Research Application Summary

Orienting higher education to support Africa's agricultural development

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Abstract

Agriculture is Africa's largest economic sector, representing 15 percent of the total GDP (or more than $100 billion annually). This pivotal sector just like the broader economy is resurging from a lull of no growth that marked the 1970's to early 1990's. Agriculture is one of the growth poles for the continent needed to both sustain current GDP growth rates, meet the continent's present and future demands and supply global goods as well. The Comprehensive Africa Agricultural Development Programme (CAADP) is the strategic framework to achieve this goal. Some fundamental questions to ask are, "what role could universities play in supporting agricultural growth processes in the continent?", "Have universities been part of growth processes taking place in the continent?" There are no straight answers to these questions. However, in this paper, we show that indeed the African university has contributed to the current growth, albeit at very low levels. The African university will however need to intensify its efforts to integrate into Africa's development agenda, and to champion change. The dismal role of universities in development processes is attributed in part, to low levels of investments which unlike is the rest of the general African economy, only begun to receive fragmented support more recently. The general consensus however, is that what Africa has and will have to offer is both its young human resource and agricultural products, has great implications for educational, research and marketing institutions. To be sure, Africa's higher education institutions especially the Universities are well placed to contribute immensely to delivering Africa's offer to the global market. Currently, the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM), a consortium of 30 Agricultural Universities in Eastern, Central and Southern Africa is marshaling University capacity to support technological progress within the agricultural sector. In this paper we highlight examples of how that has been done by strengthening innovation capacity, farm productivity, labour productivity and competitiveness of smallholder based farming. Efforts taken to rebuild capacity of universities to engage in

development agenda via home grown solutions are also discussed. The key lessons from past and ongoing initiatives as well as future perspectives are discussed within the context of strategic partnerships.

Key words: African Universities, Agricultural development, smallholder-based farming, RUFORUM

Résumé

L'agriculture est le secteur économique le plus important en Afrique, représentant 15 pour cent du PIB total, ou plus de $ 100 milliards par an. Ce secteur essentiel, tout comme l'ensemble de l'économie, est en train de resurgir d'une accalmie d'absence de croissance qui a marqué les années 1970 jusqu'au début des années 1990. L'agriculture est l'un des pôles de croissance pour le continent qui nécessitait à la fois de soutenir les taux actuels de croissance du PIB, de répondre aux demandes actuelles et futures du continent et de fournir aussi bien des produits globaux. Le vaste programme pour le développement de l'agriculture en Afrique (CAADP) constitue le cadre stratégique pour atteindre cet objectif. Quelques questions fondamentales à se poser sont les suivantes: «Quel rôle pourraient jouer les universités pour soutenir les processus de croissance agricole sur le continent?"; "Les universités ont-elles fait partie des processus de croissance qui se déroulent sur le continent?" Il n'y a pas de réponses claires à ces questions. Toutefois, dans cet article, nous montrons qu'en effet, l'université africaine a contribué à la croissance actuelle, quoique à des niveaux très faibles. L'université africaine devra cependant intensifier ses efforts à intégrer dans l'ordre du jour du développement de l'Afrique et à promouvoir le changement. Le rôle lamentable des universités dans le processus de développement est attribué en partie au faible niveau des investissements qui, ne ressemblant pas au reste de l'économie générale africaine, ont seulement commencé à recevoir un soutien fragmenté plus récemment. Toutefois, le consensus général, que ce que l'Afrique a et aura à offrirest à la fois sa ressource humaine jeune et des produits agricoles, a d'énormes implications pour les institutions d'enseignement, celles de recherche et de commercialisation. Pour être sûr, les institutions africaines d'enseignement supérieur en particulier les universités sont bien placées pour contribuer grandement à l'offre africaine fournie sur le marché mondial. Actuellement, le Forum régional des universités pour le renforcement des capacités en agriculture (RUFORUM), un consortium de 30 universités organisant des études en agriculture,situées en Afrique orientale, centrale et australe,canalise les ressources

des universités pour soutenir le progrès technologique dans le secteur agricole. Dans cet article, nous mettons en évidence des exemples de la façon dont cela a été fait par le renforcement de la capacité d'innovation, la productivité agricole, la productivité du travail et la compétitivité de l'agriculture à petite échelle. Les efforts déployés pour rétablir la capacité des universités à s'engager dans le programme de développement grâce à des solutions priseslocalement sont également discutés. Les principales leçons tirées des initiatives passées et courantes ainsi que les perspectives futures sont discutées dans le cadre de partenariats stratégiques.

Mots clés: Universités africaines, développement agricole, agriculture à petite échelle, RUFORUM

Background

Africa's growth recovery: A departure from its past. Today, Africa presents one of the regions of the world with fastest growing economies. The region has experienced remarkable economic and agricultural recovery over the past 10–15 years with an average Gross Domestic Product (GDP) (growth rate of 6 percent per year). Over the same period, Africa's agricultural sector has also remarkably grown, (Badiane, 2008; Pretty *et al*., 2011). For a continent, where 65% of the population is dependent on agriculture for their livelihoods, and the sector contributing about 25% of GDP, strategic investments in agriculture is the most logical approach to stimulate economic growth for the medium to long term. Recent statistics show that the number of people in Sub-Saharan Africa (SSA) living on less than $1.25 a day, has started to fall, after reaching a peak of 395 million in 2005. Moreover, the poverty rate, which hit a high of 60 percent in 1993, fell to 48 percent in 2008 (World Development Indicators, 2012). The main source of growth in SSA in large measure is due to a high domestic demand as a result of increasing urban populations and the relatively stronger economies today and, to an extent, external demand supported by higher commodity prices. However, because progress has been slower in SSA than in other regions, one-third of the world's poorest people now live in SSA. But, even as the number of people living in extreme poverty falls, the number of people living on less than $ 2 a day continues to rise (World Development Indicators, 2012). The slower progress in SSA relative to other developing regions of the world has been attributed to a number of factors broadly categorized as policy and management related, biophysical, as well as socio-economic challenges (Madavo 2005; Henao, and

Baanante, 2006; de Graaff *et al*., 2011). Thus strategic investments are needed to stimulate economic growth and support transition of the vast majority of Africa's rural populations from poverty to prosperity, a process that has already begun but needs to accelerate.

