has 4, Egerton University has 3, Kenyatta University and Maseno University have one each. Such rapid university expansion has been witnessed in the private sector too. Currently there are about 23 private universities in Kenya, namely:

1. Adventist University of Africa
2. Africa International University
3. Africa Nazarene University
4. Catholic University of Eastern Africa (CUEA)
5. Catholic Higher Institute of Eastern Africa
6. Daystar University
7. Great Lakes University of Kisumu
8. Gretsa University
9. Kabarak University
10. KCA University
11. Kenya Methodist University
12. Kiriri Women's University of Science and Technology
13. Mount Kenya University
14. Pan Africa Christian University
15. Pioneer University
16. Presbyterian University of East Africa
17. Riara University School of Business and Law
18. Scott Christian University
19. St. Paul's University
20. Strathmore University
21. United States International University (USIU - Africa)
22. University of Eastern Africa, Baraton
23. Uzima University College

The speedy expansion of university education in the country was a spontaneous response to the increasing demand for higher education necessitated by the increasing flow of students from schools. Looking at this expansion, it is clear that in terms of numbers, public universities have had a great explosion in the quest of developing the Kenyan citizen. Besides the increase in Universities, both private and public, and other tertiary institutions, the population in these institutions has almost doubled.

**Source:** Kiaritha *et al.* (2014)

have to strive to fulfill the promise – and this is the way to win votes in the next elections. The upgrading of polytechnics and technical colleges to university status is another common strategy in most African countries, including South Africa, Kenya and Ghana among others (Minde *et al.*, 2014). In South Africa, the technikons were transformed into universities of technology beginning 2010.

## 4. Population and education dynamics in countries at different stages of food system transformation with specific reference to AET

Moving from the Africa-wide view (Section 3) of the educational system, we now take a more focussed and detailed analysis of the population dynamics of four case study countries; representing three different tiers of food system transformation – South Africa tier 1, Tanzania tier 2 and Malawi and Uganda tier 3. These countries vary greatly in their human population – from 15 million in Malawi to 55 million in South Africa in 2010. Based on the varying population growth rates, Malawi which is at

the moment slightly more than one-third of the South African population will slightly be more than half of the South African population by 2040 (Table IV). The population growth rates for these countries in 2013 were: 0.7, 3.0, 3.3 and 2.8 percent for South Africa, Tanzania, Uganda and Malawi, respectively. We then follow up to see how the population in each country is impacting on the educational enrollment from primary to secondary and then to tertiary, and then we estimate the availability of jobs for graduates from the three levels of education.

*4.1 Population pyramids of South Africa, Tanzania, Uganda and Malawi*

South Africa has a very different population pyramid compared with the other three countries (Figure 2 (a)-(d)). The South African population pyramid is bulging in the middle while the other countries are typically cone-shaped. This is mostly influenced by the low-population growth rate of only 0.7 percent of South Africa – the lowest on the continent with the exception of Mauritius and Seychelles. The population distribution across different age groups varies a great deal as well. South Africa has the lowest cohort of the 0-14 years with 42.5 percent whereas Uganda has 48.4 percent. A close look at the Ugandan population pyramid shows the longest neck in the pyramid. Uganda has also the lowest percentage of the effective working group in the 15-64 age cohorts of 49.2 percent. This could partly be contributed by HIV-AIDS, which was at the peak in 1990s. Those that were 20-30 years in 1990 were the most affected by the disease, and these are now 44-54 years of age. This age cohort is the one most affected by the virus and a number of deaths occurred then. All these parameters have a bearing on enrollments into primary schools and the ability of countries to raise a well-prepared workforce that can work to raise productivity on farms and industry. The following four sub-sections analyze school enrollments, transition rates in the education profile through the tertiary and skill requirements to graduates of the different education profiles with special reference to agriculture.

*4.2 South Africa: educational enrollments and skill requirements*

*4.2.1 General and further education enrollment*. South Africa offers numerous lessons for the rest of sub-Saharan Africa on education system governance. The country has one of the highest rates of public investment in education in the world. At about 7 percent of gross domestic product and 20 percent of total state expenditure, the government spends more on education than on any other sector (Republic of South Africa, 2013).

Enrollment starts with grade R (reception year) otherwise called a zero grade. Registration in R grade is formal as opposed to other countries like Malawi where it is done outside the formal system making it difficult to access registration records.

**Table IV.** Population projections for the four case study countries

| | 2010 | 2025 | 2040 |
|---|---|---|---|
| Sub-Saharan Africa | 831,463,000 | 1,216,991,000 | 1,704,670,000 |
| Malawi | 15,013,000 | 22,775,000 | 33,114,000 |
| Tanzania | 44,973,000 | 69,329,000 | 102,685,000 |
| Uganda | 33,983,000 | 54,832,000 | 82,659,000 |
| South Africa | 51,452,000 | 56,665,000 | 60,937,000 |

**Source:** Computed from countries' population pyramids

Total enrollment in grade R increased from 156,000 in 1999 to 768,000 in 2012 (Department of Basic Education, 2012). From this grade onwards, gender parity in South Africa seems to be quite favorable with a good balance between male and females. There are three broad bands of education – General Education and Training (grade 0-9), Further Education and Training (FET) (grade 10-12) and Higher Education and Training. School life spans 13 years or grades, from grade 0, otherwise known as grade R.

Under the South African Schools Act of 1996, education is compulsory for all South Africans from the age of seven (grade 1) to age 15, or the completion of grade 9. General Education and Training also includes Adult Basic Education and Training, which is available to adults who want to finish their basic education. FET takes place from grades 10 to 12, and also includes career-oriented education and training offered in other FET institutions – technical colleges, community colleges and private colleges. Diplomas and certificates are qualifications recognized at this level. A total of 511,000 candidates sat the grade 12 exams in 2012.

The latest available statistics from the Department of Basic Education (DBE) show that in 2012 South Africa had 12.4 million pupils and students (also known as "learners"), enrolled in public and independent schools (known as "ordinary schools"), attending 25,826 educational institutions.

Of the total enrolled learners, 11.9 million (96 percent) were in public schools and 504,000 (4 percent) were in independent schools (Republic of South Africa, 2013). Illiteracy rates currently stand at around 18 percent of adults over 15 years old (about nine million adults are not functionally literate). Despite the challenges, much has been achieved since apartheid legislation was scrapped. For example, in 1993 nearly half of all students in higher education institutions were white, but since 1994, black African enrollments have nearly doubled, growing by 91 percent (or 4.4 percent a year) and overall enrollments have grown by 41 percent (or 2.3 percent a year). However, South Africa's student participation rate – the proportion of 18- to 24-year olds in higher education – is a low of 16 percent. The greatest challenges for schooling lie in the poorer, rural provinces such as the Eastern Cape and KwaZulu-Natal. Schools are generally better resourced in the more affluent provinces such as Gauteng and the Western Cape.

*4.2.2 Higher Education and Training enrollment*. Higher Education and Training, or tertiary education, includes education for undergraduate and postgraduate degrees, certificates and diplomas, up to the level of the doctoral degree.