Harnessing Africa's natural resources. Africa is a very large and highly diversified continent with great diversity and agro-ecological endowments. In Africa, the total area of land potentially suitable for the production of one or more cropping systems is estimated to be 874 million hectares (ha), about 30% of the continent's landmass. Out of this area, about 210 million ha is currently cultivated, but as a result of requirements for fallow and the constraints imposed by other factors, only about 150 million ha is currently harvested yearly (Henao and Baanante, 2006). Thus, Africa still has large expanses of arable land that could be exploited with potential for expansion ranging from 150 to 700% per region (Ahlenius, 2006).

Bringing more land under production has been used in the past in Africa and elsewhere and indeed accounts for most of the growth in the continent's agriculture (Fig. 1). Examples of how this has been done elsewhere provide invaluable lessons. From 1987 to 1996, Brazil, a new global economic leader, added 1 million ha annually into cultivation. If Africa could achieve half that rate, it could raise production by US $ 222 billion annually by 2030 (Roxburgh *et al*., 2010). This approach never the less requires the use of yield enhancing technologies especially improved seed, fertilizers, water for irrigation and mechanization of production processes. Economic growth in Brazil, Argentina and India the so called (BRICs nations- Brazil, Russia, India and China), which are considered as emerging global economic leaders, has been underpinned by related growth in the agricultural sector, that is associated with wide scale adoption of yield enhancing technologies. For example, Latin America's share of world food exports reached 11 percent or $141 billion in 2010 alone, due to use of cutting edge technologies which have turned even unproductive areas into net food export zones- the *Cerrado* of Brazil being a typical example. Brazil alone has increased its food exports by 387 percent between 2000 and 2010 to US $ 63 billion, accounting for 44 percent of Latin America's food exports in 2010 (World Development Indicators, 2012). Yield enhancing technologies coupled with stress and mechanization supportive innovations can thus turn even unproductive land into net excess producers as in the case of

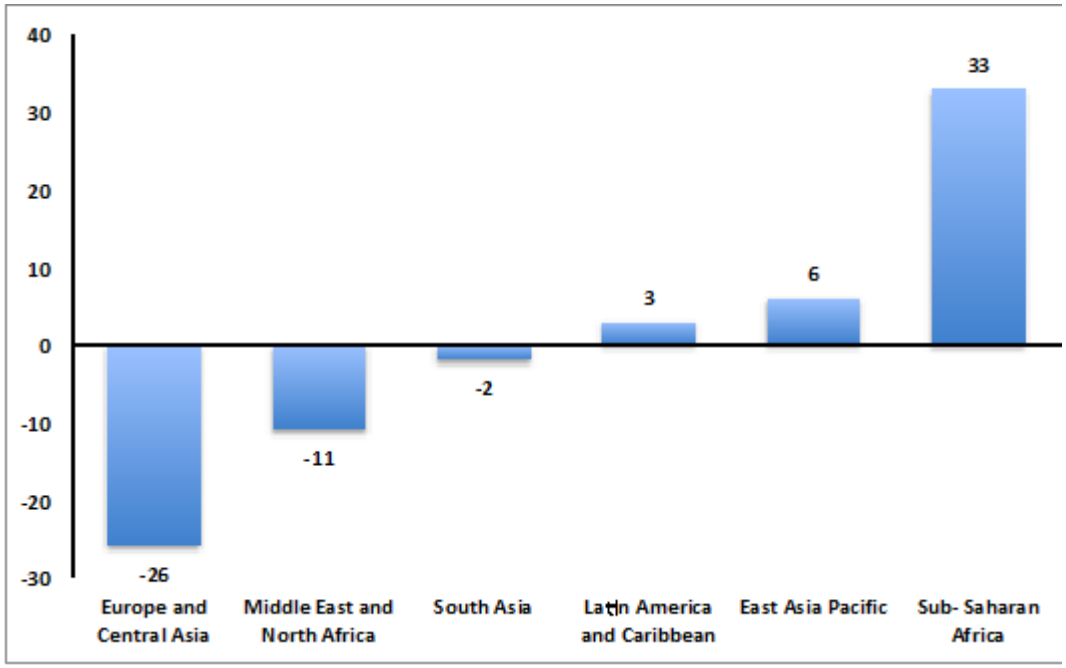

Figure 1. Analysis of changes in cereal productivity between 1990 and 2010. Compared to the developed nations the developing regions improved production by increasing acreage. Africa increased productivity by bringing 33% of its arable land under production. Europe reduced its total land area by 26% while maintaining a 7% increase in yield. Source: World Bank Indicators 2012.

Brazil and Argentina. In Europe and the North America, regions with well developed agriculture, the area under cereal production decreased by 26 percent from 1990, yet food production has gone up by 7 percent over the same period till 2010, due to a 9 percent increase in cereal yields, coupled with a 43 percent agricultural productivity (World Development Indicators, 2012). Africa's agricultural productivity could increase by two to three fold, from the current production levels, of about 0.5, to 1 metric ton of grain per hectare through positive yield synergies between improved crop varieties, management techniques and labour use efficient technologies (Twomlow, 2008). These statistics show that for Latin America, a fast developing region, and Europe, a developed region, both expansion in land area and improvements in technological efficiency have been critical for agricultural growth. These issues demonstrate the opportunity to increase Africa's aggregate agricultural production and global share in agriculture and trade following a similar strategy.