South Africa has a vibrant higher education sector, with 23 state-funded tertiary institutions: 11 universities, six universities of technology and six comprehensive institutions. Many of South Africa's universities are world-class academic institutions. Although subsidized by the state, the universities are autonomous, reporting to their own councils rather than government. According to figures from the Council of Higher Education, 893,000 students (727,000 undergraduates and 139,000 postgraduates) were enrolled in South Africa's public higher education institutions in 2010. It is worth noting though that some of this enrollment includes non-South Africans. Within the Southern African Community (SADC) countries, South Africa has the highest number of foreign students enrolled in their tertiary institutions. Most of these students come from the SADC countries.

In 2010, the public higher education institutions produced 153,741 qualifications at all levels, with 74,612 qualifications in the human and social sciences; 41,724 in business and commerce; and 37,405 qualifications in science and technology. Higher education is also offered at private institutions, of which there are 88 registered and

27 provisionally registered with the Department of Higher Education and Training (DHET) to confer specific degrees and diplomas. Since 2009, the Department of Higher Education and Training has also been responsible for FET, which covers training provided from grades 10 to 12, including career-oriented education and training offered in technical colleges, community colleges and private colleges. There are currently around 450 registered FET colleges in South Africa.

The DHET is responsible for the following institutions:

- In total, 23 public universities (with two more being established in 2014);
- In total, 50 public technical and vocational education and training (TVET) colleges (formerly known as FET colleges);
- Public adult learning centers (soon to be absorbed into the new community colleges);
- Private post-school institutions (registered private FET colleges and private higher education institutions, also to be renamed TVET colleges);
- The Sector Education and Training Authority (e.g. AgriSETA for agriculture) and the National Skills Fund (NSF); and
- Regulatory bodies responsible for qualifications and quality assurance in the post-school system – the South African Qualifications Authority (SAQA) and the Quality Councils. The DHET – through the Quality Councils – is responsible for assuring the quality of provision in these colleges and for ensuring that the qualifications that they offer are registered.

*4.2.3 AET in South Africa*. South Africa revitalized its future direction in AET through the development of the AET Strategy of 2002-2005 (Republic of South Africa, 2013). Formal agricultural training is available at five different levels, namely, at primary schools, secondary schools, colleges of agriculture, universities of technology (formerly known as technikons and universities, less practical than the technology ones). The primary and secondary schools are under the purview of the DBE while the rest fall under the Department of Higher Education and Training (DHET).

For the Foundation Phase (grades R, 1 and 2) the core subjects are language(s); mathematics and life skills. At the Intermediate Phase (grades 4-8) the subjects are mainly language(s), mathematics, natural science and technology, social sciences and life skills. At both the Foundation and Intermediate Phases, agriculture enters the curriculum primarily through the natural sciences. At the Senior Phase (grades 9 and 10-12) the national curriculum requires learners to take seven subjects: two languages; mathematics; life orientation, plus three (3) choice subjects. In the field of agricultural sciences one can choose from one of three subjects that are offered: agricultural sciences, agricultural management practices and agricultural technology. The time allocation for each of these subjects in the curriculum is four hours per week; 160 hours per year and 40 weeks per year. There are 43 schools that offer various courses in agriculture from grade 9 to 12. This is extremely helpful for those that terminate their education at this level because they will already have some basic skills that can enable them get employed on their own farms, or other farms.

Moving up the educational ladder, there are 12 public colleges of agriculture in South Africa offering qualifications at varying levels of rigor in agriculture. Students come from grade 12 and more specifically those that took agriculture as part of the

curriculum. Graduate output from the agricultural colleges has declined from 895 in 1999/2000 to 534 in 2011/2012. As regards enrollment for universities and universities of technology, AET enrollment increased from 2,582 in 1994 to 13,189 in 2011/2012 with annual graduates being 612 in 1994 to 2,149 in 2011/2012.

At the moment there are ten (out of 50) TVET colleges that offer agricultural programs to students entering with a secondary education. The curriculum of these TVETs is explicitly vocational and they contribute immensely to the intermediate and high-level skills needs of the agriculture sector. As opposed to South Africa, national vocational training systems, across the region, are generally small and are more focussed on industrial and service occupations. In Tanzania, for example, the Vocational Education and Training Authority (VETA) is just beginning to introduce agriculture into their system.

There are five universities of technology in South Africa offering AET. These are Cape Peninsula University of Technology, Central University of Technology Free State, Mangosuthu Technikon, Durban University of Technology and Tshwane University of Technology. The agricultural qualifications offered by these institutions include certificates, diplomas, bachelor in technology, master in technology and PhD in technology degrees. Total enrollment has been fluctuating from 3,946 in 1994 to 2,744 in 2011/2012 while graduates per year have been 355 in 1994 and 1,299 in 2011. As the data show, the core business (about 85 percent) is certificate and diplomas (Madakadze *et al.*, 2014).

There are 11 traditional universities that offer theoretically oriented university degrees faculties, departments or schools of agriculture, namely, University of Fort Hare, University of KwaZulu-Natal, North-West University, University of the Free State, University of Pretoria (UP), Stellenbosch University, Rhodes University, University of Cape Town, University of Limpopo, University of Western Cape and University of Witwatersrand. Training of agricultural extension officers and researchers are provided at the faculties of agriculture of the universities. Veterinary surgeons are trained at the UP's Faculty of Veterinary Sciences at Onderstepoort. State veterinarians are assisted countrywide by animal health technicians who obtained a National Diploma in Health at certain universities of technology and various other colleges of agriculture (Madakadze *et al.*, 2014). Total enrollment in 2012 in this category in all the disciplines in agriculture was 13,189 students of which 79 percent were undergraduates. On a less formal level the Agricultural Research Council regularly presents various specialized training courses and information days which are attended by farmers and delegates from South Africa and neighboring countries.

The authors took a deeper investigation at the UP with a view to learn about some specific metrics within the AET component which could be shared with other universities in the region. Unlike other AET universities in the region, UP has a good handle in managing student enrollment, the facilities are well kept, the student – teacher ratio is about 1:20 (instructor:student) and the curriculum is periodically reviewed with the participation of the private sector. The UP offers 230 qualifications involving 1,669 academic study programs, 1,343 of which are postgraduate programs. The rich cultural diversity of the South African population is reflected in the total student population of almost 62,000 students. There were almost 45,000 contact students of whom 54.9 percent are female and 45.9 percent are black students. The University has almost 18,000 distance education students, and nearly 4,000 international students, of whom more than 67 percent are from Southern African Development Community countries.

In recent times the University (on an annual basis) produced 15 percent of all three year bachelor's degrees, 14 percent of all professional four-year bachelor's degrees, 18 percent of all master's degrees and 16 percent of all doctoral degrees in South Africa. The University also contributed 29 percent of all engineers (with BEng degrees), 6 percent of all healthcare professionals, 18 percent of all natural scientists and all locally trained veterinary scientists in the country. The University has nine faculties and a business school, spread over five campuses in Pretoria and one in Johannesburg. The six campuses together comprise 1,214 hectares and there are 781 buildings on this land.

*4.2.4 Agri-food system jobs*. Turning to LSMS to look at the education shares across the different agri-food system components, it is observed that agribusiness manufacturing engages mostly the middle and secondary education levels (0.73), while trade and food services demand 75 and 78 percent, respectively, of middle and secondary education (Table V)[1]. Despite South Africa being a top tier country in the agri-food system transformation, there is negligible demand for tertiary education in the entire agri-food system, apart from the veterinary services which consistently require university training.

A key message then is – even for South Africa, low levels of education have a great demand and so strengthening their agricultural skills at an early age is critically important. However, this does not imply less emphasis on university education. Investments in agricultural universities will prove equally necessary to stimulate innovation and productivity gains.

South Africa is arguably the most strategic country in sub-Saharan Africa in matching levels and types of education with potential demand for jobs and skills in the agricultural sector. As opposed to a number of countries including the three case study countries (Malawi, Tanzania and Uganda), opening up of new universities has not been through upgrading certificate and diploma institutes. Thus, South Africa is yet to let go the much needed practical training. Compared with many countries in sub-Saharan Africa and especially the case study countries, South African universities are better equipped, less congested in terms of numbers of students and has a better learning environment. There are many lessons the rest of the countries can learn from South Africa (Minde *et al.*, 2014).

| | No primary | Some primary | Primary | Middle | Secondary | Tertiary |
|---|---|---|---|---|---|---|
| All jobs | 0.03 | 0.04 | 0.09 | 0.33 | 0.30 | 0.19 |
| Out of job market | 0.06 | 0.06 | 0.16 | 0.52 | 0.16 | 0.03 |
| Unemployed | 0.02 | 0.03 | 0.10 | 0.46 | 0.32 | 0.06 |
| Food system jobs | 0.06 | 0.07 | 0.16 | 0.41 | 0.24 | 0.06 |
| Own farming | 0.05 | 0.04 | 0.07 | 0.17 | 0.40 | 0.26 |
| Agricultural production, not own farming | 0.10 | 0.10 | 0.23 | 0.43 | 0.11 | 0.01 |
| Manufacturing | 0.03 | 0.03 | 0.10 | 0.39 | 0.34 | 0.10 |
| Trade | 0.03 | 0.04 | 0.11 | 0.42 | 0.33 | 0.05 |
| Transport | 0.01 | 0.03 | 0.09 | 0.37 | 0.31 | 0.16 |
| Food services | 0.01 | 0.02 | 0.07 | 0.36 | 0.42 | 0.10 |
| Veterinary | 0.00 | 0.00 | 0.00 | 0.36 | 0.01 | 0.63 |

**Source:** World Bank (2014), calculated from online LSMS data sets for South Africa 2011

**Table V.**
South Africa: proportionate distribution of jobs in the agri-food system, based on the level of education

*4.3 Tanzania: education enrollments and skill requirements*

*4.3.1 School enrollment in primary*. At the primary level, grade 1 enrollment for the year 2011 stood at 1.4 million children. Children usually enter grade 1 at the age of seven years. This means that for those that cannot filter into secondary school, they will enter the labor force at the age of 14 years. This is because primary education in Tanzania takes seven years. Total primary school enrollment hovered around 8.4 million over the same period (Tanzania Ministry of Education, 2013). Given the national population of 45 million of 2011, this is equivalent to 16 percent – a big load a nation to carry.

*4.3.2 School enrollment in secondary*. Secondary school education is divided into two levels. The ordinary level which runs from Form I to IV after which students sit for examinations to compete for advanced level entry (Form V-VI), often referred to as advanced level. The rate of increase in enrollment into secondary school is high. In a period of two years 2010-2012, total enrollment jumped from 1.8 to 2.1 million students. Based on the primary school enrollment in the preceding section, the transition rate from primary to secondary school is a low of 20 percent despite several education initiatives in the country in the last 20 years (United Republic of Tanzania (URT), 2011). Based on the estimate of Form IV finalists of 2012 and entrants into Form V in 2013, the transition rate is about 25 percent meaning that only one among four students in Form IV will be able to proceed to Form V (Tanzania, Ministry of Education, 2013). The unsuccessful ones may seek to get entry into certificate and diploma institutes of two to three years, which are also counted as tertiary institutions.

*4.3.3 Tertiary enrollment*. Total enrollment in tertiary institutions was 166,014 in 2012. Among these, 142,920 were in universities – both public and private. Government and private sector complement each other in fostering tertiary education. For example, in 2011, 91,568 students in both public and private higher learning institutions were given loans. It does not matter whether or not someone is in a public or private institution – a loan will be provided if the set criteria are met – a key one being the program being sought. Usually the government will not provide loans to humanities students. There are 11 public universities and about 23 private ones (URT, 2011).

About a quarter of the total tertiary enrollment is in private institutions, meaning that private schools are gradually becoming a significant contributor to national training efforts (Table VI). Gender-wise, women account for about 35 percent of students in the public institutions and about 42 percent in the private ones. Note that "tertiary" in the context of Table VI only refers to universities. However, there are numerous tertiary institutions that enroll Form IV and Form VI leavers. For example, the Ministry of Agriculture Food Security and Cooperatives, through its certificate and diploma training programs, pours about 1,000 graduates into the job market every year. The VETA trains about 150,000 students in various skill areas ranging from mechanics, masonry, carpentry, catering, etc. (URT, 2011). Recently they have also

| No. | | Female | Male | Total | % female |
|---|---|---|---|---|---|
| 1. | Public | 34,915 | 69,215 | 104,130 | 33.5 |
| 2. | Private | 15,045 | 20,464 | 35,509 | 42.4 |
| 3. | Grand total | 49,960 | 89,679 | 139,639 | 35.8 |

**Source:** BEST 2011

**Table VI.**
Tanzania: enrollment in public and private universities and its colleges 2010/2011

started agriculture. In fact, every ministry has its institution for training Form IV and Form VI leavers to take up skilled jobs in their respective ministries.

Four key features emerge from this portrait of the Tanzania education system:

(1) Primary school enrollment of 8.4 million in 2011 was about 16 percent of the population of 45 million in 2011.

(2) The secondary school enrollment of 1.5 million in 2011 shows that the transition rate is just about 20 percent. This means that about (8.4-1.6) = 6.8 million primary school leavers stop their schooling and enter the job market with primary school as a terminal qualification.

(3) Transition rate of secondary to university institutions is about 8 percent. This closely tracks the sub-Saharan Africa transition rate of 7 percent. But as shown above, there are other tertiary institutions they go to apart from universities.

(4) The 6.8 million primary school leavers who cannot find a place in secondary school or who choose not to continue their studies have to look for job opportunities. This is indeed a staggering number which remains a challenge for many governments.

*4.3.4 AET in Tanzania*. Agricultural education in Tanzania begins at primary school where it is taught as one of the subjects and continues to ordinary level secondary school. At advanced secondary school level, agriculture is an option. The Ministry of Agriculture Training Institutes offer certificate and diploma for two and three years, respectively, and all have an annual enrollment of about 3,000 students (URT, 2011).