Increasing productivity must nevertheless be done with due consideration for climate change and other socio-economic contexts. Increasing agricultural productivity will require

investments deployed through intensification mechanisms. Agricultural intensification has been defined in three different ways (1) increasing yields per hectare, (2) increasing cropping intensity (i.e., two or more crops) per unit of land or other inputs (water), and (3) changing land use from low- value crops or commodities to those that receive higher market prices (Pretty *et al.*, 2011). All these three intensification strategies inadvertently, negatively affect the environment by either mining natural resources specially soil plant nutrients, or through fertilizer applications, create sinks for waste and pollution imposing costs that are not reflected in market prices and are thus considered negative externalities (Dobbs and Pretty, 2004). These negative externalities coupled with technological and ecological challenges need to be addressed, if current agricultural GDP growth gains of up to 2 percent are to be sustained or even surpassed (World Bank, 2006; Badiane, 2008). Pro- agriculture investments have to exploit existing opportunities (Fig. 2). These investments will have to focus on intensification efforts, while minimizing negative externalities. Agriculture is already placing greater pressure on biological diversity and natural resource functions than ever before (MEA, 2005; IAASTD, 2009). Moreover as temperatures rise rainfall patterns change due to weather variability and climate change more weather extremes will potentially reduce agricultural

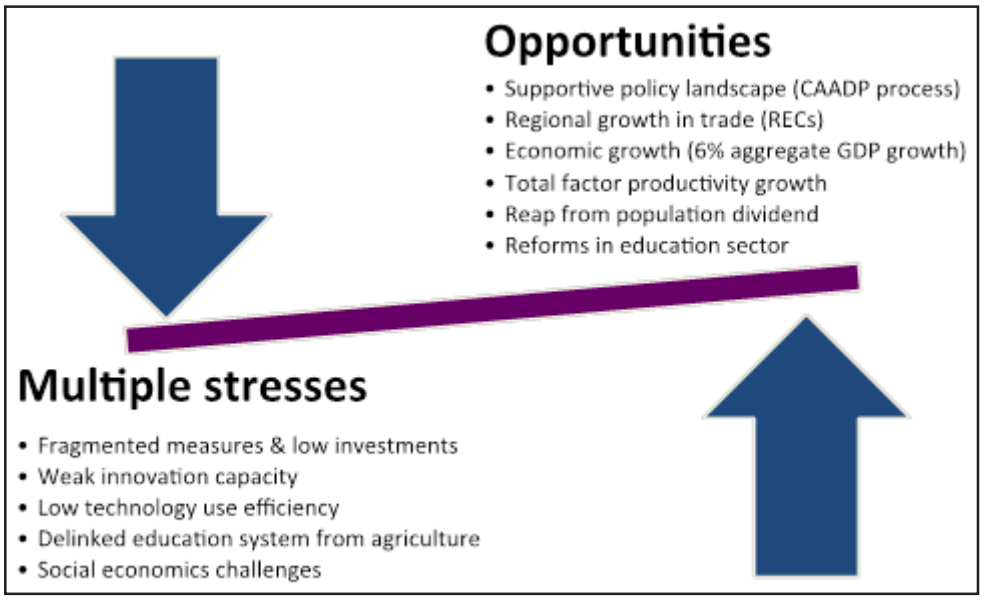

Figure 2. Exploiting mutually counterbalancing opportunities and challenges impeding growth of Africa's agriculture.

production. Investments should thus seek to ensure development of sustainable agricultural systems that contribute to delivery and maintenance of diverse valued public goods, such as clean water, carbon sequestration, flood protection, groundwater recharge and landscape amenity value and should be less vulnerable to shocks and stresses (Pretty *et al*., 2011). Research and innovation process will have to focus on generation of technologies, that support productivity and sustainable agricultural systems, making the best of both crop varieties and livestock breeds and their agro-ecological and agronomic management processes.

Imperatives for agricultural intensification. African countries today face not only the challenge of increasing agricultural production with scarce overall resources, but must raise productivity in a way that conserves the natural resource base and prevents further degradation. Yet, sustainable agricultural intensification is complex, involving mixtures of crop plants and livestock, and their associated management techniques. In the long run, sustainable agricultural growth can only be achieved through increased total factor productivity (TFP), the amount of output per unit of total factors used in the production process (Winters *et al*., 1998). Thus a more efficient use of resources becomes increasingly important as resources become scarce as is common in SSA.

Recent studies of Africa's agricultural sector based on TFP estimates show remarkable recovery in the performance of SSA's agriculture, starting in the mid-1980s and early 1990s after a long period of poor performance and decline. The recovery has mainly been due due to the catching up of technological frontier by SSA agricultural sector and the supportive fiscal and sectoral policy changes for agriculture (Yu and Pratt, 2011). The favorable policy environment particularly supported improved resource allocation efficiency and increased production and efficient use of inputs, and as a consequence, increased productivity. There is limited evidence on the role of technological progress on the 2 percent growth in Africa's agriculture. Indeed, literature shows non- significant impact of agricultural Research and Development (R&D) investment on TFP for SSA (Block, 1995; Nin-Pratt and Yu, 2008; Yu and Pratt, 2011). It should however be noted that significant investments in Africa's agricultural Research for Development (R4D) are beginning to pay-off. Alene (2010) reported that agricultural R&D and improved weather, together