Sokoine University of Agriculture (SUA) is the only university teaching agriculture, forestry and veterinary sciences in the country. Since 2006, there has been a three-fold increase in the number of students at SUA. This has moved from 2,700 in 2006 reaching 8,200 students in 2013. With about 500 teaching staff, the teacher-student ratio is about 1 to 20, which is considered to be about normal – but only if the necessary equipment and supplies are provided. Unfortunately this increased enrollment has not been matched by available teaching and learning facilities. Overall, library, laboratory and workshop sitting spaces and other essential facilities are in short supply. Classrooms are inadequate and in poor conditions due to increased number of students and lack of regular maintenance arising partly from insufficient funds being allocated from the government.

There are three main sources of funding to the University; government subvention, donor funding and internal generated income. In 2011/2012, government subvention accounted for 48 percent of the total funds while donor funds and internally generated income accounted for 33 and 19 percent, respectively. In recent years, subvention from the government especially funds for "Development and Other Charges" have been decreasing leading to deterioration of quality of services offered by the University (SUA, 2013). There is a dire need for the university to formulate and implement innovative approaches to address the increasing enrollments and lack of sufficient physical, financial and human resources to match the increasing enrollments.

There are several donors helping the university with various issues – NORAD, DANIDA, JICA and USAID to mention a few. Under a six-year (2011-2017) USAID Feed the Future capacity strengthening project called Innovative Agricultural Research Initiative, SUA is being assisted on several fronts to elevate it closely to a twenty-first century university. Apart from support in long-term training – 135 MSc and PhDs and collaborative research, the project in close collaboration with SUA is significantly involved

in institutional capacity building in several ways to assist SUA address the institutional challenges: areas of emphasis are; first, strengthening linkages with the private sector (for ensuring curriculum relevance and generating revenue to the university), alumni strengthening, classroom services unit, increasing access to digital data bases, curriculum review, leadership development, gender mainstreaming and supporting the university teaching and learning on the part of the teaching staff. Since all these are significantly influenced and run by the university and not the project, the hope is that many of these activities will be sustained even beyond the project period (iAGRI, 2015).

A majority of the SUA graduates are employed in the agri-food system. Of recent, there are several students who secure employment in non-food sector and some taking the decision to be self-employed. In a university-wide tracer study of graduates conducted in 2007, the report cited employers' complaint about poor practical and soft skills. On the side of ex-students they raised concern over inadequate infrastructure (SUA, 2013).

*4.3.5 Agri-food system employment*. Turning to LSMS to look at distribution of jobs among the educational levels, in the agri-food system of Tanzania we find that as opposed to South Africa (tier 1), in Tanzania, the educational level claiming the largest share is the "primary level" – be it in the "all jobs" or in the agri-food system (Table VII). About 50 percent of the jobs within these sectors require mostly primary school education. The share of graduate education is negligible, accounting for less than 1 percent of AFS workers. It is important, therefore, that primary school pupils become equipped with the necessary agricultural skills before graduation.

### *4.4 Uganda: education enrollments and skill requirements*

*4.4.1 Primary school enrollment*. Uganda has impressive primary school gross enrollment rates (128 percent). The total enrollment has increase gradually from 7.4 million in 2002 to 8.5 million in 2013 partially reflecting the pressure from the increase in population (Uganda: Ministry of Education, 2013). However, the proportion of pupils starting grade 1 who reached grade 5 in 2013 was 59 percent. In other words, over 40 percent dropped out of primary school somewhere along the way. A key point to take note in Uganda primary school education is the high number of pupils who do not finish primary school and also high number for those who finish primary school but fail to

| | No primary | Some primary | Primary | Middle | Secondary | Tertiary |
|---|---|---|---|---|---|---|
| All jobs | 0.19 | 0.11 | 0.55 | 0.14 | 0.00 | 0.00 |
| Out of job market | 0.08 | 0.07 | 0.33 | 0.50 | 0.01 | 0.01 |
| Unemployed | 0.03 | 0.09 | 0.54 | 0.29 | 0.00 | 0.05 |
| Food system jobs | 0.21 | 0.12 | 0.55 | 0.12 | 0.00 | 0.00 |
| Own farming | 0.21 | 0.11 | 0.54 | 0.13 | 0.00 | 0.00 |
| Agricultural production, not own farming | 0.25 | 0.17 | 0.52 | 0.06 | 0.00 | 0.00 |
| Manufacturing | 0.10 | 0.10 | 0.67 | 0.12 | 0.00 | 0.00 |
| Trade | 0.14 | 0.09 | 0.62 | 0.13 | 0.00 | 0.00 |
| Transport | 0.09 | 0.04 | 0.58 | 0.21 | 0.00 | 0.03 |
| Food services | 0.12 | 0.10 | 0.59 | 0.16 | 0.01 | 0.00 |
| Veterinary | 0.72 | 0.18 | 0.09 | 0.02 | 0.00 | 0.00 |

**Sources:** World Bank (2014a, b), calculated from online LSMS data sets for Tanzania 2011

**Table VII.** Tanzania: proportionate distribution of jobs in the agri-food system, based on the level of education

continue to secondary school. As in Tanzania, large numbers exit the educational system with partial or full primary schooling as a terminal qualification.

*4.4.2 Secondary school enrollment*. Secondary school enrollment in Uganda presents a number of striking features instructive to the rest of the region: first, enrollment increased from 656,000 in 2002 to 1.4 million in 2013 (Ministry of Education, 2013) – this is more than doubling in just 11 years – which far exceeds the population growth rate; second, about 50 percent of the students are in private schools – meaning that the private sector is contributing significantly to the education effort; third, about 45 percent of the students are female indicating a relatively gender-balanced educational level. Despite this doubling of enrollment in just a decade, the transition rate from primary to secondary is still about 16 percent. At "O"-level in secondary schools in Uganda, students study at least 12 subjects which must include sciences, mathematics and a choice of others depending on availability of teachers. Agriculture is one of several dozen subject-matter choices. At "A"-level, students usually pursue three to four subjects, which are often those best performed at "O"-level national examination (Uganda Certificate of Education).

*4.4.3 Tertiary enrollment in Uganda*. With a total enrollment in tertiary institutions of 201,000 in 2013, of which 140,000 are in universities, the transition rate from secondary to tertiary level is a mere 15 percent (Ministry of Education 2013). Table VIII shows the diversity of tertiary institutions in Uganda. A close observation of the institutions reveals the potential inter-sectorial synergies that exist across tertiary institutions. For example, there is a great likelihood for graduates from the business, management, technical and cooperative colleges to work in the agri-food system.

Makerere University is the largest tertiary institution in Uganda. The total student population at Makerere University in 2012/2013 was 37,000 and admission

| | 2011 | | | | 2006 | | | |
|---|---|---|---|---|---|---|---|---|
| Indicator | Number of institutions | Male | Female | Total | Number of institutions | Male | Female | Total |
| Universities | 32 | 78,817 | 61,270 | 140,096 | 26 | 52,507 | 40,098 | 92,605 |
| Business institutions | 58 | 12,260 | 12,724 | 25,084 | 48 | 9,348 | 8,832 | 18,180 |
| National teachers colleges | 7 | 4,989 | 2,853 | 7,842 | 9 | 7,316 | 3,681 | 10,997 |
| Health institutions | 21 | 3,924 | 3,564 | 7,459 | 15 | 2,108 | 1,024 | 3,132 |
| Management institutions | 12 | 2,293 | 3,179 | 5,472 | 8 | 2,000 | 2,156 | 4,156 |
| Technical colleges | 5 | 2,914 | 336 | 3,250 | 6 | 1,848 | 132 | 1,980 |
| Agriculture, fisheries and forestry | 3 | 1,169 | 456 | 1,625 | 6 | 1,370 | 281 | 1,651 |
| Media institutes | 4 | 967 | 653 | 1,620 | 2 | 900 | 576 | 1,476 |
| Theology | 11 | 1,326 | 271 | 1,597 | 2 | 850 | 248 | 1,098 |
| Law institute | 1 | 500 | 300 | 800 | 1 | 500 | 300 | 800 |
| Cooperative colleges | 2 | 204 | 144 | 448 | | 209 | 119 | 328 |
| Tourisms institutions | 3 | 137 | 89 | 226 | 1 | 81 | 62 | 143 |
| Art institutions | 1 | 134 | 61 | 195 | | | | |
| Aviation institutions | 1 | 127 | 20 | 147 | | | | |
| Meteorological institution | 1 | 15 | 24 | 39 | | | | |
| Survey institution | 1 | 27 | 3 | 30 | | | | |
| Others | 1 | 452 | 188 | 640 | | | | |
| Total | 164 | 110,255 | 86,135 | 196,570 | | 79,453 | 57,697 | 137,150 |

**Table VIII.**
Uganda: higher institutions enrollment 2006-2011

**Source:** Uganda: Ministry of Education (2013), Annual Report

in 2012/2013 was 18,000. Among this, the private students (those that paid all the fees themselves) was 16,000. Number of "A" level students that sat for the examination in 2012/2013 to qualify for university entrance was 102,296. This number increased from 35,706 in 2000/2001. It is therefore a very competitive environment as only 18,000 out of 102,000 could get admission into the University. It is also striking to note that the number of government sponsored students was 1993 in 2000/2001 and 12 years later – 2012/2013 was actually less (1,800 implying a greater involvement of the private sector, *MUK Fact Book*, 2012/2013).

As a measure to address large enrollments, students are also categorized according to the study time schedule of the program: day, afternoon, evening and/or external/distance learning. Day/afternoon and day/evening programs are predominantly programs offered in distance education mode; this also has provision for face to face sessions to provide interaction between staff and students each semester. All these are innovative approaches to deal with rapid expansion of university numbers.

*4.4.4 AET in Uganda*. Agriculture is taught in primary and at "O"-level secondary schools as one of the subjects. It is difficult, however, to gauge the degree of rigor and the seriousness accorded to agriculture *vis-a-vis* other subjects. Agriculture can also be taken as one of the three or four subjects at the advanced secondary level.

UNCST (2012) has observed that although the number of pupils that enroll in the school system at the start of primary school is large, the eventual number that chooses the science options later in life is getting smaller. Many of those who join the sciences remain at the theoretical level missing out applying those facts in imagination, creativity, inventions, discoveries and innovations (Mugisha *et al.*, 2014). Given the importance of science in agricultural learning and following the desire to have agriculture taught from primary school, Uganda is piloting a project aimed at demystifying and popularizing sciences in primary and secondary schools. Science projects and fairs are some of the methods that were found to enhance learning, improve comprehension and allow pupils to apply the principles they have learned to solve specific problems (Mugisha *et al.*, 2014).

Most of the tertiary AET in Uganda is concentrated at Makerere University. The total enrollment in the College of Agriculture and Environmental Sciences in 2011 was 1,600 in 2011. They teach, conduct research and outreach in agriculture, forestry and fisheries. This is a small number for an institution of 37,000. It shows that the proportion of "agriculture" in university education in Uganda is just about 5 percent and when we relate this to the entire tertiary education, it is below 1 percent. This shows the unpopularity of agriculture but at the same time is a reflection of the university-level agricultural jobs available relative to other sectors. The college has put in place a number of innovative approaches to cope with several challenges that they have faced. The AgShare model of education, for example, is aimed at linking researchers, students and the community through action research on specific problems facing society and sharing the results with the community is meant to partly ensure relevance of the curriculum among others (Minde *et al.*, 2014).

Other innovative features carried out by the college in conjunction with other colleges at the university include curriculum review involving key stakeholders of the programs, Makerere University Private Sector Forum, periodic engagement of the parliamentary committee on agriculture, a deliberate move to promote science and technology in secondary schools and involvement in community projects that make the university relevant to the surrounding communities.

The College of Veterinary Medicine and Animal Resources Biodiversity is also an AET institution. It is an outward looking college in the sense that it has evolved from the typical veterinary function and is now offering degree programs in non-vet disciplines such bachelor degrees in Biomedical Laboratory Technology, Wildlife Health Management, Animal Production Technology and Management as well as MSc degrees in the same fields. The total enrollment in 2013 is undergraduate 534 and postgraduate 102 students, respectively. There are several other universities in Uganda that teach agriculture or agricultural-related subjects such as Gulu University, Mbarara University, Mountains of the Moon University, etc. However, the breadthe and depth is relatively limited compared with Makerere University and also data are not easily available.

Bukalasa Agricultural College which is a diploma and certificate issuing institute, is now under Makerere University. The institute provides agricultural education in a broad range of fields, including crop and livestock production, horticulture, nutrition and agri-business. There are also a few private certificate and diploma issuing colleges whose total enrollment is less than 100 students each. Courses taught include crop and animal husbandry including the raising of chickens.

*4.4.5 Agri-food system employment*. Looking at the education shares in the LSMS (Table IX) across the different segments of the agri-food system, Uganda confirms its bottom tier position in the food system transformation. "Some primary" as a level of education commands the largest share. Key demand segments are in the "agricultural production (not own farming)" where "some primary" takes the share of 0.53 of total allocation across the education levels. This level of education is most prevalent in the manufacturing (0.4), trade 0.39), transport (0.4) and food services (0.41). Skill requirements from the tertiary education level are very insignificant.