with policy reforms, contributed to the recovery of agricultural productivity in SSA. Whereas agricultural R&D in Africa has contributed to technical progress, especially through improved seed, there is still need to improve production efficiency as the principal source of agricultural productivity growth in SSA. Improving production efficiency requires improved technology generation and access targeting yield improvements to the extent that it compensates for growth in rural population and improve rural income (Conway, 1996; World Bank, 2006; Yu and Pratt, 2011), new agronomic practices (Jennings, 2007; Pretty, *et al*., 2011); improved labour productivity to offset associated increase in labour costs as well as improved farmer knowledge and a host of functional support institutions for diverse value chains (Yu and Pratt, 2011). Taken together, sustaining the resurgence in growth of SSA's agriculture requires that the agricultural innovation systems, production and markets, take advantage of the positive policy environment that in large measure accounted for the current growth. This means different actors in the agricultural sector including universities will have to mutually reinforce each other's actions. The Regional Universities Forum for Capacity Building in Agriculture (RUFORUM), a consortium of 30 Agricultural Universities in Eastern, Central and Southern Africa is an example of how universities together with their partners are working with farmers and the National Agricultural Research System (NARS) to support technological progress with the agricultural sector. Key lessons and imperatives for sustained growth and improve rate of growth are discussed.

Can Universities engagement in R4D underpin economic growth

Seizing Africa's growth opportunities. Africa and Asia (excluding Japan) are the only continents that grew during the recent global recession. Though Africa's growth rate slowed down to 2% in 2009, it bounced back to nearly 5% in 2010, and in 2011 to about 5.2% (Roxburgh *et al*., 2010). Africa's collective GDP, at $1.6 trillion in 2008, is now roughly equal to Brazil's or Russia, with projections into the future being optimistic (Box 1). Moreover, economic growth acceleration in Africa over the last two decades has been widespread across countries and sectors (Roxburgh *et al*., 2010; World Development Indicators, 2012). Growth has not been wholly about resources, which nevertheless accounted for just 32 percent of Africa's acceleration since 2000. In fact, non-resource exporter African countries experienced similar growth rates to resource exporters. Most of the growth is associated with expanding domestic markets occasioned by urbanization growth in service sector and emergence of a middle class. Agriculture has and

still remains a fundamental part of growth. It is estimated that Africa's agricultural GDP will grow from US $ 280 billion in 2008 to US $ 880 billion by 2030 (Roxburgh *et al*., 2010). A key question to ask is what role should the African university play in the process?

Engaging in development process-key lessons. In his seminal paper of 2004, Carl Eicher (2004) provides a robust review of role of universities in agricultural and economic development of Africa. The paper argues that pre-independence African universities trained graduates who staffed colonial governments, with very limited research capacity. The post independence graduates described as "second generation graduates" faced many upheavals that compounded efforts to train third generation agricultural graduates as well as engage in agricultural innovation. The implementation of a strategic national-regional-global initiative comparable to the human-capital-improvement initiatives implemented in Malaysia, Brazil, Thailand, Indonesia, and India in the early 1960s has been proposed for building a strong agricultural science base within Africa (Eicher, 2004).

Africa Today

1. Collective = US $ 1.6 Trillion.
2. Consumer spending = US $ 860 Billion.
3. Africa's share of the worlds uncultivated arable land = 60%.
4. Agricultural GDP = 280 billion
5. Number of African cities with more than 1 million people = 52.
6. Proportion of African living in urban centers = 40%.

Africa Tomorrow

1. Collective GDP (2020) = US $ 2.6 Trillion.
2. Agricultural GDP = US $ 880 Billion.
3. Consumer spending (2020) = US $ 1.4 trillion.
4. Number of households with discretionary spending (2020) = $ 128 million.
5. Number of Africans of working age (2040) = 1.1 billion.
6. Proportion of Africans living in cities (2030) = 50%.

Box 1. Selected indicators of the African economy today and in the future-imperatives for investment planning. Source: Roxburgh *et al*. (2010)- McKinsey report, "Lions on The Move."

Such efforts will strengthen the continents ability to generate its own human resources who will be needed to underpin various actions needed to increase agricultural productivity such as the generation of new innovations, extension of knowledge, policy information, development and implementation as well as foresight and strategic planning for present and future growth processes. Universities are definitely well placed to undertake such processes. Bringing the "*Cerrado*" into productive land that produces 70% of the beef cattle production in the country and large amounts of soybean, required engagement of the Brazilian scientists (Batlle-Bayer *et al*., 2010). For Africa bringing large swaths of underutilized and unused arable land, can generate up to US $ 600 billion but, this, as in the case of Brazil's *Cerrado*, will require Research for Development (R4D) and other innovation processes. In recent literature reviews on the role of higher education in development, Bloom *et al*. (2006) shows that indeed investing in higher education and full engagement of university systems and their products in development processes increases both total factor productivity and ultimate growth. Tertiary education can help economies keep-up or catch-up with more technologically advanced societies. Graduates from such systems can develop new tools and skills themselves. Their knowledge can also improve the skills and understanding of non-graduate co- workers, while the greater confidence and know-how inculcated by advanced schooling may generate entrepreneurship, with positive effects on job creation (Bloom *et al*., 2006). These are the kind of graduates with skills sets that are needed to reinforce agricultural intensification that will underpin Africa's agricultural and economic growth. In the next section excerpts of how this process is taking place in Africa are shared.