### *4.5 Malawi: education enrollments and skill requirements*

*4.5.1 Enrollment at primary and secondary levels*. In Malawi, the primary school entrance age is six. Although primary education in Malawi is free, students are required to purchase their own school uniform, pens and notebooks, which many families find difficult. Rates for drop-outs are high, and, according to UNESCO Institute of Statistics (2012), only 58 percent of children will complete a full course of primary school, and 20 percent of children repeat one or more school years, often several times,

**Table IX.** Uganda: proportionate distribution of jobs in the agri-food system, based on the level of education

| | No primary | Some primary | Primary | Middle | Secondary | Tertiary |
|---|---|---|---|---|---|---|
| All jobs | 0.11 | 0.44 | 0.17 | 0.20 | 0.02 | 0.05 |
| Out of job market | 0.05 | 0.27 | 0.08 | 0.41 | 0.11 | 0.04 |
| Unemployed | 0.01 | 0.27 | 0.02 | 0.20 | 0.04 | 0.31 |
| Food system jobs | 0.12 | 0.49 | 0.16 | 0.19 | 0.01 | 0.02 |
| Own farming | 0.12 | 0.50 | 0.15 | 0.19 | 0.01 | 0.02 |
| Agricultural production, not own farming | 0.23 | 0.53 | 0.12 | 0.11 | 0.00 | 0.00 |
| Manufacturing | 0.13 | 0.40 | 0.26 | 0.14 | 0.01 | 0.05 |
| Trade | 0.06 | 0.39 | 0.21 | 0.26 | 0.03 | 0.03 |
| Transport | 0.02 | 0.40 | 0.25 | 0.25 | 0.02 | 0.01 |
| Food services | 0.09 | 0.41 | 0.23 | 0.19 | 0.06 | 0.00 |
| Veterinary | | | | | | |

**Sources:** World Bank (2014a, b), calculated from online LSMS data sets for Uganda 2010

if they have had to take significant time out of school and have fallen behind. It is very common for children in Malawi to come in and out of school depending on their family situation, employment responsibilities, pregnancy and marriage at a young age, sickness, and more. For most people in Malawi, primary education is the highest level of education they will achieve. As a result, primary education is an essential aspect of community life in Malawi, and is critical to the development of Malawi as a whole. Many of the basic skills and foundational knowledge required for life must be learned in these formative years. Therefore, it is critical to Malawi's development to support primary education (UNESCO Institute of Statistics, 2012).

The education system is structured so that the primary school cycle lasts six years, lower secondary lasts four years, and upper secondary lasts two years. In 2012, Malawi had a total of 3.7 million pupils enrolled in primary school and 643,000 enrolled in lower secondary school and 119,000 enrolled in upper secondary education. An analysis of educational achievement in the 15-24 age groups demonstrates the reality of the extent of skills within the youth. Although youth in this age group may still be in school and working toward their educational goals, it is notable that approximately 5 percent of youth have no formal education and 57 percent of youth have attained at most incomplete primary education, meaning that in total 62 percent of 15-24 year olds have not completed primary education in Malawi (UNESCO Institute of Statistics, 2012). From the figures, the transition rate from primary to lower secondary is 17 percent and from lower to upper secondary is 18 percent. It is therefore likely that the majority of secondary school graduates will end up participating directly or indirectly in the agricultural sector. In order to participate meaningfully they should be prepared scientifically and practically (Spaull, 2011). Data from UNESCO Institute of Statistics (2012) for the 15-24 age cohort give a better understanding of the appalling education situation. In this cohort we notice the following: "no education" 5 percent, "primary school incomplete" 57 percent, "primary school complete" 11 percent, "secondary incomplete"19 percent, "secondary complete" 7 percent and "post-secondary" 1 percent. This gives a reflection of the quality of the labor force.

The most recent admissions (2012) for which complete data are available provide the following numbers: University of Malawi 908, Lilongwe University of Agriculture and Natural Resources 456 and Mzuzu University 366. At this same time, enrollment in Technical Entrepreneurship Vocational Education and Training Authority was 1,500. These together with several other colleges give an enrollment of 12,203 in 2011 in a country with a corresponding population (2011) of 16,000,000. This means that only 0.07 percent of the population is able to receive tertiary education.

Bunda College, formerly a constituent college of the University of Malawi, is now a fully-fledged university specializing in agricultural sciences. Mzuzu University offers science courses that support agriculture, but the University does not offer agricultural degrees.

*4.5.2 AET in Malawi*. As in the other case study countries (South Africa, Tanzania and Uganda), agriculture is one of the subjects in primary and ordinary secondary schools. However, Malawi has only one government administered agricultural certificate/diploma institution – Natural Resources College (NRC) which is now part of the Lilongwe University of Agriculture and Natural Resources (LUANAR). The college provides certificate and diploma courses and has an annual turnover of 500 graduates. Close to half of these 500 graduates do not pick up jobs allocated by the government because they are not attractive salary-wise. Instead, they join NGOs or seek for

self-employment (www.nyasatimes.com). To circumvent the shortage of agricultural extension officers, Malawi currently has a program of training "lead farmers" who will pass on modern farming technology to other farmers.

Currently, the NRC provides courses leading into diploma in agriculture and natural resource management, animal health and production, horticulture, environmental management for sustainable development, food and nutrition and livelihood security and land administration.

Lack of adequate lower (certificate) and middle (diploma) level of agricultural education sets a significant gap in the agricultural extension sector's value chain because skill demand in the sector does not necessarily focus only on degree graduates. Currently, the annual admission of the only university of agriculture in the country – LUANAR is around 460 students. In comparison with other countries in the region and especially taking into account the population, this is a very small number to adequately serve the several demands of skills in the sector. Bunda College used to enroll certificate and diploma in agriculture students in the past but after becoming a fully-fledged university and acquiring the college of natural resources, which offers certificate and diploma, Bunda is now only concentrating on degree programs at both undergraduate and graduate levels.

Mwimba College of Agriculture, owned by the Agricultural Research and Extension Trust (ARET) of the tobacco industry, conducts a one year certificate course leading to certificate in tobacco production (www.aret.org.mw/index php).The institute began in 2011 and to date 400 students have graduated at the certificate level. In 2012, a diploma in agriculture in the same college started with 85 students. The case of ARET is a good example of private sector contribution to developing practical agricultural education.

*4.5.3 Labor force educational attainment*. The education shares in the agri-food system LSMS (Table X) show a close resemblance with the Uganda case. This is no surprise since they are in the same bottom tier in the food system transformation. The highest demand of skills in the agri-food system is from the "some primary education" category where the "agricultural production (not own farming)" takes the share of 0.3 of total allocation across the education levels. Food services are also significant with "some primary" also taking a share of 0.33. This level of education is also most

| | No primary | Some primary | Primary | Middle | Secondary | Tertiary |
|---|---|---|---|---|---|---|
| All jobs | 0.22 | 0.26 | 0.26 | 0.19 | 0.05 | 0.02 |
| Out of job market | 0.10 | 0.19 | 0.25 | 0.36 | 0.09 | 0.02 |
| Unemployed | 0.08 | 0.07 | 0.13 | 0.37 | 0.20 | 0.15 |
| Food system jobs | 0.24 | 0.28 | 0.26 | 0.18 | 0.03 | 0.01 |
| Own farming | 0.23 | 0.27 | 0.27 | 0.19 | 0.03 | 0.01 |
| Agricultural production, not own farming | 0.26 | 0.30 | 0.26 | 0.16 | 0.02 | 0.00 |
| Manufacturing | 0.21 | 0.22 | 0.23 | 0.24 | 0.07 | 0.02 |
| Trade | 0.09 | 0.20 | 0.29 | 0.29 | 0.10 | 0.03 |
| Transport | 0.05 | 0.15 | 0.20 | 0.36 | 0.19 | 0.06 |
| Food services | 0.06 | 0.33 | 0.23 | 0.25 | 0.08 | 0.05 |
| Veterinary | | | | | | |

**Table X.** Malawi: proportionate distribution of jobs in the agri-food system, based on the level of education

**Sources:** World Bank (2014a, b), calculated from online LSMS data sets for Uganda 2010

prevalent in the manufacturing (0.4), trade 0.39), transport (0.4) and food services (0.41). Trade (formal wage) presses the highest demand on "middle school" level where the proportionate share is 0.44. Once more, we observe the need to impart agricultural skills all along the value chain at the formative education stages – primary and middle schools. The share of tertiary education level is glaringly insignificant.

### *4.6 Importance of self-employment in the agri-food system*

Analysis of shares by type of employment within the agri-food system reveals that self-employment carries the largest share of 69 percent of the workers in the farm-based agriculture and 9 percent in the post-farm agri-food system (Table XI). Wage labor (casual) follows with 12 percent in the farm-based activities and 2 percent in the post-farm area. Wage labor on permanent basis is the lowest and insignificant share registering only 5 percent in the farm-based sector and 4 percent in the post-farm operations. Self-employment is largely made up of people with few years of education and skills. This therefore calls for a need to enhance the knowledge base of most of these workers through improving agricultural extension system. Given that self-employment accounts for the majority of active workers in both farming and post-farm work (Table XI), early training in primary and secondary school can help to prepare youth for the working world by demonstrating the practical applications of basic numeracy and reading skills as well as basic management and entrepreneurship skills they will need as small business operators.

## 5. Discussion

Africa's education institutions face multiple, serious challenges. They must cope with ballooning enrollments in the face of severe budget constraints virtually everywhere with the exception of South Africa. At the same time, shifting skill needs arise from the rapid growth in the post-farm segments of the food system and from the shifting structure of agricultural demand in favor of poultry, dairy, livestock and horticulture – all of which require a significant retooling of faculty, facilities and curricula. Tensions likewise arise between the political pressure for expansion of university training in the face of growing evidence that basic numeracy, literacy and practical skills at elementary, secondary and vocational levels will meet 75 to 90 percent of agri-food system job requirements. The preceding review suggests several emerging responses that may help educational institutions respond in the face of these multiple pressures.

| | Self-employed | Wage labor: casual | Wage labor: permanent |
|---|---|---|---|
| Agriculture | 32,040,955 (69%) | 5,431,739 (12%) | 2,304,508 (5%) |
| Post-farm AFS | 4,245,910 (9%) | 910,852 (2%) | 1,706,296 (4%) |
| Total AFS labor | 36,307,026 (78%) | 6,345,502 (14%) | 4,013,797 (9%) |
| Total AFS | 46,739,915 | | |

**Sources:** World Bank (2014a, b), compiled by aggregating data from LSMS tables for the countries involved

**Table XI.** The importance of self-employment in the agri-food system in Malawi, South Africa, Tanzania and Uganda

*5.1 Improving primary and secondary agricultural education*

Between 70 and 95 percent of youth in Eastern and Southern Africa enter the job market with at most primary or middle school training as a terminal qualification. For them, the question becomes how school systems can equip children in these early years to successfully compete in the changing agri-food system. Even in a highly modern agri-food system like South Africa, 70 percent of agri-food system workers enter the workforce with at most middle school education while an additional one-fourth finishes secondary school. This suggests that teaching of agriculture-related skills needs to happen at primary and secondary level. Job market evidence from employers, even in highly advanced food systems, indicates that the bulk of employment in agriculture and related agri-businesses requires not university training but rather functional literacy and numeracy along with relevant practical and problem solving skills.

All of the countries reviewed here recognize the importance of introducing agricultural education in primary and secondary schools. South Africa has proceeded the fastest with major structural reforms of agricultural education at five different levels, including primary, secondary and vocational. Others have experimented with more evolutionary models. Makerere University's very interesting work piloting agricultural science education modules in primary and secondary school aims both to make science education relevant and to help motivate children to consider careers in agriculturally related enterprises. This work suggests that one pathway forward to resolving the tension between high-level political interest in university education with job market needs for competent primary, secondary and vocational education lies in establishment of departments of primary and secondary education extension at agricultural universities. As at Makerere, these extension efforts can help to pilot and test feasible, effective agricultural education modules specific to different locational opportunities, needs and resources. Active links between tertiary AET institutions and primary and secondary schools offer multiple benefits – setting a strong foundation for student learning in the sciences and simultaneously stimulating early student interest in a broad range of agricultural and agribusiness careers.

Adult education in vocational and technical courses will likewise constitute an important option for upgrading and focussing skills of primary school leavers and drop-outs. Until very recently, the Tanzania VETA had been very flexible in admissions to the extent that even drop-outs from primary school and primary school leavers could be admitted. But because of increasing number of secondary school leavers, VETA is no longer admitting primary school leavers.

Split ministerial jurisdiction of educational institutions complicates the development of suitable agricultural and agribusiness curricula in primary and secondary schools (Temu *et al.*, 2003). Ministries of Education typically claim responsibility for lower education, while Ministries of Higher Education supervise universities and Ministries of Agriculture guide many of the technical agricultural colleges and training centers. Tanzania, for several years separated the higher education from primary and secondary education but because of the afore-mentioned complications, now it is one ministry handling all educational levels.

*5.2 Stimulating productivity gains through tertiary education and research*

Investments in primary and secondary education provide the foundation for a literate, productive workforce. Yet parallel investments in agricultural universities will prove equally necessary to stimulate innovation and productivity gains throughout the food system – through improved breeding, agronomic research, food science and food

technology development. As a result, tertiary agricultural training and research institutions will need to maintain close links with agricultural research and extension systems and with the farms, businesses and communities they serve. Many of the models described in this paper – South Africa's Council for Scientific and Industrial Research and Uganda's agribusiness incubators – aim precisely to involve university researchers in the development of more productive, commercially viable technologies for agricultural production, processing and distribution.

*5.3 Matching new skill needs for growing private sector agribusiness employers*

Skill demands for both farming and industry are rapidly changing. Employers are changing as well, as growing private sector agri-businesses supplant a declining public sector as the major clients hiring students from AET and general education institutions (Temu *et al.*, 2003; Dramé-Yayé *et al.*, 2011). These dual changes, in turn, should shape the way the curricula are formed and implemented. Yet employers and students complain about the low quality of internships as a result of the ballooning tertiary employment numbers. Employers meanwhile consistently complain that students receive too much theory and too little relevant, practical training.

Various models for linking private sector agri-businesses with AET institutions are currently being tested and will need to be more broadly assessed and adopted. The AgShare model of education at Makerere University sends students and faculty into farming communities and agri-business environments to help identify and solve practical technical problems in food processing, preservation, production and marketing. The UP and Stellenbosch's Bureau for Food Analysis and Policy similarly links faculty and students with agribusiness leaders to identify key private sector concerns and then apply university research tools to help evaluate key market and industry issues identified. Tanzania's VETA has developed a highly effective private sector advisory board that serves to review curricula and provide constant employer input and feedback on the quality and suitability of training offered. South Africa's vocational colleges (TVET) and agricultural secondary schools play a similar role in linking technical education directly with employer needs.