RUFORUM's four pronged approach to support agricultural development. The evolution of RUFORUM and its detailed impacts are presented elsewhere in the paper by Blackie and Muir-Leresche (2012). In this section, we present selected examples to illustrate how universities are engaging in the development processes. RUFORUM has mandate for advocating for advancement of tertiary education in a broad range of agricultural fields in the Eastern, Central and Southern Africa region. The organization does so by (i) engaging African universities in development and innovation practice, (ii) it is a platform owned and managed by Africans Institutions, (iii) provides unique training opportunities for faculty and students and (iv) its agenda is driven by continent-wide policy,

frameworks such as; (i) CAADP and NEPAD's S&T framework (ii) AU's policy framework on revitalizing higher education, (iii) Sub-regional Multi–Country Agricultural Productivity Programmes, and (iv) National development plans, visions. RUFORUM interventions are designed around four clusters of interventions that a) strengthen **technological efficiency-** By consolidating innovation capacity to improve technological efficiency and productivity; (b) improve **labor productivity improvement-**Targeting graduates and other human resources engaged in the agricultural sector; (c) **engaging Universities in reform-** Engaging universities and stakeholders in reform processes for relevance and competitiveness, and (d) **reinforce policy development-** By supporting knowledge based policy development and implementation for short to long term strategic positioning and competitiveness (Fig. 3). Through these four clusters of operations RUFORUM is able to provide vital capacities and innovations through its universities needed for diverse value chain and innovation systems full function. Examples of each of these interventions are now provided below.

Figure 3. RUFORUM's four-pronged approach to contribute to rebuilding Africa's capacity for agricultural innovation and growth.

Improving technological efficiency for smallholder systems

Training new generation of scientists to support innovation. In partnership with its members universities, RUFORUM is producing the next generation of innovators. Since 2004, 729 graduates (43.7% females) have been trained

(Fig. 4). These graduates are being trained as change agents, with capacity for community engagement and are fully aware of issues related to gender and equity concerns in diverse African farming contexts. The first set of competencies being developed in graduates includes: innovation competences to comprehend and evaluate new technologies, apply basic and strategic theory to development and solve complex development problems. The second set of competencies includes competences for personal as well as organisational growth and learning such as ability to formulate ethical problems and clearly communicate possible solutions at appropriate levels; awareness of different attitudes to scientific innovations and ability to discuss and advice policy for the benefit of society and personal mastery and soft skills to innovate change efficiently, manage work and lesson learning especially with communities. Efforts to strengthen innovation capacity include: generation of research outputs coming through from the research and training processes among RUFORUM member universities; conduct R&D activities that are designed along value chains, with targets of increasing productivity, natural resources management and creativity in the process; strategic partnerships, to improve staff retention and competencies. Through these efforts, member universities are now engaging with partners across the globe, way beyond the efforts initiated by RUFORUM. As an example, the cereal research team lead by the first author at Makerere University is working with diverse stakeholders to both train

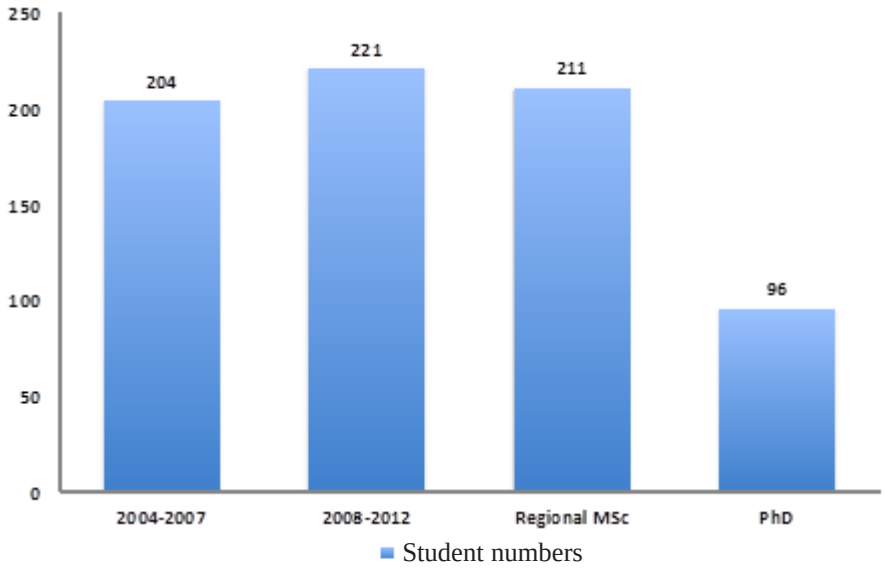

Figure 4. Spectra of students trained from 2004 to date under the RUFORUM programmes. The regional MSc and PhD programmes are new initiatives that were developed in partnerships with members universities in 2005.

and generate innovations to improve cereal productivity. The research team is guided by a conceptual framework (Fig. 5), that integrates training and research for development (R4D) producing graduates, new innovations and strengthened research processes. The team has generated over 1500 families of novel sorghum and maize genotypes for various food and industrial use. These materials are being used to develop various value added food products for human and feed purposes. The research team has also developed strong partnership with farmers organizations for research need definition as well as promoting technology use and strengthening value chains. Through the *Enhancing of research capacity and skills in Eastern and Southern Africa (ERESA) project,* RUFORUM and its member universities have improved teaching and research skills in universities and NARES by training a core of research methodology specialists to support innovation and policy processes through both regional programmes, short courses, field attachments/internships and Professional networking for enhanced research skills.

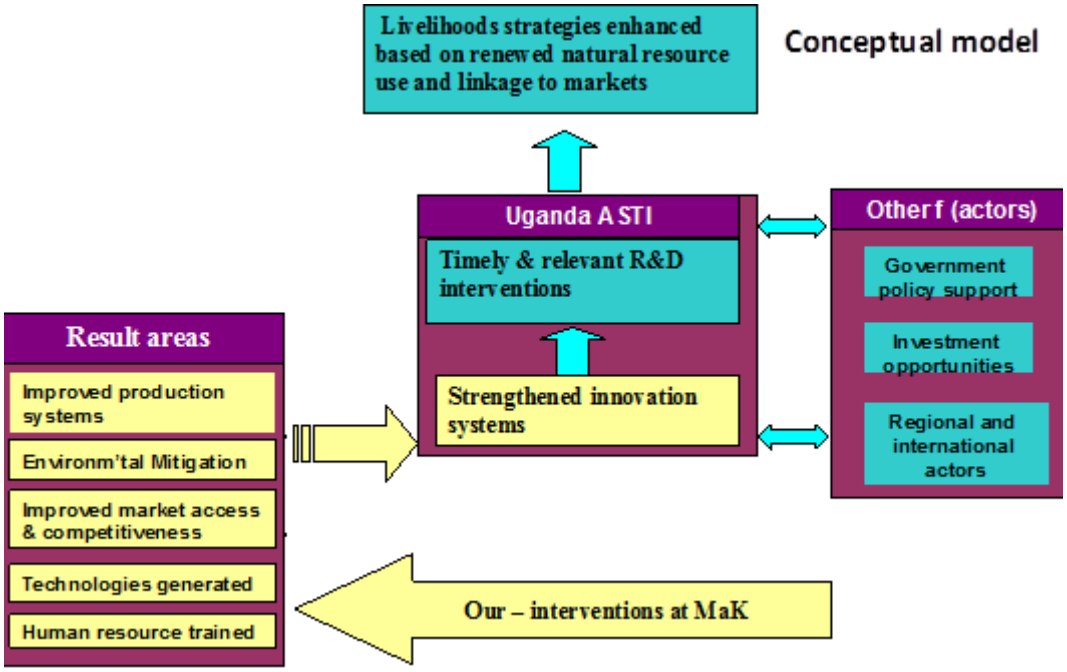

Figure 5. Conceptual model of a research and training programme managed by the author.

Improving labour productivity for smallholder systems

RUFORUM has through its Community Action Research Projects (CARP) increased opportunity for universities to directly engage with communities in rural transformation. Each CARP involves 1 PhD and 3 MSc students who both engage in

R4D as well as understudy the process. The CARP being implemented by Bunda College of the Lilongwe University of Agriculture and Natural Resources in Malawi is just one example of how CARPs are being used to improve labour productivity. The Malawi CARP aims at enhancing fish production and marketing for food security and rural incomes of small-scale producers in Malawi. The outputs are (i) improved fish productivity through best bet technologies, (ii) marketing efficiency for fish value chain strengthening, and (iii) Farmer organisations and related microfinance institutions supported. The Malawi CARP through these outputs will improve labour productivity of fish mongers and fishermen pioneering efforts to improve returns to investment of small holder fish business in Malawi.

RUFORUM and its member universities are also building entrepreneurial skills of farmers and farmer organizations. Moi University and SACRED Africa, a Non Governmental Organisation introduced cereal banking through a small grant from FORUM the predecessor of RUFORUM. Between, October 2003 and January 2004, the Banks registered 333 members who sold 4,400,000 bags of maize at US$20 per bag. The process generated US$90,000 and US$235 paid to each member, equivalent to US $ 300 (2012 rates). The concept of cereal banks has since been adopted widely in the region and is being used by farmers to pool risks and improve bargaining power when selling their produce, receiving higher returns to their labour.

Engaging Universities in reforms for relevance and competitiveness

In 2004, RUFORUM through a strategic planning process initiated a process that has led to the development of regional programmes being implemented jointly by member universities. The new programmes are either Masters or doctoral level programmes. Examples of master's degree programmes include, MSc Plant Breeding and Seed Systems, MSc Agricultural Information and Communications Management (AICM), MSc Research Methods and MSc Agrometeorology and Natural Risk Management. The doctoral programmes include, Dryland Resource Management, Plant Breeding and Biotechnology, Aquaculture and Fisheries, Agricultural and Resource Economics, Soil and Water Management, Agriculture and Rural Innovation Studies and Food Science and Nutrition. These programmes are hosted by different Universities, but draw staff from all the 30 Universities and students from across Africa. The RUFORUM network has also supported the development

of quality assurance systems for graduate programmes, the first of their kind in the region. The quality assurance systems include a conceptual framework for quality assessments developed in partnerships with regional inter-university agencies such as the Inter-University Council of East Africa (IUCEA) and Higher Education Quality Management for Southern Africa (HEQMISA). Other reform supportive efforts include the strengthening of leadership and management skills under the "*Strengthening Leadership, Management and Cross-cutting Professional Skills of Eastern and Southern African Universities.*" The programme targeted university senior managers building cross-cutting professional skills, international good practices for efficient management and enhancing partnerships for effective networking and institutional change management.

Supporting knowledge based policy development and implementation

In 2010, RUFORUM in collaboration with regional Governments, regional and continental institutions hosted the Ministerial Conference on Higher Education in Africa (CHEA). The key outcomes of the CHEA were: (i) Commitment to restoration of quality of higher education in Agriculture, (ii) Commitment to increased investment in higher education in agriculture as an integral part of CAADP, and (iii) Support to local and international partnerships which address critical capacity needs and gaps. At national level through the National Forum, member universities are engaging diverse national stakeholders to support development of relevant and policies. In Uganda, the National Forum (multi-stake-holder platform of universities and other actors) has engaged government ministries in the development of the Uganda CAADP investment Plan as well as the Climate Change, Implementation of Nation Plan of Actions. Other activities that have improved problem definition for university research and training programmes include curriculum review and conducting public awareness / marketing programmes and career opportunities for students.

Lessons learnt and moving agenda forward

Lessons learnt. Over the last 18 years RUFORUM and their University members have undertaken a number of reform processes with the aim of improving development impact of the African University. Attention has been paid to the design and administration of graduate programmes as well as quality of research undertaken. In the process, strategic partnerships for conducting training as well as R4D have been developed. The process has not been however without challenges which are summarized in Box 2.