All of these models aim to shift agricultural training and education from a didactic, lecture-based format to a teaching approach that utilizes a continuously updated information loop system of real world information. The contribution of these types of models is to provide insights to redesigning curricula so that they respond to the needs of the community and private sector. It also helps to integrate the staff and students to the real world problems as they participate in the action research aimed at solving the problems at hand.

We have noted the concentration of self-employment in the agri-food systems – 78 percent of the total labor force. This is mostly a low-educated cadre with low skills in modern agricultural technology and entrepreneurial and business skills. Since most of these self-employed are at most primary school leavers or drop-outs, it is essential that courses like basic financial management become important part of the curriculum in primary and secondary schools.

*5.4 Private schools*

In some settings, private education institutions are emerging to fill profitable gaps in the public sector education system. The Malawi tobacco industry's certificate course on tobacco production offers one very focussed example. On a larger scale, a wide range of private business management institutes and training institutions is emerging to

serve the rapidly growing need for post-farm skills in logistics, management, marketing and distribution.

However, other needed training – such as primary school agricultural education – rarely attracts high-paying clients needed to turn a profit, and so most of these needs will have to be met by hard-pressed public school systems.

### *5.5 Public agricultural education in an era of budget constraints*

At the university level, many agricultural universities are grappling with funding deficits to run their basic functions. Makerere University offers one possible response by securing a significant proportion of the internally generated funds to come from student fees that they pay themselves or through the private sector that may have funded their tuition (Minde *et al.*, 2014). Dual-track tuition policies such as that practiced by Makerere University – day and night sessions coupled with clear distinction between government and private tuition – offers one solution for countries that are similarly grappling with large student population. Large class sizes are a phenomenon that is rapidly gaining ground in many of the universities in the region. Proceeding with business as usual is detrimental to students as well as instructors. Deliberate efforts need to be in place to minimize the damage that may be caused. This could be through changing the style of delivery, making use of ICT tools and engagement of teaching assistants to support classroom lectures.

At the middle levels of AET education, more training is generally needed in technical mid-level agriculture careers. Apart from imparting agricultural and entrepreneurial skills at the formative stages of the schooling, it is very critical that the training of mid-level careers in agriculture be promoted. This is particularly so for countries like Malawi which has extremely low numbers of agriculture certificate and diploma holders. Here, the South African reforms offer a menu of options for neighboring countries to consider.

At the primary school level, expanding enrollments impose many pressures of limited public budgets. For this reason, it may prove necessary to provide technical backstopping for overstretched primary school teachers through access to local agricultural extension officers and university student and faculty outreach.

## 6. Conclusions

Africa's education institutions face multiple challenges in meeting the needs of growing student populations in the midst of a rapidly changing food system with consequently shifting skill needs. The preceding review of issues and emerging responses leads us to two fundamental conclusions.

First is the importance of primary and secondary schooling in preparing youth for productive work in the agri-food system. Even in South Africa, with its highly modern food system and ample education budgets, key education needs lie in primary and middle school (70 percent of AFS jobs) and in secondary education (another 25 percent of AFS jobs). Hence the broad need for improving the content and relevance of primary and secondary school education. Shifting agri-food system skill needs imply a growing need for basic numeracy and literacy, for technical and science education relevant to agricultural production and food transformation processes. Recent reform efforts in South Africa offer a possible restructuring solution, while a wide array of pilot efforts across the region offer more tailored, evolutionary models of enhancing agricultural education in primary and secondary schools.

Second, the changing structure of skills needed in AET reveals a clear need for more training in post-farm segments of the agri-food system: processing, packaging, distribution, logistics and food safety. This shifting emphasis will require investment in faculty re-training, new facilities and new links to private sector employers. Linked to this is the need to re-orient policy, investment plans and faculty in AET institutions to deliberately target the market. South Africa has done this relatively well and offers one potential model for emulation by other countries in the region. One key issue in this effort will be to build ongoing communication conduits with private sector agribusiness employers. Internships, field attachments, private sector advisory boards, guest lectures and applied research all offer promising tools for building bridges with employers in order to ensure relevance and quality of training for youth embarking on agri-food system careers.

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## Note

1. For more explanation and assumptions on computing information for the LSMS tables see Appendix Box 1.

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## Appendix

| | Eastern and Southern Africa | West and Central Africa | North Africa |
|---|---|---|---|
| Top tier (urbanization > 50% and GDP/capita > $5,000) | Angola, Botswana, *South Africa* | Congo, Gabon, Nigeria | Algeria, Libya, Morocco, Tunisia |
| Middle tier | Kenya, Mauritius, Namibia, Swaziland, Sudan, *Tanzania*, Zambia | Benin, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Gambia, Ghana, Mauritania, Senegal, Sierra Leone | Egypt |
| Bottom tier (urbanization < 50% and GDP/capita < $1,500) | Burundi, Eritrea, Ethiopia, Lesotho, Madagascar, *Malawi*, Mozambique, Rwanda, Somalia, South Sudan, *Uganda*, Zimbabwe | CAR, DRC, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Togo | |

**Note:** Italicized countries indicate those included in the case study investigations in this special issue

**Table AI.**
Country tiers based on commercialization of the food system

### Box 1. Approaches and assumptions in the construction of Living Standards Measurement Studies (LSMS)

Agri-food system (AFS) jobs:
To identify AFS jobs other than farming, we mapped each set of country industry codes – the (differing) industry codes used in each of the analyzed LSMS data sets – into an "ISICx" variable that was identical across countries. This variable was based on International Standard Industrial Classification codes (ISIC of All Economic Activities from the UN: http://unstats.un.org/unsd/cr/registry/regcst.asp?CI = 27) but modified to be usable in statistical analysis packages.
Challenge in data collection:
Countries collected data at differing levels of detail (corresponding to the number of digits in the ISIC and our ISICx). For example, Malawi's IHS 2010/2011 used only 32 country industry codes. When recorded at sufficiently disaggregated level to allow clear classification into our out of the AFS, the activity was classified as appropriate. Examples not related to agricultural production (which obviously fall entirely into the AFS) include "retail sale of food in specialized stores."
In contrast, Malawi used only one code for all retail trade, and even countries with more detail used a combination of codes which could be uniquely classified and ones that could not, such as "retail sale of food, beverages, and tobacco" (47.2 in ISICx) and "retail sale in non-specialized stores" (47.1 in ISICx). In cases where unique mapping was not possible (10% of the population-weighted jobs) we applied an adjustment factor:

$$af = (1/(1-x)) \times y),$$

where $x$ is the country-specific value share of non-food agricultural production in total agricultural production as per FAOSTAT, and $y$ is the share across Eastern and Southern Africa of cash food expenditure in total food expenditure, computed separately for rural and urban areas. So, for example, 319 cases (618,707 population-weighted jobs) of ISICx code 47.9 in Uganda ("retail trade not in stores") became 130.7 (253,486) AFS cases in rural areas and 146.8 (284,710) in urban areas based on an adjustment factors of 0.410 and 0.460, respectively. The balance of cases (41.5) was allocated to non-AFS.

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