1. **Fragmented investments in higher education**. In most partner countries there are still fragmented investments in tertiary education. This means that impacts of recent investments by diverse agents are small following the lull in investments under the structural adjustment programmes. In some countries therefore, there is need for longer term commitments, unfortunately support for the long haul is very limited. Intensified advocacy at higher levels as well as shared investments may provide better solutions. Many of such efforts are still at experimental stage.

2. **Limited thematic scope for R&D and training**. Strengthening of value chains has been identified as critical for improving TFP of Africa's agriculture. Unfortunately, such novel approaches to support the growth of Africa's agricultural sector require undertaking cross disciplinary operations which most universities are ill equipped to do so. The CARP approach of RUFORUM provides a learning framework, and could provide a mechanisms to address this issue.

3. **Change inertia.** In many institutions there is very slow progress to institutionalize change processes. The demand for leaders with higher propensity to institute and manage change processes in their institutions in a manner that takes universities out as service institutions to communities is high. Most change processes have been associated with strong leadership that unfortunately is not institutionalized and often end with departure of such leaders. This has undermined the fast evolution of the African Universities into equal partners in development in their respective countries.

4. **Absence of national marshal planning for tertiary education investments**. The demand for high quality human resources and engagement of Universities in national innovation is high. Yet at national level, these institutions which incidentally have the highest number of highly qualified scientists are of low priority when it comes to funding. As such Universities remain at the periphery of national development with the scientists turned into teachers rather than generators of new knowledge and innovation.

5. **Low levels of strategic partnerships**. In many countries there is still high tension between public and private sector on research/technical assistance. This is often associated with weak tradition of companies collaborating in R4D as well as sector-wide upgrading and capacity building initiatives. The need to stimulate and promote local investments into R4D call for stronger patterns of interaction between universities and other stakeholders. The linkages are more important, both to

acquire information about changing markets as well as to obtain the knowledge and support to deal with it.

6. **Complex development challenges**. Integration of social and environmental challenges into the development and market agenda is the norm. The Millennium Development Goals, poverty reduction strategy papers, the CAADP and many others all require integration of social and environmental challenges. An implication of the integration of social and environmental issues is that both public and private sector agencies including universities cannot work, plan, and intervene without interacting with actors engaged with these agendas. It also requires new types of expertise to do so.

Box 2. Challenges to successful engagement and realization of development impacts by universities in sub-Saharan Africa.

Scaling up success

RUFORUM and its member universities have piloted and ran training and research programmes many of which have been very successful. In this section examples of actions that can be up-scaled to enhance productivity gains in Africa are provided.

1. Community Action Research Projects (CARP). The CARP project is one of the innovations by RUFORUM to improve development impacts of its research and training programmes. So far it is being implemented in three countries, Uganda- focusing on cereal/legumes production with a focus on integrated soils fertility management; Kenya- Strengthening farmer associations to improve productivity and resource management; and, Malawi on improving competitiveness of fish production and marketing by smallholder farmers. Through the CARP approach 5300 farm households are directly impacted on annually in the three countries. Direct benefits of the CARPs to farmers such as; stronger farmer associations that are able to articulate demand for research products as well as negotiate and penetrate markets, increased access to innovations and knowledge directly from universities; and to universities and research institutions – deeper insights into farming contexts in order to better target research and product development as well as training and other competence needs, Other benefits includes new scientists trained to engage communities in R&D. These efforts clearly contribute to improving technology and labor use efficiency by small-scale farmers and need to be both up and out scaled.

2. Graduate Research Grants (GRG). The GRG just like the CARP is another vehicle that RUFORUM uses to train and engage communities in development processes. Through the GRGs RUFORUM is impacting 2580 households directly. A wide range of topical areas are covered by GRGs ranging from natural resources management, agribusiness and markets, extension and knowledge management systems, production enhancement (crops and livestock), new innovations and many others. Through the GRGs, RUFORUM could move into new areas such as entrepreneurship, rural finance and value addition, -training the next generation of innovators who have new skills sets for a rapidly urbanizing and changing African economy. Thus RUFORUM and its partner universities will need to scale up best practices of training as well as develop new curriculum for improving labour productivity of graduates.

3. Up-and-out scaling special project successes. In its next phase of growth, RUFORUM needs to focus on an intensification programme. The intensification programme should aim at up-and out-scaling successes of special projects that improve (i) leadership and managerial skills of RUFORUM member universities, (ii) enhance competitiveness and ability to mobilize resources for self and development agenda, and (iii) increase impact orientation of RUFORUM especially innovative training and research programmes.

4. Strengthening operations and impact thrusts. As a regional network RUFORUM will need to out scale its partnerships particularly, focusing on strengthening its regional networking ability. Models such as the Intra-ACP mobility model provide a framework for strategic expansion of network both at international and regional levels. New frontiers such as moving to West Africa should remain open. RUFORUM will also need to intensify its inter- network scope of operations to harness economies of scale by working with UBUNTU Nets (ENRENs) to strengthen ICT use in education and research as well as TEAM Africa.

5. Advocacy. The African University is in general under-resourced. Through the CHEA, RUFORUM and its partners engaged efforts to ensure bring to awareness of Governments and Development Partners the need to intensify investments in tertiary and higher education in Africa. A key outcome of that meeting was the commitment and resolve to support tertiary education by both governments and development partners.

TEAM-Africa is an outcome of that effort. What is now needed is to further deepen strategic engagements to improve opportunities for women and youth engaged in agriculture as well as develop and or support global partnerships for new areas such as entrepreneurship which are still weak yet critical to meet the needs of an expanding African domestic market. At National level there is still need to reinvigorate National Forum's engagement with Governments for resource mobilization as well as explore mechanisms for stronger engagement in development action planning and implementation.

Conclusion

Agriculture is Africa's largest economic sector, representing 15 percent of the total GDP or more than US $100 billion annually. Currently, most of these benefits are concentrated, in Egypt and Nigeria, which account for one-third of total agricultural output. The rest of the countries are performing below par, with just ten countries generating 75 percent of Africa's agricultural GDP (Roxburgh *et al*., 2010). The main message is that the vast majority of the continent especially sub-Saharan Africa needs to reform its agricultural R&D as well as production systems to meet the present and future demands from agriculture. The onus is on Africa's Universities to rise up to the occasion, and, just like their counterparts in Latin America and Asia, work with global centers of knowledge to leverage knowledge and innovations to underpin agricultural and economic growth of the continent. We have highlighted the challenges to intensified engagement of Universities in development processes; But, to be sure, innovations that increase production under current systems, expand production niches to new uncultivated lands, expand the scope, scale and utility of agricultural produce are needed. Efforts by African institutions alone will not suffice, due to capacity issues we have raised earlier, that albeit, vary within the continent. Instead, a marshal plan developed and underpinned by strategic south-south and North- south arrangements may offer faster returns that will allow Africa harness its agro-ecological potential to meet food and income requirements. This way, African institutions supported by global partners, will be enable the continent to start moving towards achieving agriculture sectoral growths of 2 to 5 percent a year, thereby harnessing the more than one-quarter of the world's arable land that currently lies dormant in this continent.

References cited

Ahlenius, H. 2006. Current and potential arable land use in Africa. Africa Environmental Collections. UNEP/GRID-

Arendal. www.grida.no/graphicslib/detail/current-and-potential-arable-land-use-in-Africa.

Alene, A.D. 2010. Productivity growth and the effects of R&D in African agriculture. *Agricultural Economics* 41: 223–238.

Badiane, O. 2008. Sustaining and Accelerating Africa's Agricultural Growth Recovery in the Context of Changing Global Food Prices. International Food Policy Research Institute (IFPRI). IFPRI Policy Brief 9 November 2008.

Batlle-Bayer, L., Batjes, N.H. and Bindraban P.S. 2010. Changes in organic carbon stocks upon land use conversion in the Brazilian Cerrado: A review. *Agriculture Ecosystems and Environment* 137: 47-58.

Block, S. A. 1995. The recovery of agricultural productivity in Sub-Saharan Africa. *Food Policy* 20: 385–405.

Bloom, D., Canning, D. and Chan, K. 2006. Higher Education and Economic Development in Africa. Human Development Sector Africa Region. Harvard University, USA.

de Graaff, J., Kessler, A. and Willem Nibbering, J.W. 2011. Agriculture and food security in selected countries in Sub-Saharan Africa: diversity in trends and opportunities. *Food Security* 3:195–213.

Dobbs, T. and Pretty, J. N., 2004. Agri-environmental stewardship schemes and multi-functionality. *Review of Agricultural Economics* 26: 220–237.

Eicher, C. 2004. Rebuilding Africa's scientific capacity in food and agriculture. Background Paper No. 4 was commissioned by the Inter Academy Council (IAC) Study Panel on Science and Technology Strategies for Improving Agricultural Productivity and Food Security in Africa.

Henao, J. and Baanante, C. 2006. Agricultural production and soil nutrient mining in Africa: implications for resource conservation and policy development. Muscle Shoals: IFDC.

IAASTD, 2009. International Assessment of Agricultural Knowledge, Science and Technology for Development: Global Report. Island Press, Washington, DC.

Jennings, P. 2007, Luck Is the Residue of Design. The IRRI Pioneer Interviews, IRRI, Philippines.

Madavo, C. 2005. Africa: The Development Challenges of the 21st Century. The Woodrow Wilson International Center for Scholars. Africa Program Occassional Papers. Number 4 September 2005.

MEA, 2005. Millennium Ecosystem Assessment. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

Nin-Pratt, A. and Yu, B. 2008. An updated look at the recovery of agricultural productivity in sub-Saharan Africa. IFPRI Discussion Paper 00787, Washington, D.C.

Pretty, J.N., Toulmin, C. and Williams, S. 2011. Sustainable intensification in African agriculture. *International Journal of Agricultural Sustainability* 9:15-24.

Roxburgh, C., Dörr, N., Leke, A., Tazi-Riffi, A., van Wamelen, A., Lund, S., Mutsa Chironga, Alatovik, T., Atkins, C., Terfous, N. and Zeino-Mahmalat, T. 2010. Lions on The Move: The progress and potential of African economies. McKinsey Global Institute.

Twomlow, S., Shiferaw, B., Cooper, P. and Keatinge, J.D.H. 2008. Integrating genetics and natural resource management for technology targeting and greater impact of agricultural research in the semi-arid tropics. *Expl. Agriculture* 44: 1-22.

Yu, B., and Nin-Pratt, A. 2011. Agricultural Productivity and Policies in Sub-Saharan Africa. Selected Paper prepared for presentation at(the Agricultural & Applied Economics Association's 2011 AAEA & NAREA Joint Annual Meeting, Pittsburgh, Pennsylvania, July 24-26, 2011

Winters, P., de Janvry, A., Sadoulet, E. and Stamoulis, K. 1998. The role of agriculture in economic development: Visible and invisible surplus transfers. *Journal of Development Studies* 34: 71–97.

World Development Indicators, 2012. Regional highlights world development indicators. The World Bank: Washington, D.C. 20433 USA.

World Bank 2006. Enhancing Agricultural Innovation: How to Go Beyond the Strengthening of Research Systems. The International Bank for Reconstruction and Development / World Bank. Washington, D.C. 20433 USA.